Agricultural Development, Trade & Regional Cooperation in Developing East Asia

Ponciano S. Intal, Jr.,
Sothea Oum, & Mercy J.O. Simorangkir
Editors

Economic Research Institute for ASEAN and East Asia

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Preface

Despite the surge in manufactures trade and production networks that anchor the industrialization process in East Asia, agriculture remains an important sector of the economy of most developing countries in the region. Indeed, for the lower-income member countries of the Association of Southeast Asian Nations (ASEAN) that rely preponderantly on agriculture, agricultural development is the key to widespread economic growth and rapid poverty reduction. For the middle-income ASEAN countries as well as China and India, agricultural development remains an important pillar for balanced growth, sustained poverty reduction, and a deeper domestic consumption base for their manufacturing and service industries.

An integrating and industrializing East Asia offers both opportunities and challenges to the region's agricultural sector. On the one hand, a robustly growing East Asia is a growing source of demand for a wider range of agricultural products for food and industrial purposes. On the other hand, for food-deficit countries, the increased opportunities for agricultural exports from a robustly growing and industrializing East Asia are tempered by the political and social imperative of food security. This is because natural disasters like drought or widespread pest infestation that significantly reduce domestic food production can cause food prices to spike unless global prices are stable.

This book consists of papers from the Economic Research Institute for ASEAN and East Asia (ERIA) research project on "Agricultural Development, Trade and Regional Cooperation in Developing East Asia" in Fiscal Year 2010-11. It aims to address the twin issues of the growing opportunities for agricultural development and trade arising from a robustly growing East Asia on the one hand and the political and social imperative of food security on the other hand. All papers in this book were presented in two workshops held in Siem Riep and Phnom Penh, Cambodia in 2010 and 2011. The collection of papers in the book examines the aforementioned concerns as follows:

- Examine the role that agricultural development can play in engendering sustained economic growth and substantially reducing poverty in the poorer countries of Cambodia, Laos, and Myanmar.
- Understand the interaction of agricultural commercialization and modernization on the one hand and rural transformation and agri-based manufacturing on the other hand and their implications on the overall economies of the middle-income countries of Indonesia, Thailand, and Viet Nam.
- Analyze the changes in consumption in the fast-growing economy and market of China and their implications on East Asia's agricultural trade, and examine how a food-deficit country like the Philippines can benefit from expanded opportunities for agricultural trade while addressing food-security concerns.
- Explore the possibilities of regional cooperation in mitigating the welfare effects of natural disasters and crises; in developing the potentials of a green economy within the confluence of Northeast India, Southwest China, and Myanmar; and in strengthening the role of agricultural research and development as a major productivity-enhancing investment in developing East Asia's agriculture

I sincerely hope that the recommendations put forward by ERIA's initial study on agricultural development issues in the region prescribed in this book would be fruitful for concerned stakeholders in the region to stimulate discussions on a more open agricultural economy in tandem with investments in productivity-enhancing interventions like irrigation and agricultural research and development, while creating regional cooperative efforts that redress or temper the negative welfare effects of crises and natural disasters. I welcome your feedback for us to advance our research in these areas.

Hidetoshi Nishimura

Executive Director

Economic Research Institute for ASEAN and East Asia

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Chapter 1

Agricultural Development, Trade, and Regional Cooperation in Integrating and Industrializing Developing East Asia: Integrative Chapter

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CHAPTER 1

Agricultural Development, Trade, and Regional Cooperation in Integrating and Industrializing Developing East Asia: Integrative Chapter

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1. Introduction: Context

Despite the surge in manufactures trade and production networks that anchor the industrialization process in East Asia, agriculture remains an important sector of the economy of most developing countries in the region. Indeed, for the lower-income member countries of the Association of Southeast Asian Nations (ASEAN) that rely preponderantly on agriculture, agricultural development is the key to widespread economic growth and rapid poverty reduction. For the middle-income ASEAN countries as well as China and India, agricultural development remains an important pillar for balanced growth, sustained poverty reduction, and a deeper domestic consumption base for their manufacturing and service industries.

An integrating and industrializing East Asia offers both opportunities and challenges to the region's agricultural sector. On the one hand, a robustly growing East Asia is a growing source of demand for a wider range of agricultural products for food and industrial purposes. Rising per

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capita incomes mean growing demand for, and therefore greater opportunities in, income-elastic agricultural products that offer higher value to farmers but need to be produced under more demanding production conditions and require better production and postharvest support systems. At the same time, improving infrastructure, transport systems, and manufacturing capabilities concomitant with the industrialization process opens up markets and improves efficiencies in (commercial) agricultural production, processing, and marketing.

On the other hand, for food-deficit countries, the increased opportunities for agricultural exports from a robustly growing and industrializing East Asia are tempered by the political and social imperative of food security. This is because natural disasters like drought or widespread pest infestation that significantly reduce domestic food production can cause food prices to spike unless global prices are stable. However, where such natural disasters are not just local but also regional, involving both net exporting and net importing countries, global prices can be expected to also increase. Substantial increases in food prices have significantly negative welfare implications on the whole populace. As a result, they also have, at times, political ramifications. Given that agricultural land, especially good agricultural land, is finite, food-deficit countries thus face the dilemma of addressing food-security considerations on the one hand and maximizing agricultural growth and trade potentials on the other hand.

The potential and dilemma facing agricultural development and trade in East Asia was well captured at the World Economic Forum in Davos, Switzerland, in January 2011 where the theme was the so-called “The New Reality.” One of the key components of “The New Reality” is the shift “from North to South, from West to East.” In effect, this is the shift from industrialized countries to emerging developing countries as well as from Western countries to the East, mainly East Asia (plus India) as the key drivers of global growth. Also given focus during the Davos forum was the warning of the Food and Agricultural Organization (FAO) of a possible repeat of the global food-price crisis of 2007--08 as grains prices worldwide have spiked due to weather-related crop failures in Russia, the United States, Australia, and Argentina. France, the incoming host of the G20 Summit, has stated that the global food situation will be an important item for discussion and appropriate action in the forthcoming G20 Summit. As pointed out by FAO Director General Jacques Diouf in an article printed in the *Business Mirror* on February 3, 2011, it is high time for the global community to address structural imbalances in the world agricultural system and not merely address the issue in crisis-management mode. Diouf warns, "Crisis management is essential and a good thing, but prevention is better. Without long-term structural decisions and the necessary political will and financial resources for their implementation, food security will persist with a succession of crises affecting most seriously the poorest populations." Social and political stability is a key concern in developed and developing countries. Sharp increases in food prices have led to major demonstrations, riots, and even a change in governments in the developing world.

This project by the Economic Research Institute for ASEAN and East Asia (ERIA) on agricultural development, trade, and regional cooperation in an integrating and industrializing East Asia attempts to address the twin issues of the growing opportunities for agricultural development and trade arising from a robustly growing East Asia on the one hand and the political and social imperative of food security on the other hand. Broadly, a key way forward is to have a relatively more open agricultural economy in tandem with investments in productivity-enhancing interventions like irrigation and agricultural research and development while creating regional cooperative efforts that redress or temper the negative welfare effects of crises and natural disasters.

The project's set of papers examine the aforementioned concerns as follows:

- Examine the role that agricultural development can play in engendering sustained economic growth and substantially reducing poverty in the poorer countries of Cambodia, Laos, and Myanmar.
- Understand the interaction of agricultural commercialization and modernization on the one hand and rural transformation and agri-based manufacturing on the other hand and their implications on the overall economies of the middle-income countries of Indonesia, Thailand, and Viet Nam.
- Analyze the changes in consumption in the fast-growing economy and market of China and their implications on East Asia's agricultural trade, and examine how a food-deficit country like the Philippines can benefit from expanded opportunities for agricultural trade while addressing food-security concerns.

- Explore the possibilities of regional cooperation in mitigating the welfare effects of natural disasters and crises; in developing the potentials of a green economy within the confluence of Northeast India, Southwest China, and Myanmar; and in strengthening the role of agricultural research and development as a major productivity-enhancing investment in developing East Asia's agriculture.

The integrative chapter consists of five sections. After the introductory section, the chapter discusses the importance and performance of the agriculture sector and trade in East Asia in the 1990s and 2000s. The third section examines country experiences in agricultural development, poverty reduction, and rural transformation as well as in agricultural trade and agro-industrialization. The fourth section deals with expanding agricultural trade and regional cooperation in East Asia. The concluding section briefly summarizes the key lessons and policy implications of the studies in the project.

2. Agriculture and Agricultural Trade in East Asia

Importance of agriculture and agricultural development in East Asia. East Asia is a highly heterogeneous region, consisting of countries ranging from low-income countries highly dependent on agriculture to rich and industrialized countries.[2] **Table 1** presents the share of the agriculture sector in national output and employment. As a **share of national output (gross domestic product or GDP)**, it is possible to group East Asian countries into three, namely:

- countries where agriculture is a **major** sector of the whole economy, accounting for at least 30 percent of GDP: Myanmar, Laos, and Cambodia
- countries where agriculture remains an **important** sector, contributing between 10 percent and less than 30 percent to GDP: China, India, Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam.

[2] The agriculture sector in the national income accounts usually includes agricultural crops, livestock, fisheries, and forestry. Forestry is minor in much of East Asia, so the value added is essentially from crops, livestock, and fisheries. Although fisheries are usually included in discussions of the agricultural sector, much of the analysis in this report focuses on crops and livestock.

- highly industrialized countries and high-income city-states where agriculture is a **minor** segment of the whole economy: Japan, South Korea, Australia, New Zealand, Brunei, and Singapore

The contribution of the agricultural sector is usually substantially higher with respect to national employment despite its lower contribution to national output. **Table 1** bears this out. As table 1 indicates:

- Agriculture is the **dominant** sector in a number of countries (e.g., Cambodia, India, Laos, Myanmar, and Viet Nam), contributing more than 50 percent of total employment
- At the other end of the spectrum, agriculture is a **minor** employment generator in highly industrialized countries and high-income city states (e.g., Japan, South Korea, Australia, New Zealand, Singapore, and Brunei), contributing less than 10 percent of total employment. Malaysia, where the share of agriculture is less than 20 percent, can be included in the group of countries where agriculture is essentially a minor contributor to total employment
- In between the two groups are the countries (e.g., China, Indonesia, the Philippines, and Thailand) where agriculture remains an **important** generator of employment, contributing least one-third, albeit not the dominant one (1/3 < x < ½)

The importance of agriculture and agricultural development does not stem solely from the direct contribution of the sector to national output and employment. A critical role of the sector is related to ***poverty reduction***. There are **three channels** by which the agriculture sector and agricultural development contribute to poverty reduction in a country:

- The **first channel** is the most direct and obvious. **Table 2** presents the number of the very poor, poor, and low income in the rural and urban areas of China, India, and Indonesia and for the whole country in Cambodia, Laos, Malaysia, the Philippines, Thailand, and Viet Nam. As table 2 shows, a number of ASEAN member countries still have significant incidence of poverty. Indeed, only Malaysia and Thailand (and the high-income city-states of Brunei and Singapore) have virtually zero incidence of abject poverty, i.e., population whose income is less than US$1.25 per day per capita in purchasing power parity (PPP) terms. Moreover, there is higher poverty incidence among rural households than among urban households in China, India, and Indonesia. Note that the population of Myanmar, Laos and

Cambodia, and even Viet Nam is preponderantly rural. Rural households are preponderantly dependent on agriculture for income, with household members working as farmers, fishermen, or as workers in farms, fishing grounds, or aquaculture ponds/pens. Thus, the first channel of agriculture development to poverty reduction is by *increasing the incomes of rural households from farming activities and/or by having household members employed as farm workers* as a result of the increase in agricultural production (and increase in agricultural terms of trade) for domestic consumption and for exports.

- The **second channel** of agricultural development to poverty reduction is more indirect than the first but it is also a very critical one. It involves the movement of labor (or an increase in the labor time spent) from the agriculture sector to the nonagricultural sector. The average productivity of labor (measured as value added as a ratio of labor employed) is usually significantly higher in manufacturing and other nonagricultural sectors than in agriculture. Other things being equal, this means that the average labor income in the nonagricultural sector is higher than in the agricultural sector.

  Rural households usually have more than one source of income. They can raise their household income and move out of poverty by having the farmer household head work part-time in the nonagricultural sector (i.e., reduce the underemployment of farmer household heads) and/or have children in the household work in the nonagricultural sector within the area, domestically, or even abroad. Indeed, one of the lasting sources of poverty reduction in the rural sector in East Asia is by increasing the share of nonagricultural sources of income in the total income of the households, either through part-time work or through the employment of the members of the household outside of agriculture.

  The second channel is feasible if there is an increase in agricultural productivity at the same time that there is an increase in demand for labor in the nonagricultural sector. Thus, higher agricultural productivity and faster growth in the nonagricultural sector are the foundations for the successful deployment of the second channel for poverty reduction through agricultural development.

- The **third channel** is even more indirect than the second channel but for many East Asian countries, it is also an important, though not always necessary, channel for poverty reduction in the region. Specifically, the agricultural sector is not only a source of products and labor for an economy, it is also the source of critical "wage goods," mainly food. Other things being equal, an increase in food prices would tend to increase the pressure for higher wages by workers in both the agricultural and nonagricultural sectors. Assuming that there is no corresponding increase in labor productivity, higher wages would reduce the international competitiveness of a country in the more labor-intensive industries. This is especially true in manufacturing where profit margins tend to be razor thin, especially for labor-intensive enterprises employing unskilled or semiskilled workers.

  Thus, for countries with large agricultural sectors, agricultural development primarily through increased agricultural productivity is needed not only to release labor to the nonagricultural sector but also to make the real price of wage goods (i.e., key food items) relatively stable in order to allow the profitable absorption of more workers by the nonagricultural sector. Clearly, this calls for a significant rise in agricultural productivity. To some extent, the successful experiences of countries in the region like China and Viet Nam, among others, in poverty reduction and early industrialization is founded on this virtuous cycle of growth in agricultural productivity and high growth of low-skilled, labor-intensive manufactures. Similarly, a key reason for the slow reduction in poverty in the Philippines is arguably due to the less-than-robust growth of agricultural productivity for a substantial period of time coupled with the low growth of low-skilled, labor-intensive manufactures.

  It is only in city-states like Brunei and Singapore and countries like Malaysia where the political economy of wage goods is less binding compared to the other members of the ASEAN as well as China and India. In Brunei and Singapore, food is virtually sourced from abroad. For countries like Malaysia where the labor situation is tight and where the agricultural sector has a comparative advantage in nongrain crops (i.e., palm oil instead of rice), importation is key in preventing a sharp rise in the price of wage goods like rice. It is therefore importation that facilitates the more robust growth of (semiskilled and skilled) labor-intensive manufactures. The case of Malaysia is somewhat unique in the ASEAN, however, because it has a very favorable agricultural land-to-labor ratio. At the same time, the share of the agricultural sector in Malaysia's total employment is relatively low, a situation that is similar to Australia's. Thus, for countries like Malaysia, the third channel is not as important as the first two channels.

Nonetheless, the Malaysian example where the social returns from agricultural trade are maximized by focusing on agricultural products where the country has comparative advantage for export and relying on imports to fill the gap between domestic production and consumption is worth examining in terms of its relevance to other countries in the region. This issue between agricultural exports and food security is discussed further later in the report.

Agricultural trade in East Asia. At first blush, agricultural trade seems to be relatively unimportant. In terms of its share in gross exports and imports, agriculture seems increasingly minor in developing East Asia (see **table 1**). The countries with the largest share of agriculture to total exports are the hugely land-abundant Australia and New Zealand. Much of developing East Asia's manufactured exports has a high percentage of imported inputs; hence, in terms of value-added exports (or exports net of imported inputs), the share of agricultural exports is actually substantially higher.

There are significant opportunities for greater agricultural trade in the region. China and Japan are among the world's top five agricultural importers. South Korea, Hong Kong, and Taiwan are among the top twenty. China is the seventh top agricultural exporter while Australia, Indonesia, Thailand, and Malaysia are among the top twenty in the world. China mimics the United States to some extent in agricultural trade. The United States is the world's largest agricultural exporter at the same time that it is the world's largest agricultural importer (Aksoy and Ng 2010, table 8, 12).

The net agricultural exporters in East Asia are Australia, Thailand, New Zealand, Indonesia, India, Malaysia, and Viet Nam while the net agricultural importers in the region are Japan, China, South Korea, the Philippines, and Singapore. Note that Cambodia, Laos, and Myanmar are marginal net importers (**table 3**). Note also that China has the sharpest increase in net imports from the mid-1990s to the late 2000s as table 3 shows.

In terms of commodity specialization, the net exporters in selected agricultural commodity groups are as follows:

- Cereals : Australia, Thailand, India, Viet Nam (minor)
- Pulses : China, Myanmar, Australia, Thailand (minor), Viet Nam (minor)
- Potatoes : China, Australia, India, New Zealand
- Sugar : Thailand, Australia, Philippines (minor)
- Fruits : Philippines, New Zealand, Australia, Thailand, Viet Nam (minor)
- Oils and Fats : Malaysia, Indonesia, New Zealand, Philippines, Thailand (minor)
- Coffee : Viet Nam, Indonesia, India, Thailand (minor)
- Cocoa : Indonesia
- Tea : China, India, Indonesia
- Tobacco : India, South Korea, Indonesia, Singapore, Malaysia (minor)

The net importers in East Asia in selected agricultural commodity groups are as follows:

- Cereals : Japan, South Korea, Philippines, Malaysia
- Pulses : India, Japan
- Potatoes : Malaysia, Singapore, South Korea, Viet Nam
- Sugar : Indonesia, China, Japan, Malaysia, Singapore, New Zealand
- Fruits : Japan, China, South Korea, Indonesia, Singapore, Malaysia
- Oils and Fats : China, India, Japan, South Korea, Viet Nam, Myanmar, Singapore
- Coffee : Japan, South Korea, Australia, Malaysia, China
- Cocoa : Malaysia, Singapore, Japan
- Tea : Japan, Australia

Table 4 shows the revealed comparative advantage (RCA) of developing East Asian countries at a more disaggregated level during the 2000s. A closer look reveals the following:

- As of 2008, India and Indonesia had the largest number of agricultural commodity groups where they have RCA, followed by Thailand and Viet Nam

- China had the sharpest net reduction in the number of agricultural products where the country lost RCA during the years 2000--08, followed by Malaysia and Singapore. This is probably not surprising; China experienced the fastest industrialization process in the region, which resulted in rising wage rates. Both Malaysia and Singapore also faced tremendous labor shortage and wage hike pressures, thereby hurting the competitiveness of the labor-intensive agriculture sector. Nonetheless, for Malaysia, part of the adjustment was the greater specialization in HS 15 (animal/vegetable fats and oils) where it holds global leadership in palm oil-based products. This increased focus on HS 15 raised the number of products it has RCA in from two in 2000 to nine in 2008.

- Cambodia experienced largest increase in agricultural products that the country gained RCA in during the 2000s. This increase is likely the result of the country's investment and comparative advantage in agriculture. The commodity groups on which Cambodia has focused are cereals, vegetable oils, tobacco, and fish and crustaceans.

- The other two developing East Asian countries that saw an increase in the number of commodity groups where they have RCA during the 2000s are the Philippines and India. However, despite the increase in the number of commodity groups where it has RCA, the Philippines is still a net agricultural importer primarily due to its imports of rice and feed grain (for livestock), a necessity given its expanding population.

A close look at the import pattern of East Asian countries suggests large potentials for profitable agricultural trade. There have been notably sharp increases in the importation of a few significant export items in the regime such as pulses by India, vegetable oil by China and India, and cocoa by Malaysia. An even more detailed analysis at a more disaggregated level reveals many sharp increases in the import values of East Asian countries (**table 5**). For example:

- Developing East Asian countries experienced practically an explosion of imports in a large number of agricultural products during the 2000s. The fastest-growing economies (i.e., China, India, and Cambodia) had the largest number of agricultural commodity groups with growth rates of more than 500 percent. The large number of agricultural products with explosive import growth in Cambodia likely reflects not only the rising demand in a fast-growing economy but also the potentials for import substitution if there is more investment in the country's agricultural sector.

- Japan registered the lowest number of commodity groups where import growth was 300 percent or more, indicative of the country's very slow growth during this period. South Korea, which had faster economic growth than Japan, had a significant number of agricultural commodity groups that grew at least 300 percent during the period, similar to Malaysia.

- Although net agricultural exporters, Indonesia, Malaysia, and India registered a large number of commodity groups with an import growth of at least 300 percent and indeed more than 500 percent during the 2000s. This may suggest opportunities for developing market niches as an export strategy.

As **table 5** suggests, robust economic growth in East Asia in the future means growing demand for more income-elastic and a wider variety of raw and processed food and agribased products (e.g., vegetable oils, pulses, meat, vegetables, animal feeds, fruits, cut flowers, rubber, etc.).
China's fast economic growth, demand changes, and trade liberalization have large implications on Southeast Asia's agricultural trade. China is net importer of agricultural products from Southeast Asia. China's main imports from ASEAN member countries are palm oil, horticultural products, and animal products. Its main exports to ASEAN member countries are horticultural products and processed agricultural products. Simulations by Huang, Yang, and Rozelle (2011) presented in **table 6** show that China's agricultural exports are shifting from land-intensive food and feed crops to labor-intensive products, particularly fish and processed food. Table 6, again taken from Huang, Yang, and Rozelle (2011) shows that by 2020, China will be most deficient in oilseeds and sugar. Although the table indicates self sufficiency in horticulture, there is also a large element of intraindustry trade, with China exporting temperate climate-based horticultural products and importing tropical horticultural products.

By 2020, China's main imports from ASEAN member countries will be oilseeds, tropical vegetables and fruits, and processed food while its main exports to ASEAN member countries will mainly be processed foods and temperate vegetables and fruits. ASEAN member countries will remain net exporters to China (ibid.). This presents an opportunity for most ASEAN member countries, especially Indonesia, Malaysia, the Philippines, and Thailand. China's imports of feed crops (maize) will also grow enormously. This is also an opportunity for land-abundant Cambodia and Myanmar. There will also be a substantial increase in ASEAN-China intraindustry trade in processed food, suggesting opportunities for profitable product niches, albeit with China as the net exporter. Overall, there is significant complementarity between China and ASEAN member countries in agricultural trade.

In summary, there are significant opportunities for profitable, deeper engagement in intraregional agricultural trade that would contribute to, and be dependent on, a robust agriculture sector within the region. Strong growth in agricultural production and productivity is critical for robust economic growth, especially for economies to which agriculture contributes a large share. Agricultural development is critical for poverty reduction as well as reduced income inequality within a country. The number of the very poor, poor, and low income in East Asia is still huge, and a large percentage of the very poor and the poor are in the rural areas. Moreover, growth in agricultural productivity facilitates the flow of labor out of agriculture to nonagricultural sectors amidst rising wages but without putting much pressure on agriculture (i.e., food) prices.

Thus, for all the hype about manufacturing trade and services in East Asia, agriculture and agricultural development as well as agricultural trade remains an important policy and development concern for the region. The experiences of selected ASEAN member countries discussed in the succeeding sections bring out in sharp relief the potentials as well as the challenges of agriculture, agricultural development, and agricultural trade for East Asia.

3. Agricultural Development and Trade, Poverty Reduction, Agro-industrialization, and Food Security

Agriculture development as engine of growth and main driver of poverty reduction

There are three countries in developing East Asia where agricultural development can be expected to be the main driver of growth and poverty reduction: Cambodia, Laos, and Myanmar, all of which currently belong to the so-called low-income group of countries. This is because the agriculture sector is the main sector of the economy in these countries, much of the populace is in the rural sector, and most of the poor live in the rural areas. All three are blessed with a relative abundance of land or natural resources; therefore, investing in the agriculture and natural resources sectors will go a long way in ensuring the robust growth of the whole economy.

Studies have shown that in developing countries, agricultural development has a larger impact on poverty reduction efforts compared with manufacturing. This is especially true in countries where the distribution of the ownership of agricultural land is relatively more equitable. In China, for example, poverty reduction arising from growth in agriculture was four times higher than from growth in industry or services (World Bank 2007, 37). A 1 percent growth in per capita agricultural GDP has led to a 1.6 percent growth in the incomes of the poorest 20 percent of the population, higher than the impact of a 1 percent growth in either per capita manufacturing or service GDP (Gallup et al., cited in DFID 2004, 9). Indeed, the dramatic reduction in poverty in China in the 1980s, Viet Nam in the 1990s, and even Indonesia in the early 1980s was largely due to a substantial increase in agriculture production and productivity, followed by a sharp growth in labor-intensive manufactures.

Although less spectacularly than it did in China and Viet Nam, the agricultural sector also grew substantially and the poverty rate declined appreciably in Cambodia and, to a lesser extent, Laos and possibly Myanmar. Nonetheless, these three countries still face significant challenges in ensuring high growth of production and productivity in agriculture in order for the sector to be a more dynamic driver of the whole economy.

Cambodia: investing in agriculture. Cambodia is the sleeper hit of Southeast Asia, ranking sixth among the fastest-growing economies of the world during the period 1998—2007 and more than doubling its per capita from US$288 in 2000 to US$900 in 2009 (Sok, Chap, and Chheang 2011, 6) Cambodia shares with Myanmar the highest rate of increase in per capita agricultural production from the mid-1990s to the late 2000s. Correspondingly, its poverty rate declined significantly even if said poverty rate is still substantial given Cambodia's still relatively low per capita income.

In addition to garments manufacturing and a booming tourism sector, agricultural development played a major role in the sharp growth of the Cambodian economy over the past decade. Cambodia has tremendous potential to be a significant net agricultural exporter in the region (ibid.). It has the third-lowest population density in the ASEAN after Laos and Brunei. In contrast to Laos and Brunei, Cambodia has vast, flat, agricultural lands and favorable water resources bisected by large rivers. In short, Cambodia has the most favorable agricultural land-to-population ratio in the ASEAN.

Despite Cambodia's remarkable agricultural performance during the past one and a half decades and its tremendous potential in agriculture, it is still a net importer of agricultural products, albeit only marginally. A major reason for this is that Cambodia's agriculture sector still suffers from serious underinvestment in irrigation, rural roads, extension services, and rural credit. Much of Cambodia's agriculture is "anchored to a fragile subsistence rain-fed system, centered on paddy rice production, where access to irrigation is often inadequate … [and] its performance is highly affected by events like drought, flood, and pest infestation. The low level of overall productivity, both in labor and land terms, is a basic feature of the sector, even though significant improvements have been achieved, especially in rice production" (Cambodia National Medium-Term Policy Framework 2011—2015, 6). Clearly, turning Cambodia from a marginal net agricultural importer to a major net agricultural exporter would require large investments and improvements in institutional structures and even policies impacting on the agricultural sector.

An important factor that will have a major impact on the trajectory of Cambodian agricultural development is labor. Cambodia has a small population relative to the size of its agricultural land and the country itself. At the same time, it has a booming tourism industry, itself a labor-intensive industry, considering the country's cultural and historical assets. Moreover, given its favorable geographic location and its liberal investment policies, Cambodia is increasingly becoming an investment destination for low-skilled, labor-intensive manufactures, exemplified by garments manufacturing. In effect, there needs to be a massive expansion in agriculture in order for the country to become a major net agricultural exporter. However, such an expansion must necessarily compete for labor with a robustly growing tourism sector and a labor-intensive manufacturing sector, thereby resulting in higher wages. With average labor productivity in manufacturing and tourism higher than in agriculture and given the growing demand for labor in the nonagricultural sector (especially in the manufacturing and tourism industries), massive expansion in agricultural production primarily for exports would be feasible only if there is a substantial increase in labor productivity in agriculture.[3] Basically, farmers have to be more productive in the face of rising wages if farms are to be profitable and survive.

Oum (2011) forcefully illustrates this dilemma in his simulations using a computable general equilibrium model for Cambodia. One scenario in Oum's simulations assumes a significant increase in investment in the nonagricultural sector, thereby substantially raising demand for labor in this sector. Oum considers one impact of this particular scenario to be a rise in the wage rate in the agricultural sector while labor productivity remains the same. Not surprisingly, the result is a significant reduction in agricultural output and employment.

Oum's simulations also suggest that investing in the nonagricultural sector would result in higher GDP growth rate than investing in the agriculture sector. However, there would likely be a more favorable impact on poverty reduction with investment in the agricultural sector than in the nonagricultural sector. This is because the poorer provinces that are heavily dependent on agriculture will benefit more while an investment bias toward manufacturing would benefit Phnom Penh where the poverty incidence is significantly less. Thus, Oum's simulations present a potential trade-off for Cambodia between higher growth rate and better poverty reduction outcome. Of course, the trade-off can essentially be theoretical since the best way to address it is to increase the overall investment rate to allow investments in both the agricultural and nonagricultural sectors.

[3] There are already anecdotal reports that the new rubber plantations in Cambodia are hiring Vietnamese workers because of the lack of interested Cambodian workers (who seem to prefer working in urban areas like Phnom Penh).

Increased investment in the agriculture sector is needed in order for Cambodia to become a major net agricultural exporter. Public investment is especially needed in irrigation and flood control because while Cambodia has an estimated annual supply of 475 billion cubic meters (BCM) of water from the Mekong system, much of it is "...concentrated during the 6-month wet season, and there is very little reservoir storage to capture and regulate wet-season runoff" (Sok, Chap, and Chheang 2011, 16). Rice is a water-intensive crop and responds well to sunlight; thus, the dry season, together with good water irrigation and control, brings higher yields than the rainy season. At the moment, only 11 percent of the area dedicated to rice is partially irrigated during the dry season and only 1 percent is fully irrigated in all seasons (Cambodia National Medium-Term Priority Framework 2011—2015, 7). Floods are also frequent and are "virtually unmanaged," damaging crops and infrastructure although they also replenish soil nutrients (Sok, Chap, and Chheang 2011, 16). Cambodia will need to invest substantially in irrigation and flood control in order for the country to emerge as a major rice exporter as envisioned by the Cambodian government.

The private sector (consisting of both domestic and foreign companies) has also been investing in Cambodia's agriculture sector, buoyed by a strong policy support, a liberal investment regime, and the availability of land. Cambodia stands out in the ASEAN as having the most liberal provisions with respect to foreign-equity participation in virtually all sectors of the economy. Major private investments in agriculture involving investors from China, Malaysia, Singapore, and Viet Nam are essentially large-scale plantations devoted to rubber, palm oil, and sugar production and processing (ibid., 20).

An important policy initiative related to the effort to entice private investments in support of large-scale agriculture is the Economic Land Concession (ELC) program where the government grants "... private state land through a contract to a concessionaire for ... the cultivation of food crops or industrial crops, production of animals and aquaculture, construction of a plant or factory and facilities to process domestic agricultural raw materials, or a combination of some or all of above activities" (Ngo and Chan 2010, 6). There were eighty-seven ELCs in force as of April 2010, involving a little over one million hectares (ibid., 7), which is very substantial considering that the country's total agricultural land area is only about 4 million hectares.

However, the initial evaluation of the performance of the ELC program is very mixed. Sok, Chap, and Chheang (2011) suggest that the ELC program has not delivered the expected results, given that only a few concessionaires have actively invested in the concessions while many have been entangled in various conflicts with indigenous communities on a number of issues. A few of the concessions have been cancelled. Case studies by Ngo and Chan (2010) show varied impacts, including clear positive net benefits to poor rural folks, apparent net loss to the poor, and unclear net balance of benefits and costs to poor communities. What the findings suggest is that there is a need to further refine the ELC program so that it becomes an effective tool for the country's agricultural modernization and commercialization and a mechanism to bring about considerable reduction in rural poverty in Cambodia.

The discussion above further suggests that the ELC program is not a panacea for Cambodia's agriculture sector and the rural poor although it can be a major complement if it is properly implemented. The government still needs to invest in irrigation, roads, and bridges as well as in rural institutions like extension service and research and development (R&D) centers, sanitary and phytosanitary facilities, etc. It should be noted that the infrastructure constraints are also potential investment opportunities. For example, investments in irrigation, roads, and postharvest facilities, which are all critical for growth in agricultural productivity, are also potential areas for Public-Private Partnership (PPP) investment initiatives. The country has a very liberal investment regime that augurs well for increased foreign direct investment (FDI) even in agriculture. Nonetheless, transparency and accountability may be needed to avoid contingent liabilities from PPP projects. Similarly, given the mixed results so far from ELCs with respect to poverty alleviation (Ngo and Chan 2010), refinements may be necessary to deepen complementarities between large concessions and small farms. Such refinements could result in a bigger and more positive impact on poverty alleviation and rural development. Finally, there is a need for an improved regulatory and facilitation regime and infrastructure, including addressing speculative land-price distortions, sharply improving trade facilitation as well as sanitary and phytosanitary management systems, and strengthening trade diplomacy and regional cooperation to enable greater market access for Cambodian exports (Sok, Chap, and Chheang 2011).

Laos: the challenge of poverty reduction and food security in a resource-rich, agriculture-constrained country. Laos has the highest land-to-population ratio but the lowest agricultural land-to-total land ratio in the ASEAN so much so that it has one of the lowest agricultural land-to-agricultural population ratios. In essence, Laos is rich in natural resources but unlike Cambodia, its potential for commercial agriculture is much more limited. This is because its mostly mountainous terrain and the poor roads in the uplands allow primarily only subsistence farming in those areas. The country has a diverse agro-ecological environment that, to some extent, determines the degree and location of poverty—the relatively flat lands of the Mekong Corridor planted mainly to rice; the rich soils of the Bolovens Plateau, which are particularly suited to horticulture and coffee cultivation; the shifting cultivation done in the mountains of the Vientiane Plain and the commercializing Northern Lowlands, which are threatened by severe erosion; the poor soils of the remote Central-Southern Highlands and Northern Highlands. Laos also has the lowest adult literacy rate in the ASEAN and a high incidence of rural poverty with about four-fifths of the poor living in the rural areas (Lao PDR Ministry of Agriculture and Forestry, Strategy for Agricultural Development 2011 to 2020, 3—5).

Given the topography of, and poor infrastructure in, the uplands, commercial agriculture is done in pockets, and the strategy for agricultural development necessarily has to be area specific. This strategy has to consider the farming system approach (rather than monoculture). It also has to strike a balance between farming activities and the preservation of natural resources in the uplands to prevent serious erosion. Laos, with its small population, has a small domestic market. Institutional capacity at the local level is generally viewed to be weak. Given these constraints, Laos's current agricultural development strategy is the "...gradual shift from subsistence into commercial smallholder production" (ibid., 27) primarily for domestic food security and the production of agricultural inputs for the rising tourism industry as well as export niches (e.g., tree crops in the upland Bolovens Plateau, rubber for China). China, Laos's northern neighbor, offers significant export-market potential.

Compared with Cambodia, the performance of Laos's agriculture sector was significantly less during the 2000s except for 2007 when the value added of agriculture rose by a whopping 8.6

percent against an average of 2 percent during 2000—08, excluding 2007. Per capita agricultural production index rose by 18 percent during 1999—2007, which is much lower than the 45 percent increase in Cambodia and Myanmar during the same period.

Despite a less-than-stellar performance during the past decade, the agriculture sector in Laos has been moving forward toward commercialization. Commercial maize cultivation has been increasing especially in the Northern Lowlands, partly in response to the market opportunity in China. Similarly, rubber production is growing, driven mainly by FDI from China and Viet Nam and with output geared mainly for China. Most of the rubber trees are still young and currently unproductive. When they become productive within a few years, rubber could become one of the country's key agricultural exports (Leebouapao and Voladet 2011).

Rice and coffee, Laos's two key agricultural products, suffer from low yield. Coffee yields, in particular, have been declining. Indeed, the key challenge for Laos's agriculture is how to substantially raise agricultural productivity while significantly reducing the agricultural population-to-agricultural land ratio (and reducing rural poverty in the process).

What are the possible ways forward for Laos's agriculture sector? The country has a well-articulated agricultural development strategy for the years 2011—20; however, the constraint ultimately is in financing in the light of the formidable infrastructural and even institutional challenges facing the sector, especially in the uplands. Leebouapao and Voladet (2011) show that the budget for agriculture has, in fact, been declining in absolute amount from 2005 to 2010. This is suggestive of a country facing tight budgetary constraints.

Perhaps the best way forward is to make natural resources work for agriculture and rural development in Laos. This is because natural resources, especially energy and mining, are where Laos has a comparative advantage. Energy and mining are now the "main exports" of Laos. Expanding the natural resources sector means increased royalties and revenues for the government, a larger proportion of which could be spent for rural infrastructure (e.g., roads, communal irrigation, etc.), the agriculture sector (e.g., extension service, research and development), and rural education and health. The energy and mining industries, however, are capital intensive, which means that Laos would have to rely on an improved investment climate and increased FDI in order to substantially expand its natural resources sector.

The other major way forward also relies a great deal on FDIs in commercial, plantation-type agriculture (e.g., rubber and sugarcane plantations). The case study of a sugarcane plantation in the Sing district, Luang Numtha province, in Leebouapao and Voladet (2011) shows that an FDI-led agriculture project could provide market access to, and technology transfer from, China as well as an eventual significant reduction in poverty incidence. When they become fully productive, the rubber plantations in the northern and southern parts of Laos may also be able to attract capital, technology, and market access in addition to providing employment and increased income.

Commercial, plantation-type agriculture is given significant importance in Laos's agricultural development strategy. The agricultural promotion policy of the Laotian government centers on the land-leasing program where investors are "…able to get big land by concession for very long time and [for] very cheap price" (Leebouapao and Voladet 2011, 13). The economic rationale is clear and compelling: in a country faced with severe capital and technology constraints, FDIs that can provide capital, technological and managerial know-how, and market access (and thereby increase the economic value of land and raise the incomes of households) are most welcome indeed. Such FDI-led, plantation-type agriculture tends to use contract-farming arrangements as a method of operation, which is useful in supporting and strengthening institutional innovations in agriculture production arrangements. The extensive use of contract farming can be used to leverage people and access to land for better supervision, quality control, and access to technology and markets.

However, if sugarcane plantations are any indication, FDI tends to go to places with favorable agricultural conditions and good access to markets. The Sing district has good road and information links with China and a relatively high socioeconomic status among the districts in Northern Laos (ibid., 22—23). This suggests that commercial, plantation-type agriculture cannot be a panacea for Laos, especially in areas with less favorable agricultural conditions and poor infrastructure facilities. It is essentially just one pillar, albeit an important one, of the Laotian agricultural development strategy.

Landlocked Laos faces substantial disadvantages vis-a-vis other countries in the region for export-oriented manufactures that rely heavily on sea transport. Air-transported manufactures, especially electronics, require skilled labor, of which Laos has a severe shortage. Laos has greater comparative advantage in tourism given its substantial natural (including its topography) and cultural assets (including its many ethnic groups with unique traditions). Indeed, a significant share of FDI in Laos is in the tourism industry.

The growth of tourism and other nonagricultural and non-resource-based industries contribute to the agriculture sector and to rural development primarily by expanding employment. Tourism-related enterprises, for instance, source food requirements from the agriculture sector. Robust growth in the nonfarm sector, therefore, expands nonfarm employment. Income and remittances from nonfarm employment reduce rural poverty and generate funds for investment in farms by recipient households. This is, nonetheless, a decidedly more indirect way forward for Laos's agricultural and rural development. Moreover, this presumes that members of rural households have the requisite education and skills to be employable in the tourism and nonagricultural industries. The fact is that the level of education in the country and the literacy rate of agricultural households are low (Lao PDR Agricultural Development Strategy 2011—2020, 2). It is thus important to increase investment in rural education as a poverty alleviation measure that complements agricultural development in the rural areas.

At the macro level, apart from ensuring macroeconomic stability, the most important policy challenge relates to the further improvement of the investment climate. Given limited domestic savings, FDI is central to major expansion in the commercial agriculture, mining, energy, and tourism industries in the country. Toward this end, a much-improved investment facilitation and overall investment climate in the country is important. This includes the strengthening of institutions and personnel as well as streamlined processes in the government. The results of the ERIA survey on investment facilitation in 2010 indicate that Laos still has much to do in order for it to be on par with many countries in the region in investment facilitation let alone become a frontrunner such as Singapore and Malaysia (Intal, Narjoko, and Simorangkir 2010).

Myanmar: performance and the challenge of unleashing its potentials in agriculture. Myanmar has tremendous potential in agriculture but also faces major challenges in developing a robust and dynamic agriculture sector. An indication of Myanmar's potential is that it was once the world's largest rice exporter before the Second World War. Although the quality of data in Myanmar is suspect, it shares with Cambodia the distinction of being the best performers in the region in terms of the FAO's per capita agricultural production index during the past one and a half decades. However, the sector faces major challenges, not the least of which is the serious problem of rural poverty and malnutrition.

Myanmar has substantial, latent comparative advantage in agriculture. The country covers a wide range of agroecological and climatic regions for different types of tropical, semitropical, and temperate agricultural products. It also has favorable soil for agriculture, with cultivated lands significantly lower than cultivable lands. It has tremendous water resources with four major river basins and large, untouched ground water (UNDP/FAO Myanmar Agriculture Sector Review 2004).

Myanmar's agricultural performance has been remarkable since the end of the 1980s. With the government's huge investments in canal irrigation and the construction of reservoirs, irrigated area rose dramatically from 2.5 million acres in 1988—89 to 5.56 million acres in 2007—08. This allowed for a significant rise in cropping intensity from 120 in 1988—89 to 168 in 2007—08 (Kan Zaw 2011, 15—16). Total sown area in the Ayeyarwady Delta rose from 4.2 million acres in 1988 to 9.1 million acres in 2009 as the Myanmar government reclaimed virgin and vacant land during this period. Net sown area for the whole country rose from 19.9 million acres in 1988—89 to 32.7 million acres in 2007—08 (Kan Zaw 2011, 14, 31). Road investments also widened market reach for domestic crops.

The sharp rise in cultivated land and irrigated land may have been the main reason for the significant increase in per capita agricultural production during the period since yields do not appear to have increased substantially. Fertilizer usage of between 30 kg and 60 kg per hectare in the early 2000s was very low compared with Thailand's 90 kg, the Philippines's 130 kg, China's 256 kg, and Viet Nam's 285 kg per hectare (Fujita and Okamoto 2006, 13, 29). This would have limited the full productivity impact of increased irrigation. High fertilizer application in irrigated areas is a key reason for the success of Viet Nam and China with respect to rice production.

However, despite the substantial increase in cultivated and irrigated land and in per capita production, Myanmar's agricultural foreign trade performance is not impressive. First, Myanmar is a marginal net importer, rather than a net exporter, of agricultural products (if we accept what official statistics seem to indicate). Second, Myanmar's export of rice and rice products has been spotty and, in a number of cases, even below the amount exported by tiny Cambodia. Third, despite Myanmar's potential in a wide range of exportable agricultural products, its range of agricultural export products is actually very narrow and heavily focused on pulses and, to a lesser extent, rice and maize. The volume of exported maize is also highly variable, similar to the volume of exported rice. Other agricultural exports range from minimal for rubber to zero for raw cotton and raw jute, which was the second-most important export product of Myanmar before the mid-1980s. The only consistently and secularly rising agricultural export product during the past two decades has been pulses, much of it geared to the growing Indian market.

What are the factors behind the relatively poor performance of Myanmar's agricultural trade despite its apparent comparative advantage in agricultural products? It is likely that policy bias, incentive structure, and agricultural market-related institutions all contributed to Myanmar's relatively poor performance vis-a-vis its potential. Arguably, the most important factor is the policy emphasis on maintaining domestic stability. A critical element of domestic stability is the price of rice; hence, it is not surprising that the government's intervention has been mainly in the rice sector and primarily by setting the domestic price of rice substantially lower than the world price. That was accomplished largely through an aggressive expansion of rice production (through subsidized irrigation and land expansion) and government control of rice exports (Fujita and Okamoto 2006). In contrast, the government barely intervened in the production and trading of pulses (ibid.). This is probably the key reason why pulses production and exports grew secularly and emerged as the country's key agricultural export, as the farmers responded to the increased demand for pulses in nearby India. Pulses are a very profitable secondary dry season crop in paddy fields with little water. In effect, the expansion of pulses is like a “vent for surplus” response to India’s demand.

The second factor, incentive structure, is related to the first to some extent. Setting a low price for rice for local consumers effectively means that farmers also receive a low price for the rice they produced. However, with the exception of irrigation fees, the prices of other purchased inputs, especially fertilizers and diesel fuel for irrigation pumps, are market determined since the country is a net importer of both fertilizers and diesel. The market price of rice as a ratio of the market price of fertilizer declined dramatically from 0.7 in 2000 to 0.2 in 2005. The official procurement price of paddy rice as a ratio of the official fertilizer distribution price declined from 1.3 in 1986 to 0.6 in 1994 and then to 0.1 in 2003 (Fujita and Okamoto 2006, table 9, 35). Given the sharp deterioration in the relative price of rice, it is probably not surprising that fertilizer usage rate per hectare in Myanmar was very much lower than in other developing Asian countries. This tempered the actual yield relative to the potential yield. It also resulted in Myanmar’s average yield (in rice, for example) being lower than the average yields in other countries like China and Viet Nam.

The third factor that tempered the performance of Myanmar’s agricultural trade is the inadequacy of production support institutions, especially formal rural credit. This is particularly important for the use of purchased inputs like fertilizer. Myanmar’s financial system is undeveloped, which affects the credit situation for the country’s rural poor. Arguably, another reason for the low usage rate of fertilizers is that farmers just do not have the financial means to purchase fertilizers. A third related and compounding reason for the low usage rate of fertilizers is the tight foreign-exchange constraint that prevailed during much of the past two decades. This curtailed the imports of fertilizers, thereby leading to their high domestic price and to the lower price of rice as a ratio of the price of fertilizer. Foreign-exchange constraints (national and of government) and very limited credit resources (due to a poorly developed financial system) lead to suboptimal supply of imported inputs (especially fertilizer) and low private investment. This highlights the issue of the overall macroeconomic environment, which can also be considered as an agricultural production support institution, albeit much more circuitously. Finally, weak agriculture R & D and poor quality of seeds and planting materials indicate a serious technological gap that will hinder a sustained, robust agricultural growth and stronger international competitiveness of Myanmar's agricultural products.

The discussion above suggests that the stability-focused policy regime, adverse incentive structure, and inadequate support institutions have prevented Myanmar from becoming the major agriculture exporter it once was before the Second World War. It should be noted, though, that Myanmar's policy, incentive, and institutional environment since the late 1980s is, in fact, much better than it was during the 1960s, 1970s, and the early 1980s when the country was under a socialist system. An indication of how bad the incentive structure was to farmers at that time was the substantial secular decline in the sown acreage of rice in the Ayeyarwady Delta, Myanmar's rice bowl, from 1963—64 to 1986—87 and the stagnation in the total sown area for rice in the whole country during the same period (Kan Zaw 2011, tables 2.1 and 2.2, 3—4). Nonetheless, given the country's serious problem of poverty and its tremendous potential in agriculture, it would be better for Myanmar's government to substantially improve the policy regime, incentive structure, and the necessary support institutions for agriculture in order for the sector to truly become an engine of robust growth and poverty reduction in the country.

"Shared integration" with Northeast India, Bangladesh, and Southwest China? India and China are Myanmar's major export markets. A subregional grouping among Northeast India, Southwest China, and Eastern Bangladesh would likely maximize Myanmar's large agricultural export potential. However, the analysis of Rasiah and Quasem Al-Amin (2011) indicates major bottlenecks before such subregional economic integration efforts can be undertaken. Among the most important bottlenecks are:

- Bureaucratic and political problems in India and Bangladesh with respect to their border states (Northeast India and Eastern Bangladesh, respectively), which have been largely the neglected states in the current dynamics of development in the two countries
- Serious infrastructure and spatial linkage problems in the area
- Peace and ethnic issues

Agriculture is likely going to be the cornerstone of such a subregional integration effort. Nonetheless, much remains to be done, starting with the development of a common framework for shared development and integration in the area. Perhaps an expert group from the component countries is needed to flesh out the common framework, which will be the basis for intergovernment discussion and negotiations, similar to the expert or vision groups that facilitated the initiatives for the ASEAN+3.

Agricultural trade, agro-industrialization, and food security

Thailand, Viet Nam, Indonesia, and Malaysia are the net agricultural exporters in the ASEAN region. They provide possible trajectories for Cambodia and Myanmar and even, to some extent, Laos in their agricultural development. All four made international agricultural trade opportunities as an important anchor of their agricultural and rural development strategies. And as Malaysia and Thailand show, maintaining global preeminence in agricultural trade demands a complementary policy support regime, competitive firms, and a greater focus on innovation as a source of productivity growth and competitiveness. At the same time, as an economy develops and wages rise, countries could lose comparative advantage in some agricultural products and activities. Indeed, where the overall agricultural land-to-population ratio is increasingly less favorable, the issue of agricultural production primarily for food security versus agricultural production for exports becomes more pressing as shown in the case of the Philippines, the only major ASEAN country with a large agricultural sector that has become a net agricultural importer.

Viet Nam. The case of Viet Nam appears to be the one most similar to that of the CLM (Cambodia, Laos, Myanmar) countries. Like the three, Viet Nam also emerged in the late 1980s from a tumultuous period with a policy regime and development strategy inimical to the long-term growth of the agricultural sector. Yet during the 1990s and 2000s, Viet Nam's agricultural performance was remarkable and contributed substantially to the fast growth of the economy and, perhaps more importantly, to the dramatic drop in poverty incidence during the period. Viet Nam is second only to China in terms of the largest absolute decline in poverty rate in East Asia (and possibly the world) from the early 1990s to the mid-2000s (i.e., using a US$2 per day per capita PPP). Viet Nam's absolute poverty declined from 86 percent in 1993 to 48 percent in 2006

(ADB Key Indicators, 2009, 158). It is also worth noting that Viet Nam's growth has been far more equitable than Cambodia's during the past two decades: Viet Nam's Gini ratio inched up only slightly from 0.36 in 1993 to 0.38 in 2006 while Cambodia's Gini ratio increased substantially from 0.32 in 1994 to 0.41 in 2007.

Studies indicate that the important sources of growth for Viet Nam's agriculture sector varied over time since the late 1980s. These growth sources included the efficiency gains from institutional reforms in the late 1980s (Nguyen and Goletti 2001); the expansion of physical inputs, especially irrigation and fertilizer usage, in the 1990s (Nguyen and Vo 2011; Nguyen and Goletti 2001); and the technical changes in the 2000s (Nguyen and Vo 2011). Agricultural R&D, roads, and education also contributed to the growth in per capita agricultural production. As in the case of China in the late 1970s and the 1980s, institutional reforms that enabled a shift from a collective production system to a household responsibility system resulted in efficiency gains. This meant less administrative intervention in agricultural production and greater reliance on the market system (Nguyen and Goletti 2011, 12). The initial growth from the institutional reforms was followed by major investments in irrigation and fertilizer, two critical ingredients for higher cropping intensity and farm yield. The expansion of irrigated areas and improvements in water control were keys to Viet Nam's export expansion (Barker et al. 2004). Fertilizer application rate rose dramatically from 51 kg per hectare in 1970 to 214 kg per hectare in 1995, the highest rate in the ASEAN. This resulted in the fastest growth during the period 1989—95. The high fertilizer application rate was partly due to the sharp drop in the price of nitrogen fertilizer as a ratio of the price of rice—from 6.7 in 1990 to 3.3 in 2000. The sharp rise in the application of fertilizer led to the tripling of fertilizer imports during the period 1990—99.

It is worth noting that the incentive structure favorable to agriculture and farmers unleashed by the institutional reforms and the greater reliance on a less distorted market system has facilitated the diversification and commercialization of Viet Nam's agriculture. Agricultural exports expanded from rice to coffee, shrimps, pepper, fruits, and other produce. Case studies in the Mekong delta show that changes in land use (shift from rice to fruits and diversification within fruit production) follow market signals and offsetting risks (Hoang, Dinh, and Nguyen 2008). Market conditions and factor-price changes meant shifts in the agricultural commodities where

Viet Nam has RCA. Thus, during the period 2000—08, Viet Nam's global share increased in coffee, tea, mate, and spices (HS 9); fish and crustaceans (HS 3); cereals (HS 10); edible preparations of meat, fish, crustaceans, etc. (HS 16); and edible fruits and nuts, peel of citrus/melons (HS 8), among others. Viet Nam lost RCA in animal and vegetable fats and oils (HS 15); sugars and sugar confectionary (HS 17); oil seeds, etc. (HS 12); and dairy, eggs, honey, and edible products (HS 4).

Agricultural development and diversification contributed to the growing transformation of the rural sector. The average number of income sources for households rose from 4.02 in 1992 to 4.67 in 2002. It dipped to 4.20 in 2008. Better education led to greater mobility and employability for the young in the nonagriculture sector, thereby contributing to the rise of household incomes in the rural areas. The growth of nonfarm employment (e.g., in trading, transportation, and services) in the periurban areas in the countryside also provided an additional income source. The net effect of these has been a dramatic reduction in the poverty incidence in the rural areas during the 2000s. Using Viet Nam's own national poverty line (which uses the national poverty threshold), it can be ascertained that the rate of rural poverty declined from 45 percent in 1998 to 19 percent in 2008 (Duong and Thanh 2011).

Thailand. Thailand presents one logical trajectory of agriculture-sector development for CLMV countries. Fundamentally, the trajectory is where agriculture initially serves as an engine of growth for economies with abundant land and cheap labor. As the land frontier closes and wage rates rise, the challenge is to have a resilient sector that is flexible enough to adjust to changing global and domestic markets. The goal is to have a robustly growing agriculture sector that is also able to shed its manpower to the faster-growing sectors of the economy. The basic adjustment will involve moving up to higher value-added and less labor cost-sensitive segments. This means producing primarily better-quality, safer, and a wider variety of processed foods. In a few cases, it would mean farmers shifting their production to crops for which there is a growing demand and which are more consistent with the agroclimatic production conditions prevailing in their areas. An example of this is when farmers in the northeast shifted from maize to cassava in the 2000s in response to increased demand for cassava chips from China.

At present, there is virtually no absolute poverty at US$1.25 per day per capita PPP in Thailand. Thailand has succeeded in maintaining a robust agriculture and agribased manufacturing sector despite its drive for industrialization and the rise in wages in the country. It has also maintained its position as one of the world's top exporters of rice, rubber, cassava, canned tuna, shrimp, chicken, and sugar, among other products. In addition to the country's relatively favorable agricultural land-to-population ratio, the other reasons for Thailand's success as a major agricultural exporting country include the following (Poapongsakorn 2011):

- *Role of agribusiness firms*. Agribusiness firms are the driving force of Thailand's agricultural modernization and continued comparative advantage in agricultural and food products. These firms, with their extensive experience in using contract farming as a mechanism for introducing new crops, have been central to the diversification of the agricultural sector. They have been investing in modern facilities; market information and linkages; the development of shrimp-based, processed-food products; and increasingly on R&D. These firms are at the heart of the upgrade to better, safer, and more varied processed foods for export and the domestic market using local and imported inputs. (Thailand became a net importer of maize and soya bean partly due to the increased feed requirements of the poultry industry for export.) A number of export-oriented agribusiness firms also invested in meeting the sanitary and phytosanitary (SPS) standards of the European Union, Japan, and the United States, thereby enabling the successful entry of Thai processed products into the markets of developed countries.

  Supportive and facilitative government policies. The Thai government has shifted from taxing the agriculture sector (i.e., net negative resource transfer out of the agriculture sector) in the 1960s through the mid-1980s to increasing support for the sector (i.e., net positive resource transfer into the sector) during the past two decades. Infrastructural support investments in the sector included irrigation and education since the 1960s, roads since the 1970s, electricity and telecommunications in the 1980s and 1990s. The focus of government support intervention in recent years has mainly been in the area of postharvest facilities (e.g., investments in deep-sea/deep-water ports and airport-based refrigeration facilities for vegetable exports). Such investments also include the establishment of food-testing laboratories and the refinement of SPS food-testing procedures. The government has also been the main driver of agricultural development R&D in Thailand, with the country having one of the highest ratios of agricultural R&D expenditures-to-agricultural GDP in the ASEAN. Thailand's private sector has also been investing in specialized areas like hybrids, although there has been a shift in government funding in recent years toward agricultural extension.

Other supportive policies that improve the policy regime for investing in agriculture and/or agribased industries include investment incentives and tariff elimination on critical inputs. Perhaps most important, the long years of macroeconomic stability with low interest rates encouraged long-term private investments in agriculture and food-processing industries, including R&D.

There are also noninfrastructural policies that are directly linked to agriculture, some of which did not turn out well. Subsidized low interest rates were given to farmers who were willing to borrow to shift from "surplus" products like rice and coffee to the "more promising" products like cashew nuts and dairy products, but these efforts largely failed. The "paddy-pledging program," initially successful, became a major fiscal burden and a potential source of distortion in the rice market when the program was tweaked, apparently primarily for political purposes. Some agricultural products have been protected substantially from import competition (e.g., soy bean, palm oil), although the protection rates may likely decline substantially as various free trade agreements (FTAs) and the ASEAN Economic Community take shape. Overall, the more "price- and marketing-related" policy interventions have had mixed results.

- *Fundamental sources of growth*. The study of Poapongsakorn and Anchitworawong cited in Poapongsakorn (2011) indicates that capital (60 percent) and total factor productivity (44 percent) account for the robust growth of Thailand's agriculture sector since the 1980s. There is some variation in the relative importance of the growth factors by subsectors. Specifically, total factor productivity (TFP) was the preponderant (75 percent) source of growth in crops while capital formation was preponderant (almost 75 percent) in fisheries.

Labor, adjusted for quality and working hours, accounted for nearly 75 percent of growth in livestock.

The results of the growth decomposition above bring out the importance of investment climate, including the critical foundation of macroeconomic stability, for robust investment in the sector. On the other hand, institutional innovations and agricultural R&D drive the growth of TFP. The major institutional innovation is contract farming, which Thailand seems to have successfully implemented much more than most developing countries. Thailand has one of the highest ratios of agricultural R&D relative to agricultural GDP in the ASEAN, although the ratio has declined in favor of higher government spending in agricultural extension.

The case of Thailand is noteworthy because of the government's largely "light touch" approach to intervention in the agriculture sector. Specifically, the focus of government intervention is in the provision of productivity-enhancing investments (e.g., roads, electricity, agricultural R&D) and the encouragement of private investments in the agriculture sector through a conducive, stable macroeconomic environment and the provision of fiscal incentives for private investments. With the exception of export taxation on rice before the 1980s, the government's intervention in agricultural markets and pricing had very mixed results. As a result, Thailand's agribusiness firms have been comparatively strong compared to others in the ASEAN region.

Indonesia. Indonesia has one of the largest numbers of agricultural commodity groups with RCA among the ASEAN member countries. It has become the world's largest producer and, since 2009, the largest exporter of crude palm oil (Hirawan 2011, 7). As indicated earlier in the paper, there has been a sharp increase in demand for crude palm oil from China and India. Indonesia is also one of the largest producers of rubber and spices and a rising supplier of cocoa, tea, and specialty coffee (Alatas 2011). Like Thailand and Viet Nam, Indonesia is a net agricultural exporter. However, unlike Thailand and Viet Nam, Indonesia's RCA is in nonfood agricultural products. Indonesia is also a net food importer.

Palm oil looms large in Indonesia's agricultural export economy. The sector posted export earnings of about US$9 billion in 2007 and employs about 3.8 million full-time workers (World Bank 2010, 1). The rise of palm oil in Indonesia, spectacular as it is, would have to start in Malaysia, which has been the world leader in the development of palm oil as a leading vegetable oil worldwide. Malaysia's "…plantations, processors, and manufacturers are generally operating at the industry's technological frontier. Malaysia evolved from simple cultivation and crude oil processing to become the industry's leading innovator, controlling the industry's value added chain" (Rasiah and Shahrin 2006, 1—2). Malaysia became the world's leading exporter and producer of palm oil in the late 1960s and early 1970s, dislodging Nigeria. Indonesia's rise in the global palm oil industry occurred during the 1990s and the 2000s.

Rasiah and Shahrin highlighted the following as the key factors for the emergence of Malaysia as the driver of the global rise of palm oil:

- Active government support during the early development of palm oil plantations and diversification of exports and products
- Consistent but flexible policy support of palm oil processing instead of price-volatile crude palm oil exports, which led to major private investments in processing facilities and infrastructure, etc.
- Network cohesion among firms, institutions (universities, MARDI, associations), and policy instruments drove systemic efficiency, product innovation, and more stable pricing
- Effective R&D led to large yield increases to make palm oil the highest-yielding oil seed in the world

The list above indicates that R&D and innovation coupled with a cohesive network of firms and support institutions, and not only the presence of available agricultural land, play major roles in gaining and maintaining global leadership in agricultural products.

Nonetheless, the availability of suitable land is a prerequisite in order for a latecomer to benefit from technological innovations (e.g., new, high-yielding seeds) from other countries. Palm oil is not new to Indonesia; it was actually the world's largest exporter of palm oil in 1938 before the Second World War (Rasiah and Shahrin 2006, 21). However, it was the success of the Palm Oil

Research Institute of Malaysia (PORIM) in developing new, high-yielding varieties that propelled Malaysia to become the global leader in palm oil. In that sense, Indonesia is a technological latecomer. Indeed, labor and land abundance plus favorable growing conditions in the face of Malaysia's tightening labor constraint led to a spectacular expansion in Indonesia, now the world's largest producer and exporter of palm oil. Government expansion programs are also important contributors. Hirawan (2011) discusses the evolution of government policies and programs on palm oil development in Indonesia resulting in the change in the makeup of the industry from the state-owned plantations in the 1970s and the 1980s to a greater preponderance of large private plantations, followed by smallholders and state-owned enterprises. The privatization policies in the late 1990s sparked the sharp expansion of oil palm plantations while the procooperative program (KKPA scheme) at the turn of the twenty-first century contributed significantly to the growth of smallholder oil palm farms.

The spectacular growth of the palm oil industry in Indonesia can be gleaned from the sharp rise in the area planted to oil palm—from around 1 million hectares in 1994 (Rasiah and Shahrin 2006, 24) to 6 million hectares in 2005 and likely 7 to 8 million hectares at present, with more than 600 firms involved in the industry (Hirawan 2011) and about 3.8 million full-time workers (World Bank 2010, 1). Output exploded from about 5 million metric tons in 1996 (Rasiah and Shahrin 2006, 24) to about 19.3 million metric tons in 2008 (Hirawan 2011, 5). The share of crude and refined palm oil account in Indonesia's exports has correspondingly risen substantially—from 14 percent (1995) to 50 percent (2008) of agricultural exports or from 1.7 percent (1995) to 9.0 percent (2008) of total exports.

Hirawan (2011) provides some indications, albeit patchy, that the palm oil boom has contributed to favorable socioeconomic outcomes. Total employment in Sumatera and Kalimantan where much of the palm oil output comes from has risen substantially between 2004—2005 and 2009. The palm oil-producing provinces have become net in-migration destinations while the non-palm oil-producing and nonindustrial provinces have become net out-migration areas. Poverty incidence in the palm oil-producing provinces is, on average, less than in the non-palm oil-producing provinces. The infrastructure gap between the non-palm oil-producing provinces and the palm oil-producing provinces (hitherto the more disadvantaged areas in terms of infrastructure) has declined.

The favorable developments in the palm oil-producing provinces cannot be attributed solely to the boom in palm oil production and exports. This is because some of these provinces are also major producers and exporters of other commodities like minerals and coal, and those commodities also experienced export booms during the 2000s due largely to the China factor. Nonetheless, it is likely that the palm oil boom contributed substantially to the favorable economic developments in the palm oil-producing provinces and, in effect, also contributed to the continuing transformation of Indonesia's countryside.

It may be noted that virtually all the palm oil-producing provinces (and, for that matter, commodity net exporting provinces) are non-Java provinces. To a large extent, Indonesia is divided into two groups of islands. The first group of islands consists of Java and Bali, which are populous and are primarily into food agriculture (mainly rice), manufacturing, and tourism. The second group consists of the rest of the country, especially Sumatera and Kalimantan, which are essentially commodity-producing provinces. Arguably, the palm oil boom and commodity boom of the past decade allowed the non-Java provinces to grow in tandem with (and indeed, somewhat higher than) the growing industrial, tourism, and food heartland of the country that is Java. As a result, the growth of the whole Indonesian economy during the past decade has not led to a significant deterioration in the distribution of income in the country that characterized the China economic boom.

Agricultural exports and food security: Indonesia and the Philippines. As indicated earlier, Indonesia is a net agricultural exporter but a net food importer. The Philippines is both a net food importer and a net agricultural importer, but nonetheless has significant exports in a few agricultural products, mainly fruits and marine and aquaculture products. Thus, among the major ASEAN economies with large agriculture sectors, it is in Indonesia and especially the Philippines where the issue of food security looms large as a policy concern.

The food security issue in Indonesia and the Philippines revolves, for the most part, around the availability and price of rice, the most important grain in the diet of Indonesians and Filipinos. The two countries differ dramatically in their use of trade policy to deal with the issue of the availability and price of rice. Specifically, the Philippines has become the world's largest importer of rice in recent years partly because of the government's decision to raise the rice inventory for the lean months of July to September. This decision resulted in an apparent significant increase in consumption per capita (Tiongco 2011). In contrast, Indonesia has largely banned the importation of rice, although there is leakage. The leakage indicates a de facto import quota, with level of imports currently substantially lower than previous import levels.

The food security issue in Indonesia and the Philippines is best handled by increased domestic production, especially because imports form a very small portion of rice consumption in both countries. (In contrast, imports account for a much higher share of rice consumption in Malaysia, which has little RCA in rice.) In the Philippines, rice area harvested increased by 1.8 percent per annum and yield rose at an average rate of 1.6 percent per annum during the 1994—2009 period, resulting in an annual average growth rate in output of 3.6 percent (Tiongco 2011, 16). The growth rate in output was just about the same as the growth in population and the rise in per capita rice consumption during the period, thereby forcing the country to rely on imports to provide an inventory buffer for the lean months of July to September. In view of the tight agricultural land situation in the country and the high cost of constructing gravity irrigation (in part because the country does not have huge rivers like Mekong), it is more expensive for the Philippines to dramatically expand its irrigated rice lands. At the same time, the two distinct seasons (wet and dry) in the western part of the Philippines, traditionally considered the country's rice granary, require the availability of good irrigation in order to produce very good yields. In the quest for food security, the land constraint is more pressing for the Philippines than it is for Indonesia.

In contrast, Indonesia has more cultivable lands than the Philippines. The main problem lies more in location or geography. Specifically, the land constraint in Java, the heartland of Indonesia's rice sector, is essentially binding. What appears to be cultivable land and suitable for rice is in Papua—the nearer island of Sumatera is better geared for oil palm—which is indeed very far from the main markets for rice (i.e., Java and Sumatera). Moreover, rice production is relatively labor intensive and Papua is relatively underpopulated. The emerging solution is to establish large-scale rice farming in Papua. The goal is to encourage transmigration to Papua in order to attract the necessary labor and trade infrastructure for the massive (possibly up to one million hectares) rice production program, the output of which will be primarily for the Java and Sumatera markets.

In light of the greater supply-response capability in Indonesia, simulations by Warr (2011) nonetheless suggest that the supply response from productivity improvement (and expansion of agricultural land) would be more beneficial to farmers under a more open trading regime. This would arrest the significant reduction in the domestic price that is likely to happen when there is a substantial increase in output and given the volume of domestic demand under a closed economic regime that does minimal international trading in food crops.

Given its more binding land frontier, the Philippines would have to focus more on raising the yield growth rate that it currently has. This would mean the need for improved management of irrigation systems to increase the number of areas with good water control; possibly some expansion in irrigated areas; increased fertilizer application (where feasible) given the relative certainty of water supply; and better-quality rice seeds suitable for the water and soil quality in various parts of the country. Beyond these, the country may have to seriously explore the possibility of increasing its production of high-value export crops (e.g., fruits) and simply ensure long-term supply contracts with rice-surplus countries like Cambodia or Viet Nam to guarantee the relative stability of rice supply in the domestic market. Tiongco (2011) shows that the rate of return to farmers is consistently higher from high-value crops than from grain production. Similarly, the Malaysian example shows that a country need not be self-sufficient in rice production to be food secure; robust and sustainable export earnings can provide the same food security as long as the supply contracts are longer term. Tiongco (2011) also shows that the percentage of Philippine agricultural land devoted to high-value crops like fruits is miniscule so much so that an increase in areas devoted to export crops would not likely lead to serious domestic supply constraints and substantially rising product prices.

In summary, the major challenge on food security for the Philippines is that the country has relatively low land-to-population ratio but high population growth. Moreover, it has low irrigation rate, but rice is a water-intensive crop. It has emerged as the world's largest rice importer but the world rice trade is thin, resulting in highly variable global price. The thinness of the global market is not due to lack of rice consumers; it is the result of government interventions to control the importation of a politically sensitive commodity like rice. The Philippines's agricultural comparative advantage is in tropical fruits and vegetable oils (specifically coconut) plus fishery (aquaculture and mariculture). Reducing the trade-off between the political imperative of food security and the need for exports would call for a greater focus on productivity-enhancing investments (irrigation, roads, R&D in rice, maize, fruits, coconut, etc.) and a substantial reduction of funds for price stabilization. Strong support would also be needed for the gradual reduction of rice and maize tariffs and to encourage investors to flock to the development of East Asia and its agricultural sector. Specifically, better incentives are needed to attract private sector investments in the agriculture sector.

4. Expanding Agricultural Trade and Regional Cooperation in East Asia

Agricultural Trade Liberalization and East Asia Agriculture Trade

Protection, productivity growth, and agricultural trade. Anderson and Martin (2009) provide a clear, quantitative look at the evolution of agricultural protection and liberalization in East Asia. In the 1960s, industrialized Northeast Asia (Japan, South Korea, Taiwan) provided only a low level of protection and assistance to agriculture but that situation has changed; Northeast Asia today provides a very high rate of protection and assistance to the agriculture sector. Developing East Asia has historically taxed or left the agriculture sector unprotected until the 1970s. India and the Philippines started providing protection and net assistance to agriculture in the 1980s. The rest (with the exception of Thailand) followed suit starting in the late 1990s and the early 2000s, but at a much lower level than industrialized Northeast Asia (see **table 7**). The protection or net assistance given by these countries (except for Taiwan and Viet Nam) to agriculture is basically protection or assistance for import-substituting agriculture. (The Anderson and Martin study does not include the CLM countries.) In virtually all cases, the protection or net assistance is a result mostly of protective tariffs and nontariff measures (Anderson and Martin 2009).

The shift in the pattern of protection in East Asia follows the stylized pattern that usually results from factors of political economy where agriculture is increasingly protected when an economy with little comparative advantage in the sector becomes industrialized.

The result of a high level of protection for the agriculture sector, however, is a thin global agricultural market that produces volatile international prices. This is especially true for agricultural products like rice (1) in which there is significant regional-policy interest; (2) that is produced in a region which is the center of global production and consumption for that specific commodity; and (3) which is, in itself, a politically sensitive product for food-security reasons.
In addition, where there is a large gap in assistance between exportable and import-competing agricultural products in favor of the latter, scarce resources for the agricultural sector is diverted too much AWAY from the production of agricultural products in which countries have comparative advantage.

Thus, *a key agricultural policy challenge facing East Asia is how the region can open up its agricultural sector in a manner consistent with regional integration initiatives such as the ASEAN+3 FTAs while simultaneously ensuring greater food security for each country in the region.*

The best option is to drastically change the nature of the assistance given to the agriculture sector. This means giving less emphasis on tariffs and nontariff measures to protect domestic agriculture against imports and instead expanding productivity-enhancing investments like infrastructure, agricultural R&D, and rural education. The rich and developed economies with enough fiscal leeway can also increase income-equalizing transfers to poor farmers and rural households without linking such transfers to agricultural output. This should clearly be a long-term trend, not a short-term solution.

What would be the effects on East Asia's agricultural trade and economies if there were improvements in agricultural productivity in cases of partial liberalization and full liberalization of the agricultural sector, assuming that the rest of the economy is also open? We uses a ten-sector, sixteen-country Global Trade Analysis Project (GTAP) model covering the ASEAN+6 countries (except for Brunei) to simulate the effects of a 5 percent improvement in agriculture productivity under partial liberalization (removal of all tariffs and subsidies except for grains and crops) and under full liberalization (removal of all tariffs and subsidies). In both simulations, we adopted the following assumptions across regions:

- Capital is mobile, moving across regions to equalize disturbances in rates of return generated by the tariff shocks;
- Aggregate employment of labor and of land is fixed in each region;
- Government budget balances are slack, implying that the deterioration in government budget balances caused by the loss of tariff revenue is not explicitly offset by reduced government spending or by increases in other taxes; and
- In the solution year, investment and capital in each region move together, with the world rate of return adjusting to ensure that the weighted sum of changes in each region's investment equals the change in global savings.

The model is static and multimarket, with markets for final goods, intermediate goods, traded goods, and factors of production. It is also multiregional, with a region representing a country or a group of countries. The model assumes perfect competition, and that prices will adjust to clear all markets. See Appendix A for an extended discussion of the model.

Table 9 shows the simulated macroeconomic effects of the 5 percent productivity improvement in the ASEAN+6 economies for both partial and full liberalization. In terms of real GDP, the productivity improvement in both simulations lead to an absolute percentage change in most countries, but the smallest gains for Singapore as it is the most open economy. There is a slight contraction in GDP for the rest of the world. Myanmar, Lao PDR, Viet Nam, India, Thailand, and Cambodia are among the biggest winners in either scenario as grains and crops in these countries have higher shares in GDP on top of the gains from the simulated partial and full liberalization.

As expected, trade in all the countries involved in the simulation exercise experienced an increase in export values and volumes (except Thailand), with trade expansion in China, Japan, and India being the highest. The contraction in Thai exports was due to a reduction in the exports of nongrains and crops as Thai products have to compete with other exporting countries in the region. All countries had a larger increase in imports than in exports, worsening their trade balances.

The sectoral effects can be expected to be different for various countries. For example, in the case of full liberalization, countries with less protection given to grains and crops will have the highest gains while those with a high level of protection will be vulnerable to big losses. Japan's and Korea's output in grains and crops decreased due to relatively high protection whereas Malaysia moderately gained from full liberalization. It is precisely these sectoral effects that are at the heart of considerations of political economy in agricultural trade liberalization, especially in Japan and Korea.

East Asia regional integration and agricultural trade. Simulations on the impact of the ASEAN+1 FTA with China, India, Japan, and South Korea (Fouquin 2008) where all tariffs and the protective effect of nontariff barriers were eliminated suggest that the ASEAN member countries will be the major beneficiaries in the aggregate in terms of GDP as well as in agricultural trade while other developing regions (South America, South Asia, etc.) will be the main losers (see **table 8)**. For ASEAN member countries, agricultural exports would grow by 33 percent and agricultural imports 24 percent from baseline projections for the year 2020. Underpinning the favorable impact on ASEAN member countries is that Japan, South Korea, and India would stand to gain a large percentage of agricultural imports.

At present, the largest volume of global agricultural trade occurs between developed countries. More important, much of the trade between developed countries is **within** regional groupings such as the European Union (EU) and the North American Free Trade Agreement (NAFTA). As has been stated earlier, the regional integration efforts in East Asia, of which the ASEAN+1 FTA is a prime example, would lead to increased agricultural trade within the region. But as in the case of the EU and NAFTA, the increase in agricultural trade within East Asia would not only eliminate intraregional tariffs but also put in place:

- Minimal tariff/nontariff barriers
- Streamlined, transparent, nonprotectionist sanitary and phytosanitary measures
- Improved facilities and institutional capacity in developing EA for surveillance, testing, certification, etc.
- Harmonized standards and technical regulations
- Mutually recognized arrangements on testing and product certification

Toward regional cooperation on crises, disasters, and food security in an integrating and industrializing East Asia

The simulations above show that open economies (in both the agricultural and nonagricultural sectors) in the region would be beneficial especially to the ASEAN member countries under the ASEAN+1 FTA regime. A key challenge is engendering an open agriculture sector. To do that requires addressing a key concern in some countries in the region—food security.

Global food prices declined secularly by half in real terms during past 30 years, according to the FAO (2009), although there have been short but sharp price spikes. The worry of governments is that an open agricultural sector can subject a country to sharp global price hikes, which can potentially be socially and politically destabilizing. Hence, domestic food agriculture tends to be sheltered from global markets and, as such, the sector is not wholly open. However, this kind of protection results in the inefficient allocation of resources in the agricultural sector and even more volatile international food prices given the thin global food markets.

Can the concern for food security be reconciled with an open agricultural sector? Studies have shown that the global food and oil price inflation that happened in the period 2007—2008 had significant negative effects. Reyes and Mandap (2011) estimate that in the Philippines alone, these price increases may have increased the number of poor people by nearly 1.8 million, other things being equal. Chan (2008), cited by Reyes and Mandap (2011), said that the nearly 77 percent increase in the price of rice between November 2007 and November 2008 hit hard the 20 percent of Cambodia's rural population that are landless as well as 45 percent of net food buyers among Cambodia's farmers.

A village case study indicates that Philippine households borrowed money, either pawned or sold properties, and used up savings in order to cope with the surge in food and oil prices. Such coping measures basically jeopardized the future economic status of the families. A similar case study in Cambodia shows that some families took children out from school, borrowed money, and migrated out of their village at a faster rate (Reyes and Mandap 2011).

Simulations done for Indonesia (a net agricultural exporter but net food-importing country) using a computable general equilibrium model by Warr (2011) show that a sharp agricultural price increase in a completely open agriculture sector substantially reduces the real income of poor rural households while somewhat increasing the real income of poor urban households. When food imports are severely restricted and the agricultural food sector is protected, the negative impact of the sharp global price increase on poor rural households is substantially reduced at the same time that the positive real income effect on poor urban households also substantially declines.

Agricultural food protection tends to temper the effect of sharp global price hikes on domestic food prices and their impact on households. This tempering effect is at the heart of the policy bias of food-deficit countries for agricultural food protection, even if politicians' concerns are more focused on the more politically powerful urban households rather than rural households.

Is there a solution to this political economy dilemma?

Simulations by Warr (2011) in the same Indonesian case involving the impact of agricultural productivity improvements in an open agriculture sector as well as under restricted food imports point to a way out of the dilemma. Specifically, Warr's (2011) simulations suggest two things: (1) that both rural and urban poverty decline when there is agricultural productivity improvement under free trade and (2) that both rural and urban poverty increase when there is agricultural productivity growth under a protected agricultural sector.

The Warr simulations suggest that **in the long run**, it is best for East Asian countries to open their agriculture sector while simultaneously increasing investments in productivity growth in agriculture. Since investing in productivity growth in agriculture is a long process, the Warr simulations suggest **that East Asian countries gradually open up their agricultural sectors while stimulating greater productivity-enhancing investments in said sectors**.

While the Warr productivity simulations show the long-term policy trajectory, the issue of managing the impact of short but steep global price hikes remains. A related issue is how to manage the effects of natural disasters, especially within the context of maintaining the stability of food prices and food security. There has been a sharp increase in the number of natural disasters in the 1990s and 2000s compared to the previous decades (Sawada 2011; Reyes and Mandap 2011), and Sawada's (2011) analysis shows that affected countries had to bear the brunt of the adverse economic impact of these disasters. The ASEAN region is especially prone to natural disasters, and the cost of such disasters has been significant and indeed disastrous for poorer countries like Laos, Cambodia, and Myanmar where scarce resources for development are lost or have to be diverted to recovery efforts (Bildan 2003).

Thus, *an important policy and regional cooperation issue is how the effects of natural disasters and spikes in food prices can be managed effectively while the countries in the region further open their agricultural sectors. Is there scope for regional cooperation?*

An FAO study (2009) shows the following major policy actions undertaken by East Asian countries to address the high food prices of 2007—08:

- Reduced taxes on food grains
- Increased the supply of food grain using food grain stocks
- Instituted price controls or consumer/food subsidies
- Imposed export restrictions

The first three measures are the ones most used by East Asian countries. These measures are mainly domestic in character. The first two have a more general effect on, and application to, the economy and society. The third is politically popular and needs to be implemented in a targeted manner. However, the use of the third measure is marked by a history of ineffective implementation in many parts of the developing world.

Reyes and Mandap (2011), one of the papers in the ERIA project, presents the experience of the community-based monitoring system (CBMS) as a viable mechanism for the effective targeting of poverty-alleviation and food-aid programs as shown in a number of developing Asian and West African countries, including the Philippines, Cambodia, and Viet Nam. The CBMS mechanism is especially effective for antipoverty programs that are implemented in a decentralized manner through local government units (LGUs) or institutions. It is even more effective if it is tied to self-identifying and self-correcting programs like conditional cash transfers and workfare projects. It may be noted that targeted food distribution programs and the like become effective measures to address high food prices (and even the effects of natural disasters) if they are already in place and need to be scaled up only when the crisis occurs (FAOP 2011, 42).

The discussion above suggests the short-term strategy that complements the long-term strategy of gradually opening up the agricultural sector coupled with a significant increase in productivity-enhancing investments. **The complementary short-term strategy is the institution of a viable set of safety-net programs for vulnerable populations together with effective targeting mechanisms (like CBMS) in East Asian countries.** Safety-net programs, when undertaken well, do not have lasting distortionary effects on the agricultural sectors of East Asian countries.

Regional cooperation toward food security and addressing emergencies. The same thing (not having a distortionary effect on the agricultural sector) cannot be said of the fourth measure—the imposition of export restrictions. The fourth measure is inconsistent with an open-economy framework and was actually instrumental in aggravating global price hikes for grains like rice in 2007—08 when there was a particularly thin global market. A possible area of cooperation as the region accelerates its integration efforts is an agreement on policy rules, or rules of behavior, among East Asian governments to prevent volatility-enhancing policies by exporters (e.g., export restrictions) and to encourage volatility-reducing policies by importers (e.g., reduction in taxes) during food price-inflation periods.

Another important regional cooperation initiative to address food security concerns, especially under emergency conditions, is the development of regional food security reserve initiatives, which is, in fact, a key action program of the ASEAN Integrated Food Security (AIFS) Framework under its strategic thrust of strengthening food security arrangements in the ASEAN region. One specific action point in the strategic action plan of the AIFS framework is the "…establishment of a long-term mechanism for *ASEAN Plus Three emergency rice reserve*" (ibid, 5). The initial emphasis on rice for the emergency reserve initiative reflects the fact that rice is the primary food grain in the region and that the major producers, consumers, exporters, and importers of rice in the world are in the Greater East Asia region (including India). There is a great likelihood that such an emergency rice reserve will become a reality in 2011 when Indonesia hosts the ASEAN Summit.

Cooperation initiatives, some examples of which are the following, can also be drawn up to address natural disasters in the region:

- Sawada (2011) proposes the exploration of a regional disaster fund similar to the Caribbean Catastrophe Risk Insurance Facility (CCRIF), which, as Sawada notes, "has been effective as the world's first multinational risk pool fund to cover sovereign risk via parametric insurance against hurricanes and earthquakes" (16).

- Similarly, the United States government appears to be planning to propose at the East Asia Summit (EAS) to be held in Bali, Indonesia, in October 2011 a voluntary model agreement aimed at facilitating the fast movement of foreign disaster-response teams to disaster-stricken areas when an affected country requests help from foreign governments under the framework. (The model agreement covers operational matters like visas for the disaster-response teams, tariffs and taxes on disaster-relief goods, etc.)

The discussion above suggests that when there are effective safety-net mechanisms to address the short-term challenges of steep food price hikes and natural disasters, it is important to move towards the long-term goal of having an open agricultural sector in an economically integrated East Asia with a strong focus on creating robust productivity growth in the agricultural sector. A critical foundation of robust agricultural productivity growth is agricultural R&D, which is the focus of the next section.

Agricultural development and regional cooperation in agricultural R&D in East Asia

As suggested earlier, a key challenge is how to reconcile the efficiency benefits of an open trading system in agriculture while ensuring food security in each country in the region. The ERIA study focused on two areas. One way forward is to focus on productivity-enhancing investments in agriculture. Long-term productivity growth in agriculture is determined primarily by agricultural R&D. The other key area of intervention is the management of crises and disasters as well as the challenge of minimizing the adverse effects of crises and disasters on the poor and the near-poor in the region. This section discusses the role of, and the potentials/imperatives for regional cooperation in, agricultural R&D. The next section addresses crises and disasters.

Developing East Asia is a major global supplier of food, especially rice, fish, oilseeds, fruits and vegetables, and even meat. Agricultural R&D breakthroughs are a key reason for the success of developing East Asia in agriculture. Some examples of these breakthroughs are hybrid rice from China, a net rice exporter, which sharply raised yields and production even with reduced rice land area; palm oil from Malaysia and Indonesia; tilapia culture from the Philippines; bivalve mariculture and zero-tillage technology from India; ground nuts from China; baby corn and orchids from Thailand; and energy-saving, solar greenhouses for vegetables, fruits, and flower production from China, among others.

Nonetheless, developing East Asia still holds huge number of poor and undernourished, posing the greater challenge of providing affordable food in a sustainable manner and with increasingly tight land resources, a changing climate, and globalization. This calls for more investment in, and the need for a new approach to, agricultural R&D. The need for a new approach to agricultural R&D is partly due to the changing diets in the region as per capita income increases. Changing diets could mean that R&D also has to find ways to build competitiveness in high-value subsectors in addition to basic food crops such as rice. There is also a need for production systems to be aligned to resource base-carrying capacity and to “broaden growth base in rainfed and marginal areas” (Sombilla 2011).

Sombilla (2011) presents some possible ways forward, namely:

- Stronger focus on small farmers managing in a globalized world
- Stronger basic research and technology development for agriculture (e.g., biotechnology, nanotechnology)
- Greater emphasis on strengthening developing countries’ access to, capability to understand, adoption of, and use of new technologies. This underscores the importance of capacity building.
- Greater collaboration among stakeholders and countries in agricultural R&D because technological innovations are increasingly products of transnational research networks. Possible areas of collaboration include (1) the use of information, communication, and technology (ICT) to control communicable diseases threatening food security and (2) research, surveillance, and control of transboundary plant and animal diseases, etc.
- Strengthen intraregional institutional tie-ups and networks to facilitate knowledge flow and strengthen research capacity and the development of technologies with public good nature (e.g., environmental benefits).

5. Concluding Remarks

The country papers in the study provide a number of important lessons and insights for policy and development, namely:

- The critical role of an appropriate incentive structure
  - Farmers respond well to favorable incentive structures (e.g., institutional reforms in Viet Nam; lack of restrictions on pulses in Myanmar; significant drop in relative price of fertilizers for growing rice in Viet Nam)

   - Good investment climate and investment incentives contributed to the sharp expansion of oil-palm farming and processing in Indonesia and Malaysia

- Government support is important.
   - Government investments in irrigation, agricultural research, roads, and rural education are the most important contributors to agricultural production, productivity growth, and rural poverty reduction in China and India. Irrigation investments are central to Myanmar and Viet Nam's agricultural growth.
   - Export support facilities and rules (e.g., testing laboratories, quality surveillance) contributed to Thailand's agricultural-export competitiveness

- Organizational structure of the industry
   - Cohesive networking of firms, research and training institutions, and private sector-driven government policies (i.e., industrial cluster development) is a critical factor for Malaysia's success in the palm oil industry

- The importance of innovation and productivity growth for international competitiveness
   - PORIM's varietal research breakthroughs are the foundation of Malaysia's palm oil industry boom. PORIM's new-product research is an important factor in Malaysia's global leadership in palm oil.
   - China's agricultural growth stems in part from research breakthroughs in rice, ground nuts, etc. China's agricultural R&D- to-agriculture ratio was relatively stable from the 1950s to the early 1990s. China has the world's largest agriculture research system and personnel.
   - Thailand's agricultural R&D-to-agriculture GDP is comparatively high although it has declined in recent years. Its private sector firms are investing more and more in agricultural R&D.

The review and analysis of the country experiences in East Asia bring out important key words that can underpin the robust agricultural development, trade, and regional cooperation in the industrializing and integrating (developing) East Asia, namely:

- Incentivize
  - A favorable incentive structure for farmers and private investments in agriculture and agribusiness are a foundation for the robust development of the agricultural sector
  - A favorable macroeconomic regime and investment climate is important
- Mobilize
  - Government support infrastructure and mechanisms
  - Network cohesion among firms, institutions, and policies
- Globalize
  - A more open agriculture sector to engender more efficient utilization of limited agricultural resources in the region
  - Improved trade facilitation for deeper intraregional integration
- Institutionalize
  - Safety-net programs with effective targeting mechanism
- Innovate
  - Invest more in agricultural R & D (both government and private)
  - Improve agricultural R & D and agricultural extension capacity
- Cooperate
  - In managing crises and disasters (as well as in managing regional commons)
  - In expanding the reach and benefits of new technologies for agricultural development

Tables

Table 1. Share of the Agriculture Sector in National Output and Employment (%)

Country	Agriculture Value Added (% of Total Value Added)		Employment in Agriculture (% of Total Employment)		Agricultural / Total Exports (%)		Agricultural / Total Imports (%)	
	1995	2007	1995	2007	1994 - 1996	2007	1994 - 1996	2007
Australia	3.4	2.4	4.9	3.3	26.0	16.7	4.5	4.7
Brunei Darussalam	1.2	0.7	2.5	n.a	0.5	0.0	11.1	12.9
Cambodia	49.6	31.9	81.4	59.1	9.1	1.7	38.1	10.4
China	20.0	11.1	52.2	40.8	4.9	1.8	6.5	3.8
India	26.5	18.1	n.a	n.a	15.5	11.4	6.5	3.6
Indonesia	17.1	13.7	44.0	43.7	12.0	15.0	11.6	9.3
Japan	1.8	1.4	5.7	4.2	0.4	0.3	12.6	7.4
Korea, Republic of	6.3	2.9	11.8	7.4	1.4	0.7	7.3	4.2
Lao PDR	55.0	33.4	n.a	n.a	12.9	4.2	14.3	18.9
Malaysia	12.7	10.0	20.0	14.8	10.8	10.0	5.3	6.1
Myanmar	60.0	n.a	64.1	n.a	44.1	7.4	22.7	20.7
New Zealand	7.2	n.a	9.7	7.2	45.7	50.1	7.6	8.4
Philippines	21.6	14.2	43.4	36.1	10.0	6.1	8.7	9.7
Singapore	0.2	0.1	0.2	1.1	3.7	1.7	4.3	2.6
Thailand	9.5	10.8	46.7	39.5	16.2	11.8	4.3	3.7
Vietnam	27.2	20.3	71.3	53.8	29.9	11.6	11.6	7.3
World	n.a	n.a	n.a	n.a	8.8	6.3	9.1	6.4

***Source*:** ADB Key Indicators for Asia and the Pacific (2009).

Table 2. Poverty Incidence in Developing East Asia (millions)

Country	Year	Income[a]		
		Very Poor	**Poor**	**Low Income**
		< $ 1.25	**$1.25 < x < $2**	**$2 < x < $3**
China				
Rural	1990	610.41	156.83	37.5
	2005	198.37	225.64	176.72
Urban	1990	n/a[b]	194.78	80.24
	2005	9.32	42.22	95.44
Total	1990	**610.41**	**351.61**	**117.73**
	2005	**207.68**	**267.86**	**272.16**
India				
Rural	1993.5	348.37	217.81	69.53
	2004.5	338.37	276.68	105.3
Urban	1993.5	95.92	74.18	38.25
	2004.5	111.26	91.82	56.37
Total	1993.5	**444.28**	**291.99**	**107.78**
	2004.5	**449.63**	**368.5**	**161.67**
Cambodia	1994	**5.03**	**3.05**	**1.32**
	2004	**n/a**[b]	**9.43**	**2.25**
Indonesia				
Rural	1990	70.66	38.24	10.43
	2005	27.48	42.8	28.18
Urban	1990	26.05	16	7.41
	2005	19.81	29.01	25.54
Total	1990	**96.71**	**54.24**	**17.83**
	2005	**47.29**	**71.81**	**53.72**
Lao PDR	1992.2	**2.42**	**1.27**	**0.42**
	2002.2	**2.37**	**1.78**	**0.78**
Malaysia	1992	**0.31**	**1.85**	**2.42**
	2004	**0.13**	**1.83**	**3.32**
Philippines	1991	**19.15**	**15.51**	**11.69**
	2006	**20.24**	**20.18**	**17.32**

Thailand	1992	**3.12**	**11.58**	**11.63**
	2004	**0.25**	**7.15**	**11.19**
Viet Nam	1992.7	**43.79**	**15.4**	**5.86**
	2006	**18.1**	**22.91**	**19.39**

***Source*:** PovcalNet: the online tool for poverty measurement developed by the Development Research Group of the World Bank. http://iresearch.worldbank.org/PovcalNet/jsp/CChoiceControl.jsp?WDI_Year=2007.

Note: [a] The income/consumption ranges are in per capita per day PPP at 2005 international dollars.

[b] n/a = not applicable

Table 3. Net Agricultural Trade, 1994—96 and 2007 (US$ billion)

Countries	***Net Agricultural Trade,* US$ billion**	
	1994—96	**2007**
Australia	11.127	15.885
Brunei Darussalam	-0.208	-0.269
Cambodia	-0.158	-0.497
China	-6.417	-27.075
India	2.649	8.974
Indonesia	0.868	9.046
Japan	-38.569	-43.769
Korea, Republic of	-7.837	-12.308
Lao PDR	-0.050	-0.162
Malaysia	3.725	8.740
Myanmar	0.006	-0.215
New Zealand	5.030	10.884
Philippines	-0.659	-2.541
Singapore	-0.946	-1.945
Thailand	5.705	12.739
Viet Nam	0.706	1.083

***Source*:** FAO Statistics (2009).

Table 4. Agriculture Products with RCA Index > 1 in ASEAN Member States, China, and India, 2000 and 2008

HS Code	Cambodia		Indonesia		Malaysia		Philippines		Singapore		Thailand		Vietnam		China		India	
	2000	2008	2000	2008	2000	2008	2000	2008	2000	2008	2000	2008	2000	2008	2000	2008	2000	2008
HS 01. Live Animals																		
0101 - 0106 (6 products)	0	1	1	1	0	1	0	1	0	0	1	0	1	1	2	0	0	0
HS 02. Meat and edible meat offal																		
0201 - 0210 (10 products)	0	0	1	1	1	0	0	0	0	0	1	0	1	0	2	0	3	2
HS 03. Fish & Crustacean, Mollusc & Other																		
0301 - 0307 (7 products)	1	2	5	7	3	3	4	5	1	1	4	6	6	6	5	2	3	3
HS 04. Dairy Prod; birds' eggs, natural ho																		
0401 - 0410 (10 products)	1	1	2	2	1	3	0	1	1	1	1	1	4	2	2	2	2	3
HS 05. Products of animal origin, nes or																		
0501 - 0511 (11 products)	0	0	2	2	4	0	2	2	1	1	4	3	3	1	5	3	5	4
HS 06. Live tree & other plant; bulb, root																		
0601 - 0604 (4 products)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
HS 07. Edible vegetables and certain roots																		
0701 - 0714 (14 products)	0	1	1	1	4	0	0	0	0	0	2	3	2	2	7	6	4	4
HS 08. Edible fruit and nuts; peel or citr																		
0801 - 0814 (14 products)	0	2	2	2	2	0	3	3	1	0	4	3	3	2	3	2	4	4
HS 09. Coffee, tea, mati and spices																		
0901 - 0910 (10 products)	1	1	8	7	6	1	0	0	5	3	1	1	5	6	4	4	6	7
HS 10. Cereals																		
1001 - 1008 (8 products)	0	2	0	0	1	0	0	0	0	0	2	2	1	1	3	0	2	4
HS 11. Prod.mill.indust; malt; starches																		
1101 - 1109 (9 products)	0	1	2	1	1	2	1	1	0	0	3	3	1	2	0	0	2	2
HS 12. Oil seed, oleagi fruits; miscell gr																		
1201 - 1214 (14 products)	1	1	2	2	4	0	2	1	1	1	2	0	4	2	5	4	4	4
HS 13. Lac; gums, resins & other vegetables																		
1301 - 1302 (2 products)	0	0	1	1	2	0	1	1	1	1	1	1	0	1	0	1	2	2
HS 14. Vegetable plaiting materials, veget																		
1401 - 1404 (4 products)	1	1	4	2	2	1	1	1	1	1	1	1	1	2	3	1	3	2
HS 15. Animal / veg fats & oils & their clea																		
1501 - 1522 (22 products)	0	2	8	9	2	9	3	3	3	2	3	4	5	4	3	2	5	4
HS 16. Prep of meat, fish or crustaceans,																		
1601 - 1605 (5 products)	0	0	1	2	0	1	1	2	0	0	3	3	1	2	3	2	0	2
HS 17. Sugars and sugar confectionery																		
1701 - 1704 (4 products)	0	0	2	1	1	0	3	3	0	0	2	3	1	1	0	0	2	2
HS 18. Cocoa and cocoa preparations																		
1801 - 1806 (6 products)	0	0	5	4	0	4	0	0	3	3	0	0	0	0	0	0	0	0
HS 19. Prep. Of cereal, flour, starch / milk;																		
1901 - 1905 (5 products)	0	0	1	2	0	1	1	1	0	1	2	3	2	2	2	1	0	1
HS 20. Prep of vegetable, fruits, nuts or o																		
2001 - 2009 (9 products)	0	0	2	2	1	0	2	3	1	0	5	5	2	4	5	5	3	3
HS 21. Miscellaneous edible preparations																		
2101 - 2106 (6 products)	0	0	0	1	1	1	0	1	1	1	4	4	2	1	1	0	1	1
HS 22. Beverages, spirits and vinegar																		
2201 - 2209 (9 products)	0	0	1	0	0	0	1	1	1	1	2	1	1	1	4	0	1	0
HS 23. Residues & waste from the food indu																		
2301 - 2309 (9 products)	0	0	2	2	2	2	1	1	1	0	2	2	1	0	2	1	3	4
HS 24. Tobacco and manufactured tobacco su																		
2401 - 2403 (3 products)	0	2	2	2	1	1	0	3	1	0	0	0	0	1	0	0	2	2

***Sources*:** Author's computation and WITS database (2011).

Table 5. Agriculture Products with Import Growth between 300% and 500% and > 500%, 2000–2008

HS Code	Cambodia		Indonesia		Malaysia		Singapore		China		India		Japan		ROK	
	Growth Rates (%)															
	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5
HS 01. Live animals																
0101 - 0106 (6 products)		1	1		1		1	1	1	1	0	0		1	0	0
HS 02. Meat/edible meat offal																
0201 - 0210 (10 products)		1	1	1	2			1		5	1	2	0	0		2
HS 03. Fish & crustaceans, molluscs, & others																
0301 - 0307 (7 products)		4	1	1	0	0	0	0	1		1	5	0	0	0	0
HS 04. Dairy products; birds' eggs, natural honey																
0401 - 0410 (10 products)	1	1	2	2		1		2		3		4		1	2	2
HS 05. Products of animal origin, nesoi																
0501 - 0511 (11 products)	1		1		0	0	1		1			3	0	0		1
HS 06. Live trees & other plants; bulbs, roots																
0601 - 0604 (4 products)	1		0	0		2	0	0	2	1		4	0	0	0	0
HS 07. Edible vegetables and certain roots																
0701 - 0714 (14 products)	1	3	1	4		1	0	0	2	2		4	0	0	1	4
HS 08. Edible fruits and nuts; peel of citrus/melons																
0801 - 0814 (14 products)	2	4	4			1	0	0	1	8	1	5	0	0	6	3
HS 09. Coffee, tea, mate, spices																
0901 - 0910 (10 products)		1		1	1	2	1		1	2	2	3	0	0		1
HS 10. Cereals																
1001 - 1008 (8 products)		3	1	2	2	1	1	1		4		3	0	0	1	
HS 11. Milling industry prod.; malt; starches																
1101 - 1109 (9 products)	1	4	1	2	1	3	0	0	3		1	5	1		1	2
HS 12. Oil seeds, oleaginous fruits; misc. grains																
1201 - 1214 (14 products)		1	1	1		1	2	0	1	6	3	3	0	0		2
HS 13. Lac; gums, resins & other vegetable products nesoi																
1301 - 1302 (2 products)		1	0	0	0	0	0	0	0	0	1		0	0	0	0

Table 5. Agriculture Products with Import Growth between 300% and 500% and > 500%, 2000–2008 (continued)

HS Code	***Cambodia***		***Indonesia***		***Malaysia***		***Singapore***		***China***		***India***		***Japan***		***ROK***	
	Growth Rates (%)															
	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5	3 to 5	> 5
HS 14. Vegetable plaiting materials, veg. prod. nesoi																
1401 - 1404 (4 products)		1		1		1	0	0	0	0	1	1	0	0	0	0
HS 15. Animal/veg fats & oils & their fractions																
1501 - 1522 (22 products)		4	2	8	3	7		5	2	10	3	4	2	3	3	5
HS 16. Prep of meat, fish, & crustaceans, etc.																
1601 - 1605 (5 products)		2		3	0	0	0	0		2		5	0	0	1	
HS 17. Sugars and sugar confectionery																
1701 - 1704 (4 products)			1		1		0	0	1		1		0	0	1	
HS 18. Cocoa and cocoa preparations																
1801 - 1806 (6 products)			2	1	1	4	2	2	2	2		4		1	0	0
HS 19. Prep. of cereal, flour, starch, or milk																
1901 - 1905 (5 products)		1	2	1	1		0	0	1	2		1	1		1	
HS 20. Prep of vegetables, fruits, nuts , etc.																
2001 - 2009 (9 products)		3	2	1		1	0	0	2	2		7	0	0	1	
HS 21. Miscellaneous edible preparations																
2101 - 2106 (6 products)	1	3		2	0	0	0	0	1	3	1	3	0	0	0	0
HS 22. Beverages, spirits, & vinegar																
2201 - 2209 (9 products)		3	1	1	1	3		1		5		4	0	0		5
HS 23. Residues & waste from the food industry																
2301 - 2309 (9 products)		1	1	1		1	1	2		2	1	2	1	1	1	1
HS 24. Tobacco & manuf. tobacco substitutes																
2401 - 2403 (3 products)	1		0	0	1		0	0	1	1		2	0	0		1

***Sources*:** Author's computation and WITS database (2011).

Table 6. China's Self-Sufficiency Level (%) in Different Scenarios in 2020

	Baseline	**High GDP**
Rice	102	101
Wheat	95	94
Coarse grains	87	86
Oilseeds	48	46
Sugar	78	77
Fiber	67	65
Horticulture	102	101
Beef and Mutton	93	92
Pork and Poultry	99	98
Milk	81	80
Fish	102	101
Processed Food	106	105

***Source*:** Huang, Yang, and Rozelle (2011).

Table 7. Nominal Rates of Assistance (NRA) for Agricultural Products, Asian Focus Economies, 1980—2004 (%)

Economy, indicator	**1980—84**	**1990—94**	**2000—04**
Northeast Asia	*-38.2*	*-1.7*	*11.9*
Korea, Republic of	89.4	152.8	137.3
Taiwan, China[a]	14.9	38.1	61.3
China	-45.2	-14.3	5.9
Southeast Asia	*4.6*	*-4.2*	*11.1*
Indonesia	9.2	-6.6	12.0
Malaysia	-4.6	2.3	1.2
Philippines	-1.0	18.5	22.0
Thailand	-2.0	-5.7	-0.2
Viet Nam	-	-25.4	21.2
South Asia	*0.6*	*0.7*	*13.6*
Bangladesh	-3.3	-1.5	2.7
India	1.9	1.8	15.8
Pakistan	-6.4	-6.9	1.2
Sri Lanka	-13.5	-1.2	9.5
Unweighted Average[b]	3.2	12.1	21.7
Weighted Average	-20.6	-2.0	12.0
Dispersion, country NRAs[c]	39.9	47.5	38.0
Product Coverage[d]	*74*	*75*	*66*

***Source*:** Anderson and Martin (2009).

Notes:

a. Taiwan, China: 2000—04 is 2000—03.

b. The unweighted average is the simple average across the 12 economies of the national weighted NRA averages.

c. Dispersion is a simple five-year average of the annual standard deviation around the weighted mean of the national NRAs.

d. Weighted averages for the covered products.

Table 8. Impact on Agricultural Trade of ASEAN+3 FTA (in %, SC 1)

	Agriculture Exports (Volume)		***Agriculture Imports (Volume)***	
	2015	**2020**	**2015**	**2020**
ASEAN 10	35.12	33.12	23.61	23.98
Japan	7.04	5.35	19.64	20.45
Korea	4.57	3.75	24.85	24.35
China	11.06	13.00	3.43	3.44
India	43.66	46.45	50.43	50.45
Hong Kong, Taiwan, Rest of East Asia	0.76	0.49	-1.25	-1.37
South Asia	-6.96	-8.48	-0.85	-0.91
EU-25	-0.10	-0.16	-0.18	-0.20
EFTA	-0.11	-0.15	-0.15	-0.18
Russian Federation	-0.16	-0.36	-0.42	-0.48
North Africa	-0.24	-0.20	-0.62	-0.72
Rest of Europe	-0.40	-0.50	-0.08	-0.08
United States	-0.63	-0.64	-0.48	-0.46
Canada	-0.01	0.00	-0.26	-0.35
Mexico and Central America	-0.19	-0.16	-0.17	-0.21
South America	0.27	0.24	-0.83	-0.94
Australia and New Zealand	0.40	0.51	-1.37	-1.51
Rest of the World	-0.99	-1.03	-0.65	-0.68

***Source*:** Fouquin (2008).

Table 9. Simulated Main Macroeconomic Effects of a 5% Improvement in Agricultural Productivity under Partial and Full Liberalization in ASEAN + 6 Economies

Region	Partial Liberalization in Nonagriculture Sectors								Full Liberalization						
	Change in GDP (%)	Change in Export ($ Million)	Change in Import ($ Million)	Change in Export (%)	Change in Import (%)	Change in Terms of Trade (%)	Change in Investment		Change in GDP (%)	Change in Export ($ Million)	Change in Import ($ Million)	Change in Export (%)	Change in Import (%)	Change in Terms of Trade (%)	Change in Investment
Cambodia	1.18	283.06	475.43	6.68	14.77	-1.38	26.35		1.26	335.63	479.74	7.92	14.90	0.45	19.11
Indonesia	0.83	4831.24	6336.16	5.52	8.23	0.67	3.25		0.84	5043.03	6491.29	5.76	8.44	0.74	3.13
Lao PDR	2.33	44.21	88.77	6.71	9.55	-2.55	11.95		2.38	56.27	90.14	8.54	9.69	-2.33	9.68
Malaysia	0.91	5121.78	7573.91	3.31	7.12	0.13	15.43		1.19	5200.55	7534.27	3.36	7.09	0.01	15.98
Myanmar	2.69	197.07	186.32	6.69	5.79	-1.32	2.24		2.65	205.39	205.57	6.97	6.38	-0.03	2.14
Philippines	0.62	1514.97	1820.90	2.94	3.73	-0.55	4.72		0.70	1800.53	2074.08	3.50	4.25	-0.69	4.98
Singapore	0.07	1148.73	2262.06	0.69	1.41	0.60	1.45		0.07	1142.36	2247.19	0.68	1.40	0.60	1.45
Thailand	1.31	-1240.48	18278.69	-1.02	17.78	1.47	46.38		1.25	-1213.96	18189.80	-1.00	17.69	2.18	44.39
Viet Nam	2.24	3435.54	7162.61	10.52	19.55	-1.10	27.34		2.24	3360.91	7751.61	10.29	21.16	1.07	27.35
China	0.69	40801.31	45043.06	5.88	7.52	-0.34	1.67		0.66	41393.19	45298.06	5.96	7.56	-0.29	1.61
Korea	0.29	13299.44	20113.64	4.31	7.85	1.17	2.78		0.69	13386.53	21016.92	4.33	8.21	1.02	3.48
Japan	0.13	23348.31	36801.13	3.56	6.82	1.58	0.56		0.16	25956.31	39379.19	3.96	7.30	1.47	0.59
Australia	0.23	5831.29	12950.63	5.37	10.54	3.40	2.57		0.24	5730.88	13339.89	5.27	10.86	3.80	2.64
New Zealand	0.19	660.54	888.27	2.38	3.32	0.25	1.13		0.19	655.86	853.84	2.37	3.19	0.16	1.07
India	1.48	16289.84	15405.59	15.64	12.11	-2.53	1.72		1.50	16817.66	15856.18	16.15	12.46	-2.64	1.74
Rest of the World	-0.01	13547.50	-46307.00	0.17	-0.56	-0.21	-0.74		-0.01	12943.50	-48012.50	0.16	-0.58	-0.22	-0.75

***Source*:** Results from GTAP simulations.

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APPENDIX A:

Impact of Agricultural Productivity Growth on East Asia

The Model

The version of Global Trade Analysis Project (GTAP) used here is that documented in Hertel (1997). Calibration was based on data from version 7 of the database. The model is static and multimarket, with markets for final goods, intermediate goods, traded goods, and factors of production. It is also multiregional, with a region representing a country or a group of countries. The model assumes perfect competition, and that prices will adjust to clear all markets.

In our simulations, we grouped the data on the 113 countries included in the GTAP database into 16 regions: nine ASEAN member countries (excluding Brunei Darussalam); the People's Republic of China; Japan; Korea, Australia, New Zealand, India; and the rest of the world. The GTAP database contains data on fifty-seven sectors, which have been aggregated into ten sectors (table A.1).

Table A.1. Aggregation of GTAP Sectors

Aggregated Sectors	Disaggregated Sectors
1 Grains and Crops	Paddy rice; wheat; cereal grains not elsewhere classified (nec.); vegetables, fruit, nuts; oil seeds; sugarcane, sugar beet; plant-based fibers; crops nec.; processed rice
2 Livestock and Meat Products	Cattle, sheep, goats, horses; animal products nec; raw milk; wool, silkworm cocoons; meat; meat products nec.
3 Mining and Extraction	Forestry; fishing; coal; oil; gas; minerals nec.
4 Processed Food	Vegetable oils and fats; dairy products; sugar; food products nec; beverages and tobacco products
5 Textiles and Clothing	Textiles; wearing apparel
6 Light Manufacturing	Leather products; wood products; paper products, publishing; metal products; motor vehicles and parts; transport equipment nec; manufactures nec.
7 Heavy Manufacturing	Petroleum, coal products; chemical, rubber, plastic products; mineral products nec; ferrous metals; metals nec; electronic equipment; machinery and equipment nec.
8 Utilities and Construction	Electricity; gas manufacture, distribution; water; construction
9 Transport and Communication	Trade; transport nec; sea transport; air transport; communication
10 Other Services	Financial services nec; insurance; business services nec; recreation and other services; public administration, defense, health, education; dwellings

***Source*:** GTAP database 7

We conducted two simulations:

(i) a 5 percent improvement in agricultural productivity under partial liberalization (removal of all tariffs and subsidies except for grains and crops) and

(ii) a 5 percent improvement in agricultural productivity under full liberalization (removal of all tariffs and subsidies).

In both simulations, we adopted the following assumptions in regions:

- Capital is mobile, moving across regions to equalize disturbances in rates of return generated by the tariff shocks;
- Aggregate employment of labor and of land is fixed in each region;
- Government budget balances are slack, implying that the deterioration in government budget balances caused by the loss of tariff revenue is not explicitly offset by reduced government spending or by increases in other taxes; and
- In the solution year, investment and capital in each region move together, with the world rate of return adjusting to ensure that the weighted sum of changes in each region's investment equals the change in global savings.

Table A.2 reports average ad valorem import tariffs from the GTAP database showing patterns of import protection in nine ASEAN member countries (Brunei Darussalam was excluded) together with six more countries. The most protected sectors are processed food and grains and crops while the least protected is mining and extraction. There are no data in the GTAP database on trade barriers on services.

Table A.2. Average Ad Valorem Import Tariffs in ASEAN + 6 Economies (%)

	Grains and Crops	Livestock and Meat Products	Mining and Extraction	Processed Food	Textiles and Clothing	Light Manufacturing	Heavy Manufacturing	Utilities and Construction	Transport and Communication	Other Services
Cambodia	8.02	11.30	6.80	16.54	10.48	20.91	11.71	0.00	0.00	0.00
Indonesia	3.76	1.73	1.24	7.93	4.69	5.09	2.18	0.00	0.00	0.00
Lao PDR	6.59	5.12	0.76	17.54	6.35	13.20	5.46	0.00	0.00	0.00
Malaysia	38.29	0.90	1.16	35.96	8.25	10.55	2.08	0.00	0.00	0.00
Myanmar	2.53	5.03	1.25	6.71	6.27	3.32	2.22	0.00	0.00	0.00
Philippines	11.02	8.99	2.06	4.38	4.45	5.47	1.92	0.00	0.00	0.00
Singapore	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00
Thailand	22.83	8.85	5.51	25.37	12.64	9.79	4.76	0.00	0.00	0.00
Viet Nam	7.27	8.72	4.40	22.57	17.62	12.17	5.09	0.00	0.00	0.00
China	10.67	9.25	1.57	9.62	13.37	7.47	7.54	0.00	0.00	0.00
Korea	24.00	13.14	0.76	11.80	4.28	1.27	0.26	0.00	0.00	0.00
Japan	76.10	28.93	5.17	23.27	8.60	5.29	3.35	0.00	0.00	0.00
Australia	0.12	0.25	0.05	0.94	12.32	3.63	1.79	0.00	0.00	0.00
New Zealand	0.14	0.40	0.01	2.51	4.38	3.20	1.62	0.00	0.00	0.00
India	29.94	10.50	10.79	47.45	13.68	12.93	11.87	0.00	0.00	0.00
Rest of the World	11.43	6.92	1.74	10.54	8.58	4.01	2.52	0.00	0.00	0.00

***Source*:** Calculated from the GTAP database 7

Table A.3 shows the simulated macroeconomic effects of the 5 percent productivity improvement in ASEAN+6 economies under partial and full liberalization. In terms of real GDP, the productivity improvement in both simulations led to an absolute percentage change in most countries, but the smallest gains for Singapore as it is the most open economy. There was a slight contraction in GDP for the rest of the world. Myanmar, Lao PDR, Viet Nam, India, Thailand, and Cambodia were among the biggest winners in either scenario as grains and crops in these countries have higher shares in the GDP, on top of the gains from partial and full liberalization.

As expected, trade in all countries, except the rest of the world, experienced an increase in export values and volumes (except Thailand), with trade expansion in China, Japan, and India, being the highest. The contraction in Thai exports was due to a reduction in exports of nongrains and crops as Thai products have to compete with other exporting countries in the region. All countries had a larger increase in imports than in exports, worsening their trade balances.

As for the terms of trade (the change in the relative price of exports to imports, both weighted by base-year quantities), the simulation results in an improvement for eight out of the fifteen countries under partial liberalization and ten out of the fifteen countries under full liberalization.

The differences in changes in terms of trade depend on each country's average import tariffs and trade before liberalization. If a country began with significant exports and either low or no import tariffs, there was no change in its import prices. Its export prices, however, increased due to tariff reductions among its trade partners. Therefore, that country's terms of trade improved because it received a higher price for its exports. The opposite was true for countries with low exports but high import tariffs.

2. Simulated Sectoral Effects

Productivity improvement in agriculture under partial and full liberalization produced mixed effects on different sectors but with similar patterns (tables A.4 and A.5). Under partial liberalization, productivity improvement led to an increase in output of grains and crops for all ASEAN+6 economies, except Australia, due to both export and import competition.

Under full liberalization, a country with less protection in grains and crops posted the highest gains. Japan and Korea saw their output in grains and crops decrease due to relatively high protection while Malaysia and India moderately gained under full liberalization.

These sectoral results are dependent on how productivity improvement in agriculture under partial and full liberalization affects the relative prices of imports and exports of goods and services as presented in tables A.6 and A.7.

Table A.3. Simulated Main Macroeconomic Effects of a 5% Improvement in Agricultural Productivity under Partial and Full liberalization in ASEAN + 6 economies

Region	Partial Liberalization in Nonagriculture Sectors							Full Liberalization						
	Change in GDP (%)	Change in Export ($ Million)	Change in Import ($ Million)	Change in Export (%)	Change in Import (%)	Change in Terms of Trade (%)	Change in Investment	Change in GDP (%)	Change in Export ($ Million)	Change in Import ($ Million)	Change in Export (%)	Change in Import (%)	Change in Terms of Trade (%)	Change in Investment
Cambodia	1.18	283.06	475.43	6.68	14.77	-1.38	26.35	1.26	335.63	479.74	7.92	14.90	0.45	19.11
Indonesia	0.83	4831.24	6336.16	5.52	8.23	0.67	3.25	0.84	5043.03	6491.29	5.76	8.44	0.74	3.13
Lao PDR	2.33	44.21	88.77	6.71	9.55	-2.55	11.95	2.38	56.27	90.14	8.54	9.69	-2.33	9.68
Malaysia	0.91	5121.78	7573.91	3.31	7.12	0.13	15.43	1.19	5200.55	7534.27	3.36	7.09	0.01	15.98
Myanmar	2.69	197.07	186.32	6.69	5.79	-1.32	2.24	2.65	205.39	205.57	6.97	6.38	-0.03	2.14
Philippines	0.62	1514.97	1820.90	2.94	3.73	-0.55	4.72	0.70	1800.53	2074.08	3.50	4.25	-0.69	4.98
Singapore	0.07	1148.73	2262.06	0.69	1.41	0.60	1.45	0.07	1142.36	2247.19	0.68	1.40	0.60	1.45
Thailand	1.31	-1240.48	18278.69	-1.02	17.78	1.47	46.38	1.25	-1213.96	18189.80	-1.00	17.69	2.18	44.39
Viet Nam	2.24	3435.54	7162.61	10.52	19.55	-1.10	27.34	2.24	3360.91	7751.61	10.29	21.16	1.07	27.35
China	0.69	40801.31	45043.06	5.88	7.52	-0.34	1.67	0.66	41393.19	45298.06	5.96	7.56	-0.29	1.61
Korea	0.29	13299.44	20113.64	4.31	7.85	1.17	2.78	0.69	13386.53	21016.92	4.33	8.21	1.02	3.48
Japan	0.13	23348.31	36801.13	3.56	6.82	1.58	0.56	0.16	25956.31	39379.19	3.96	7.30	1.47	0.59
Australia	0.23	5831.29	12950.63	5.37	10.54	3.40	2.57	0.24	5730.88	13339.89	5.27	10.86	3.80	2.64
New Zealand	0.19	660.54	888.27	2.38	3.32	0.25	1.13	0.19	655.86	853.84	2.37	3.19	0.16	1.07
India	1.48	16289.84	15405.59	15.64	12.11	-2.53	1.72	1.50	16817.66	15856.18	16.15	12.46	-2.64	1.74
Rest of the World	-0.01	13547.50	-46307.00	0.17	-0.56	-0.21	-0.74	-0.01	12943.50	-48012.50	0.16	-0.58	-0.22	-0.75

***Source*:** Results from GTAP simulations

Table A.4. Simulated Sectoral Effects of Improvement in Agricultural Productivity under Partial Liberalization in ASEAN + 6 Economies (% change)

Output	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam	China	Korea	Japan	Australia	New Zealand	India	Rest of the world
Grains and Crops	0.61	3.87	3.02	3.7	3.56	3.49	8.47	3.02	1.53	2.48	2.6	0.35	-2.87	3.07	2.11	-0.93
Livestock and Meat Products	-0.22	1.41	1.99	2.71	29.24	-1.73	1.48	-3.57	0.47	0.76	-5.69	-12.52	35.02	5.75	1.34	-0.34
Mining and Extraction	-2.84	-0.75	-0.85	-0.91	0.3	1.13	0.63	-0.3	-5.76	0.05	-1.9	-0.52	-0.16	0.15	-0.24	0.2
Processed Food	-5.65	11.85	-3.52	11.82	5.46	5.2	38.36	10.97	-6.54	3.4	-2.47	-0.98	6.41	4.91	-8.11	-0.25
Textiles and Clothing	4.78	-5.71	9.95	11.31	9.05	0.43	-6.82	-16.13	30.16	7.46	8.16	-0.23	-14.35	-5.22	4.45	-1.52
Light Manufacturing	-3.83	-5.15	-21.26	-3.47	-7.55	-4.54	-3.04	-4.77	-3.82	-0.86	0.16	1.35	-5.91	-3.79	2.34	0.06
Heavy Manufacturing	2.91	-0.87	2.63	-0.17	-3.4	0.54	1.03	-0.88	-5.92	-1.03	-0.07	0.13	-3.6	-1.31	2.72	0.23
Utilities and Construction	17.61	2.14	8	4.85	1.59	2.51	0.81	27.26	16.63	1.28	2.12	0.32	1.76	0.56	1.26	-0.38
Transport and Communication	-3.45	0.34	1.3	-1.12	0.86	-0.02	-0.16	-1.44	-0.98	0.06	-0.3	-0.01	-0.22	-0.16	1.25	0.15
Other Services	-2.8	-0.22	1.24	-1.65	0.09	-0.59	-1.27	-2.44	-7.23	-0.02	-0.42	-0.02	-0.27	-0.15	0.63	0.03
Export																
Grains and Crops	31.99	15.62	33.03	5.55	15.51	13.4	5.59	7.58	6.79	13.51	30.62	23.46	-14.22	2.78	46.17	-3.25
Livestock and Meat Products	6.59	-4.81	20.87	6.03	234.21	0.51	-3.14	-22.48	-11.19	26.72	85.39	5.8	89.84	10.2	53.98	-3.64
Mining and Extraction	-9.27	0.04	19.56	-0.33	0.91	42.65	2.71	-36.43	-7.57	23.51	53.3	74.52	3.27	3.29	20.91	0.22
Processed Food	58.58	55.39	57.01	24.04	22.66	27.89	60.5	34.78	1.38	27.41	39.55	34.54	29.64	9.82	13.72	-1.71
Textiles and Clothing	6.83	-3.08	14.9	22.55	13.1	6.29	-7.48	-15.95	67.91	16.32	25.21	55.8	28.5	6.06	17.58	-3.84
Light Manufacturing	14.9	-4.02	-19.63	16.64	-8.24	0.84	-5.18	-0.88	7.69	3.61	3.75	8.07	-10.55	-4.25	11.23	-0.06
Heavy Manufacturing	53.03	5.7	26.74	0.86	4.73	1.7	1.13	1.57	-1.47	3.59	4.36	2.1	1.46	-0.58	21.79	0.26
Utilities and Construction	-3.75	-8.57	10.46	-5.64	-2.5	-6.39	-4.63	-20.29	-22.39	-1.68	-10.05	-8.46	-14.94	-4.85	6.26	1.24
Transport and Communication	-13.28	-8.68	0.95	-4.08	-2.81	-2.7	-0.69	-19.5	-2.01	-1.6	-1.92	-2.1	-12.43	-2.39	3.84	2.12
Other Services	-10.1	-11.42	5.03	-6.62	-5.89	-6.87	-4.46	-22.88	-25.22	-4.56	-11.57	-7.3	-14.21	-4.41	2.04	1.24
Import																
Grains and Crops	-13.81	-1.92	-12.18	4.19	-6.18	-6.35	8.21	-5.68	-1.84	-7.11	-12.44	-8.52	10.22	-0.98	-17.85	0.44
Livestock and Meat Products	34.5	1.55	41.98	3.38	28.09	39.02	3.47	15.84	17.01	25.69	26.61	53.34	27.01	-3.06	6.66	-0.99
Mining and Extraction	20.41	6.67	0.04	6.29	19.05	4.87	1.15	5.17	4.91	2.83	0.93	0.89	7.15	0.24	7.09	-0.09
Processed Food	17.13	25.44	30.76	26.84	4.2	4.41	12.57	38.91	24.44	5.61	32.7	20.16	9.79	3.51	167.67	-0.26
Textiles and Clothing	10.46	13.45	13.53	19.81	13.22	8.77	0.44	51.21	54.64	24.3	30	21.3	34.25	16.92	45.32	-0.12
Light Manufacturing	23.82	18.52	12.21	25.35	6.56	11.07	1.4	42.46	30.13	19.32	14.99	9.41	13.61	6.45	14.21	-0.68

Heavy Manufacturing	16.03	6.49	4.08	3.85	4.92	2.26	0.92	14.85	12.7	6.79	8.06	5.24	7.91	1.95	9.25	-0.68
Utilities and Construction	23.42	7.13	-1.57	12.17	3.53	7.27	0.89	16.43	39.58	0.64	6.5	4.83	9.29	1.19	-1.33	-0.84
Transport and Communication	7.78	4.85	0.08	4.39	4.4	2.61	1.48	16.3	2.1	1.94	3.03	3.1	7.54	0.65	-0.31	-0.69
Other Services	3.94	4.77	-3.32	2.47	3.44	3.27	1.33	12.43	11.81	2.67	5.93	3.84	8.24	1.2	0.4	-0.48

***Source*:** Results from GTAP simulations

Table A.5. Simulated Sectoral Effects of Improvement in Agricultural Productivity under Full Liberalization in ASEAN + 6 Economies (% change)

Output	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam	China	Korea	Japan	Australia	New Zealand	India	Rest of the world
Grains and Crops	19.64	4.85	4.77	1.08	5.27	3.41	9.55	8.1	9.64	3.88	-11.8	-5.64	7.26	2.2	1.87	-1.33
Livestock and Meat Products	-7.64	0.91	1.28	5.97	18.15	-1.77	0.99	-6.4	-0.82	0.46	5.02	-10.64	30.4	5.6	1.44	-0.28
Mining and Extraction	-4.77	-0.76	-1.37	-1.03	-0.34	1.1	0.5	-0.62	-6.43	-0.02	-1.77	-0.38	-0.31	0.18	-0.22	0.2
Processed Food	-20.75	11.04	-4.14	14.17	0.87	6.03	38.41	7.84	-13.61	2.93	6.73	-0.19	5.3	4.75	-8.01	-0.26
Textiles and Clothing	2.4	-5.72	6.16	17.01	4.76	0.89	-6.99	-15.36	26.84	6.89	11.29	-0.15	-15.06	-5.12	4.92	-1.52
Light Manufacturing	-9.62	-5.35	-21.88	-3.63	-11.39	-4.6	-3.06	-4.85	-5.82	-1.05	-0.24	1.5	-6.22	-3.66	2.42	0.09
Heavy Manufacturing	-5.88	-1.04	1.94	-0.44	-6.2	0.43	1	-2.22	-7.69	-1.17	-0.55	0.31	-4.01	-1.14	2.82	0.26
Utilities and Construction	11.99	2.04	6.46	5.06	1.16	2.66	0.79	25.95	16.67	1.21	2.7	0.36	1.78	0.54	1.26	-0.38
Transport / Communication	-4.51	0.22	0.75	-1.2	-0.52	-0.01	-0.12	-1.5	-1.95	-0.04	0.32	0.02	-0.31	-0.14	1.3	0.16
Other Services	-3.21	-0.17	1.39	-1.63	0.57	-0.65	-1.28	-2.21	-6.36	-0.05	-0.32	-0.01	-0.27	-0.15	0.64	0.03
Export																
Grains and Crops	499.68	47.27	104.26	35.25	57.74	44.04	7.28	42.76	49.66	72.57	277.93	42.07	15.42	0.6	50.31	-6.16
Livestock and Meat Products	-75.35	-10.56	7.4	15.44	155.84	0.74	-3.1	-36.74	-41.2	22.03	266.84	14.09	78.66	9.92	56.33	-3.3
Mining and Extraction	24.67	0.24	19.53	-0.47	0.69	42.2	2.51	-33.37	-8.04	23.72	48.99	73.5	3.17	3.36	20.8	0.21
Processed Food	8.49	52.6	50.68	26.58	-1.65	30.19	60.67	29.16	-12.54	24.64	84.09	38.76	25.34	9.54	13.9	-1.77
Textiles and Clothing	4.47	-2.99	10.78	28.89	8.82	6.98	-7.66	-14.84	62.96	15.59	29.55	55.98	25.73	6.14	18.72	-3.86
Light Manufacturing	6.29	-4.34	-20.36	16.18	-13.62	0.57	-5.21	-0.83	4.48	3.26	2.46	8.45	-11.44	-3.9	11.42	0.01
Heavy Manufacturing	36.54	5.45	25.62	0.54	-1.37	1.55	1.1	-0.12	-5.12	3.32	3.45	2.5	0.47	-0.26	22.02	0.32
Utilities and Construction	-2.58	-8.72	9.13	-6.04	-3.77	-6.69	-4.7	-20.03	-24.81	-2.04	-11.15	-8.27	-15.7	-4.69	6.38	1.25
Transport / Communication	-12.18	-9.07	-0.46	-4.33	-5.49	-2.66	-0.6	-19.27	-3.2	-1.75	-1.15	-1.79	-13.12	-2.18	4.02	2.2
Other Services	-16.81	-11.44	3.44	-6.9	-9.86	-7.08	-4.48	-23.55	-27.84	-4.7	-12.55	-7.06	-14.84	-4.15	2.16	1.29
Import																
Grains and Crops	104.22	2.51	23.76	1.42	22.2	13.96	8.28	30.88	59.41	-4.22	19.55	17.85	15.02	-3.25	15.46	-0.24
Livestock and Meat Products	125.97	3.87	33.55	1.15	32.09	40.51	3.57	18.53	41.23	25.98	8.71	48.57	29.89	-4.52	3.87	-1.12
Mining and Extraction	0.33	6.44	-0.59	6.2	18.16	4.84	1.12	3.38	3.3	2.65	0.81	1.1	6.79	0.39	7.17	-0.06
Processed Food	24.96	25.98	31.97	26.82	8.21	3.59	12.62	39.95	28.26	6.21	23.96	18.76	10.46	3.68	166.39	-0.27
Textiles and Clothing	8.2	13.72	11.6	21.28	10.54	9.03	0.43	51.38	52.77	24.73	30.48	20.93	34.57	16.74	44.89	-0.12
Light Manufacturing	22.25	18.58	11.53	25.41	6.83	11.18	1.4	41.94	29.9	19.35	15.75	9.21	13.96	6.33	14.1	-0.7

Heavy Manufacturing	13.66	6.43	3.46	3.83	4.88	2.26	0.89	14.05	12.9	6.72	8.2	5.06	8.11	1.85	9.17	-0.69
Utilities and Construction	16.21	7.1	-1.65	12.77	3.94	7.66	0.88	16.14	41.54	0.75	7.48	4.74	9.72	1.01	-1.37	-0.84
Transport / Communication	5.19	5.03	0.95	4.66	4.85	2.64	1.52	15.8	3.08	2	3.05	2.98	7.99	0.49	-0.3	-0.69
Other Services	8.37	4.72	-1.58	2.67	3.41	3.35	1.34	13.11	15.4	2.68	6.67	3.76	8.63	1.04	0.4	-0.49

***Source*: Results from GTAP simulations

Table A.6. Simulated Sectoral Price Effects of Improvement in Agricultural Productivity under Partial Liberalization in ASEAN + 6 Economies

Export Prices	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam	China	Korea	Japan	Australia	New Zealand	India	Rest of the world
Grains and Crops	-8.72	-5.02	-7.84	-3.56	-7.28	-6.35	-3.32	-4.01	-3.40	-5.50	-9.50	-6.50	0.92	-3.13	-9.98	-1.02
Livestock and Meat Products	-1.97	1.14	-2.25	-0.67	6.72	-0.16	0.84	2.83	1.62	-1.14	-1.54	-0.63	7.01	1.73	-6.01	-0.79
Mining and Extraction	1.73	1.49	-0.47	1.39	0.84	0.19	1.12	6.05	1.58	0.98	1.02	1.03	3.56	1.27	-1.15	-0.28
Processed Food	-2.37	0.52	-1.83	-0.69	-6.24	-0.57	0.26	1.63	0.55	-1.38	-0.99	0.35	3.58	1.17	-3.71	-0.66
Textiles and Clothing	-1.71	0.08	-2.76	-2.59	-2.76	-1.10	0.28	2.47	-7.13	-0.77	0.02	-0.13	0.27	-0.41	-2.82	-0.61
Light Manufacturing	-3.50	0.95	-2.09	-2.11	0.47	-0.45	0.60	0.46	-0.94	0.01	1.65	1.54	2.26	0.47	-1.82	-0.54
Heavy Manufacturing	-7.20	0.64	-2.66	0.47	1.30	-0.29	0.40	1.17	1.95	-0.01	1.11	1.44	2.39	0.61	-2.25	-0.50
Utilities and Construction	0.53	1.73	-2.45	1.03	0.19	1.25	0.85	4.78	5.40	0.13	2.47	1.62	3.62	1.14	-1.49	-0.57
Transport / Communication	3.76	2.24	-0.31	1.66	0.83	0.92	0.79	6.60	0.86	0.68	2.23	1.60	3.77	1.22	-1.21	-0.60
Other Services	2.58	2.92	-1.63	1.53	1.28	1.61	0.92	6.76	7.61	0.94	3.09	1.74	3.98	1.35	-0.84	-0.61
Import Prices																
Grains and Crops	-2.37	-1.53	-3.28	-2.86	-3.31	-2.33	-2.75	-1.37	-2.89	-1.1	-2.29	-1.65	-2.29	-1.4	-2.02	-1.38
Livestock and Meat Products	-11.6	1.26	-12.96	-1.22	-9.93	-10.82	0.55	-5.11	-3.58	-8.39	-13.8	-14.7	-0.22	3.14	-7.45	-0.44
Mining and Extraction	-2.57	0.2	-0.27	0.25	-0.74	-0.74	0.17	-0.17	-1.39	-0.02	-0.64	0.1	0.83	0.59	-3.51	-0.2
Processed Food	-16.33	-9.17	-16.45	-13.87	-7.2	-2.51	-0.28	-14.53	-16.78	-3.34	-15.84	-9.02	-0.58	-0.17	-40.97	-0.54
Textiles and Clothing	-9.56	-6.06	-7.07	-11.48	-7.3	-5.63	-0.84	-13.32	-21.51	-5.92	-8.52	-7.64	-13.71	-7.62	-12.26	-0.74
Light Manufacturing	-12.58	-6.42	-13.51	-16.94	-3.9	-5.38	-0.32	-14.29	-13.35	-5.89	-3.02	-1.32	-3.24	-2.39	-5.52	-0.29
Heavy Manufacturing	-8.75	-1.89	-4.75	-1.48	-1.62	-0.91	0.1	-4.23	-5.11	-2.64	-2.04	-0.22	-1.05	-0.16	-4.4	-0.25
Utilities and Construction	-0.16	-0.13	-0.51	-0.12	-0.34	-0.15	-0.32	-0.36	-0.13	-0.18	-0.08	-0.36	-0.2	1.09	-0.15	-0.32
Transport / Communication	-0.27	-0.12	-0.33	-0.26	-0.35	-0.29	-0.25	-0.24	-0.2	-0.34	0.09	-0.01	-0.13	0.85	-0.14	-0.21
Other Services	-0.35	-0.35	-0.4	-0.39	-0.36	-0.35	-0.37	-0.37	-0.4	-0.39	-0.22	-0.26	-0.31	0.65	-0.39	-0.36

***Source*:** Results from GTAP simulations

Table A.7. Simulated Sectoral Price Effects of Improvement in Agricultural Productivity under Full Liberalization in ASEAN + 6 Economies (% change)

Export Prices	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam	China	Korea	Japan	Australia	New Zealand	India	Rest of the world
Grains and Crops	33.61	-2.8	-4.21	-6.96	-0.33	-6.39	-2.26	6.98	14.13	-4.71	-30.3	-8.5	4.39	-3.27	-10.29	-1.18
Livestock and Meat Products	23.13	2.17	0.42	-1.85	10.1	-0.22	1.13	5.98	8.14	-0.54	-10.56	-1.64	8.08	1.65	-6.35	-0.85
Mining and Extraction	-1.21	1.48	-0.55	1.4	0.75	0.24	1.12	5.56	1.62	0.98	1.34	1.09	3.59	1.26	-1.14	-0.27
Processed Food	7.2	1.02	-0.69	-1.23	-1.17	-1.16	0.38	2.63	4.13	-1.12	-7.97	-0.72	4.11	1.13	-3.81	-0.67
Textiles and Clothing	-1.4	0.07	-2.26	-3.32	-2.23	-1.2	0.29	2.26	-6.72	-0.67	-0.54	-0.22	0.54	-0.44	-2.95	-0.62
Light Manufacturing	-2.25	1.03	-1.95	-2.03	1.53	-0.4	0.62	0.47	-0.43	0.09	1.87	1.49	2.44	0.44	-1.84	-0.54
Heavy Manufacturing	-5.55	0.69	-2.53	0.53	2.14	-0.26	0.42	1.43	2.51	0.03	1.25	1.39	2.54	0.59	-2.27	-0.5
Utilities and Construction	0.28	1.77	-2.2	1.12	0.48	1.32	0.87	4.71	6.13	0.21	2.74	1.58	3.83	1.11	-1.51	-0.57
Transport and Communication	3.41	2.36	0.13	1.78	1.69	0.93	0.81	6.53	1.33	0.76	1.86	1.52	4	1.18	-1.24	-0.6
Other Services	4.7	2.93	-1.23	1.62	2.44	1.68	0.93	7.02	8.64	0.99	3.4	1.7	4.19	1.31	-0.86	-0.61
Import Prices																
Grains and Crops	-5.11	-2.07	-12.62	-12.92	-7.73	-12.4	-1.55	-8.72	-11.77	-1.75	-50.59	-18.06	-0.91	-0.41	-13.5	-1.17
Livestock and Meat Products	-9.74	1.41	-8.85	-1.11	-10.15	-11.23	0.59	-4.98	-4.04	-7.98	-13.38	-14.18	-0.24	3.58	-6.9	-0.44
Mining and Extraction	-2.63	0.2	-0.3	0.25	-0.81	-0.74	0.18	-0.18	-1.4	-0.01	-0.63	0.11	0.83	0.59	-3.5	-0.2
Processed Food	-15.7	-9.11	-16.08	-13.63	-6.91	-2.5	-0.23	-14.93	-16.84	-3.52	-15.69	-9.11	-0.52	-0.31	-40.87	-0.55
Textiles and Clothing	-9.64	-6.16	-7.04	-11.46	-7.35	-5.67	-0.88	-13.35	-21.61	-6.05	-8.47	-7.58	-13.67	-7.56	-12.27	-0.75
Light Manufacturing	-12.55	-6.41	-13.47	-16.91	-3.86	-5.36	-0.3	-14.3	-13.3	-5.87	-3	-1.28	-3.24	-2.36	-5.5	-0.28
Heavy Manufacturing	-8.61	-1.87	-4.58	-1.45	-1.55	-0.89	0.13	-4.22	-5.06	-2.62	-2.04	-0.18	-1.03	-0.12	-4.36	-0.24
Utilities and Construction	-0.17	-0.13	-0.51	-0.13	-0.33	-0.15	-0.32	-0.36	-0.13	-0.19	-0.08	-0.35	-0.2	1.11	-0.15	-0.32
Transport and Communication	-0.27	-0.12	-0.33	-0.27	-0.35	-0.29	-0.25	-0.24	-0.2	-0.35	0.08	-0.02	-0.14	0.9	-0.14	-0.21
Other Services	-0.35	-0.35	-0.4	-0.38	-0.36	-0.35	-0.37	-0.37	-0.4	-0.39	-0.21	-0.24	-0.31	0.69	-0.38	-0.35

***Source*:** Results from GTAP simulations

Chapter 2

Investing in Agriculture and Rural Infrastructure for Robust Economic Growth and Accelerated Poverty Reduction in Cambodia: Challenges, Prospects, and Issues for Regional Cooperation

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CHAPTER 2

Investing in Agriculture and Rural Infrastructure for Robust Economic Growth and Accelerated Poverty Reduction in Cambodia: Challenges, Prospects, and Issues for Regional Cooperation

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1. Introduction

"Besides making ourselves food sufficient, we have to strive to make Cambodia a real exporter of rice and one of the main actors in regional and world food security."[1]

Cambodia has succeeded in generating high economic growth in its recent history, but the challenge lies in sustaining that growth for an extended period of time. Almost a decade of rapid growth exerted a significant impact, with per capita income more than doubling from US$288 in 2000 to US$900 in 2009. As a result, Cambodia is one of the few countries to achieve sustained rapid growth. Of 194 countries with data, forty-six achieved 7 percent annual growth on average for fourteen consecutive years. From 1998 to 2007, Cambodia's growth performance ranked sixth in the world.[2]

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[1] Samdech Hun Sen, Cambodian Prime Minister, in a speech made on August 17, 2010.

[2] World Bank, *Sustaining Rapid Growth in a Challenging Environment*, February 2009.

Cambodia went through a unique window of opportunity in its recent history with the end of a decades-long conflict and the establishment of peace and political stability coinciding with a favorable external environment of rapid growth in global trade. A profound structural transformation took place with an aggressive pace of economic integration into the global economy. This transformation was facilitated by clear policies to encourage Cambodia's fast-track accession to the World Trade Organization (WTO); a shift of jobs from agriculture to manufacturing; a booming tourism sector; and migration from rural to urban areas. Cambodia's growth was fueled to some extent by some of the country's natural and agricultural assets (forests, fisheries, land) and its cultural assets, such as the Angkor Wat temples. Cambodia is a coastal country in a dynamic, rapidly evolving, and regionally integrated Southeast Asia and East Asia. As such, it presents a prime example of geography-driven regional integration since geography played, and continues to play, an influential part in Cambodia's growth.

With vast, flat, agricultural lands and access to a number of big rivers and their tributaries, Cambodia has the potential to become a significant agricultural net exporter. In order to realize the full potential of the agriculture sector, investment in basic physical infrastructure such as irrigation and rural roads are necessary. Agricultural technical support, facilitation of the trading process, and supply-chain sustainability are also important to raise productivity and trade volume. With the government's ambition to turn Cambodia into a major rice exporter, the country needs to attract investment in agriculture and rural areas from various public and private sources.

This paper aims to examine the current state of agricultural and rural infrastructure development in Cambodia through the lenses of public policy and investment, private investment, the activities of nongovernment organizations (NGOs), and the assistance provided by development partners to the agricultural sector. The paper argues that Cambodia's agricultural sector has started to attract increasing attention and investment. Increasing productivity and market expansion coupled with regional cooperation and integration are bringing Cambodia's agriculture sector to the frontline of the national economic development strategy with windows of opportunities. However, the process of infrastructure investment and development is still slow; value-chain creation and product diversification are also facing many challenges.

2. The Agricultural Development Policy of Cambodia

Aware of the significant role of agriculture in poverty reduction, the government of Cambodia has included agriculture as one of the priorities in its Rectangular Strategy. The four sides of this rectangle are: (1) improving agricultural productivity and diversification (including animal husbandry, food security and nutrition, and rural development); (2) land reform and demining; (3) fisheries reform; and (4) forestry reform (including environment protection and conservation). In the last two and a half years, the government's continuous efforts, aided by favorable weather conditions, helped arrest the depletion of natural resources and destruction of the environment; rehabilitate and enhance irrigation potential; in the diversification into cash crops; in the issuance of more land titles to farmers; and to further improve rural infrastructure. The National Strategy for Agriculture and Water 2006—10 was developed through a consultative process and adopted in 2007.[3]

The government's overall goal is "poverty reduction and economic growth through enhancement of agriculture sector development." The sectoral goal is to "ensure food security, increase incomes, create employment and improve nutrition status for all people by improving productivity and diversification, and commercialization of agriculture with environmentally sound protection and food security."

2.1. Agriculture Sector Strategic Development Plan

The Ministry of Agriculture, Fisheries, and Forestry (MAFF) prepared the Agriculture Sector Strategic Development Plan 2006—10 in October 2005 to guide the government's strategic goals as well as the National Strategic Development Plan (NSDP) 2006—10. A strategy for the agriculture and water sectors prepared by the technical working group (TWG) for agriculture and water and with the coordination of developing partners was adopted in March 2007. A sector-wide program to implement this strategy was supposed to have been finalized and approved in 2010.

[3] NSDP Update 2009—2013.

The Agriculture Sector Strategic Development Plan 2006-2010 identified the following strategic objectives for the agriculture, fisheries, and forestry sectors:

- Food security, productivity, and diversification
- Improve and strengthen agricultural research and extension systems
- Market access for agricultural products
- Institutional and legislative development framework
- Land reform (land market development and pro-poor land access)
- Fisheries reform (sustainable access)
- Forestry reform (promote sustainable conservation and management of forests, ensure better management of natural protected areas)

To achieve these seven strategic objectives, MAFF organized activities in the following areas:

- Program I: Improving productivity and diversifying the agriculture sector
- Program II: Promoting market access to agriculture products
- Program III: Strengthening institutional and legal framework and human resources development
- Program IV: Managing sustainable fishery resources
- Program V: Managing sustainable forestry resources

The MAFF has made significant progress in increasing the land area for crops and paddy-cultivated areas, yield per hectare, fishing lots and areas released to fishing communities, fish catch (from all sources), forestry cover, and percentage of reforested land area. Moreover, there have been remarkable achievements in research and development (R&D) on agricultural technologies, such as: (1) high-yield, high-quality seeds; (2) land preparation methodologies; (3) effective use of green manure residuals; (4) land fertility management and use of organic fertilizers; (5) identification of types of pests and the damage they can do as well as correcting misconceptions about pests and pest-control measures; and (6) seed-storage methodologies and timing of harvest and seed drying. From 2006 to 2009, key laws and regulations were put in place to further develop this sector. These include the following:

- Law on Plant Seed Management and Plant Breeder Rights

- Sub-decree on Phytosanitary Inspection
- Sub-decree on Establishment and Management for Village Animal Health Workers (VAHWs)
- Sub-decree on the Sanitary Inspection of Animals and Animal Products
- Sub-decree on Abattoir Management and Meat and Animal Product Inspection
- Law on Fishery
- Sub-decree on Community Fisheries Management
- Sub-decree on Endangered Fishery Product
- Sub-decree on the Legal Procedures on Investments, Public Bidding, Contractual Leasing, and Payment of Fishing Fees
- Sub-decree on the Appointment of the Composition of the National Authority for Resolving Land Conflict
- Sub-decree on the International Trading of Endangered Wildlife and Wild-plants Species
- Sub-decree on the Establishment and Functioning of the General Secretariat of the National Authority for Resolving Land Conflict
- Sub-decree on Forest and Non-Timber Forest Products Permitted for Import-Export
- Sub-decree on Permanent Forest Reserve Classification, Transferring, and Conferring of Tenure Rights in Dom Rei Phong Area in Trapeang Pleang Commune of Chhouk District and Stung Keo Commune of Kampot District in Kampot Province
- Sub-decree on the Establishment of Control and Conservation Areas of Bird Sanctuaries for Sarus Cranes and Other Birds in Boeng Prek Lopoeuv of Borei Cholosar and Koh Andet Districts in Takeo Province
- Sub-decree on Detaching of Land Areas from Protected Forest Areas for Conservation of Genetic Resources of Wild-plants and Wildlife in Mondulkiri Province
- Sub-decree on Rules of Conferring of Rights to Use State Forestlands for Tree Planting
- Sub-decree on Transforming MAFF's General Directorates to General Secretariats; Upgrading Forestry and Fishery Administrations to General Directorate Levels; Upgrading the Department for Agronomy and Improving Agricultural Lands to General Directorate of Agriculture; and Transforming the General Directorate of Rubber Plantation to a MAFF General Directorate

- Sub-decree on the Establishment of Protected Forest Areas for Recreation and Hunting Sport in Oya Dav, Ratanakiri Province
- Sub-decree on the Establishment and Conservation of “Sei Ma” Protected-Forest and Biodiversity Areas of Mondulkiri and Kratie Provinces

Besides contributing to the increase in crop productivity, the technologies mentioned earlier have also contributed to the diversification of cropping systems by allowing farmers to shift from monoculture rice cropping to multiple cropping systems and animal husbandry. This was shift was facilitated by the identification of appropriate soil types, timing, and crop-planting methods before and after the wet-season rice cropping as well as crop-rotation patterns in upland areas. Moreover, the MAFF has conserved 2,557 accessions of rice germplasm and identified rice varieties that are resistant to flood, drought, and the brown planthopper (BPH). It has also conserved the germplasm of other crops such as bananas, cassavas, chillies, and papayas, among others, in order to ensure the sustainable use of natural resources in Cambodia. In addition, the transfer of these technologies has been promoted through improved linkages between research and extension in the form of human resource-capacity development, including short and medium training courses, field demonstrations, workshops, seminars, and conferences.

Overall agricultural production increased from 2006 to 2008 aided by favorable weather conditions and the efforts of concerned institutions to change farmers’ practices in crop farming, crop preservation, and harvesting and to increase irrigation capacity. The growth rate of the agriculture sector was 5.5 percent in 2006, 5.0 percent in 2007, and 5.7 percent in 2008. In 2008, the total cultivated land area was 2.61 million hectares. This translated to about 7.15 million metric tons of paddy rice, resulting in an average yield of 2.74 tons of rice per hectare and a surplus of 2.02 million metric tons of milled rice (see table 2.1).

Livestock production moderately increased from 2004 to 2008 while the number of cattle raised increased by 2.5 percent on average per year. The number of pigs raised declined from 2.42 million heads in 2004 to 2.21 million heads in 2008 due to an increase in the inflow of pigs and other pig-related products from neighboring countries. On the whole, however, the animal husbandry subsector’s contribution to the economy has steadily increased and currently accounts for about 4 percent of GDP. This subsector needs to grow in order to meet local needs for improved nutrition and to supply the tourism industry. The top priorities of MAFF include: (1) the development of a legal and regulatory framework as well as human resources; (2) the reduction of animal morbidity and mortality rates; (3) the improvement of public health, particularly in relation to zoonotic diseases and food safety; (4) promotion of animal feed production; (5) improvement of the quality of animal breeding stocks; (6) promotion of the use of animal manure for biogas production; (7) enhancement and strengthening research and extension programs on livestock production and veterinary activities; (8) improvement of credit services for livestock production; (9) promotion of investments in livestock production and veterinary activities; and (10) promotion of markets for animals and animal-originated products.

Notwithstanding the significant progress that has been made, a number of challenges remain, such as the need to:

- increase productivity in rice and other crops; increase and improve access to extension services, credit, and inputs; increase irrigation; ensure better benefits for farmers through marketing; address farmers' inadequate knowledge on the use of agricultural inputs and techniques and soil improvement;
- develop appropriate legal and regulatory tools and law-enforcement capacity for the monitoring and control of agricultural inputs and the management of soil and soil fertility (e.g., An example of a legal tool is the Law on Agricultural Lands, which defines the land areas to be targeted for agricultural production and proper soil fertility management.);
- improve postharvest management; promote export and domestic markets for agricultural products (including rice and not merely paddy rice, fruits, and vegetables); promote agro-industry, including postharvest processing; improve the quality standards of agricultural products; organize farmers' organizations for better bargaining power; aim for optimum use of land and other resources; and encourage and increase private sector investments and participation;
- establish mechanisms at the local level to provide techniques and services to farmers; promote an agricultural extension program at the local level; and promote the concept and formations of farmers as effective partners of the private sector.

Livestock production in Cambodia has been adversely affected due to:

- repeated threats from pandemics of severe animal diseases, particularly HPAI and H1N1, and from natural disasters such as typhoons (e.g., the devastating Ketsana typhoon of 2009), which typically cause serious loss of life (both human and animals) and resources (e.g., crops, infrastructure, houses, etc.);
- limited resources for the prevention of the spread of severe animal diseases and for animal health care and protection;
- the reluctance of some investors to invest in livestock production after the occurrence of HPAI and the effects of certain animal products imported from neighboring countries;
- the lack of market competition for meat and animal feeds, resulting in the high cost of animal feeds;
- Inadequate and ineffective implementation of laws and regulations pertaining to this particular subsector.

2.2. From food self-sufficiency to food export

Cambodia developed its economy based on agriculture as a core sector. After emerging from, and surviving, the Khmer Rouge regime in 1979, the country had to produce enough food to feed its population. Later, it started to ensure self-sufficiency in food and food security. The basic policies for the development of the agricultural, forestry, and fisheries sectors from 2001 to 2005 were:

- to continue to focus on food security, especially at community and household levels, and reduce the high poverty rate in the agricultural sector; to increase food production, especially the production of rice and subsidiary crops;
- to contribute to the growth of the national economy through the export of surplus agricultural products;
- to improve the quality of agricultural products and increase value added by promoting the development of agro-industrial processing, including the creation of new jobs for rural areas;
- to increase family income and reduce poverty by diversifying crop production, ensuring high yields, and keeping production costs low;

- to manage natural resources through regulation and technical measures that will ensure sustainable use.

Table 2.1: Main Agriculture Statistics

	Unit	2008	2009	2010	2011	2012	2013
Land under crops	000 ha	596	645	774	930	1000	1000
Irrigated land area	000 ha	1120	1145	1170	1195	1220	1245
Paddy: cultivated area	000,000ha	2.61	2.63	2.65	2.65	2.65	2.65
Yield per hectare (rice)	tons	2.74	2.77	2.8	2.83	2.87	3
Fishing Lots	sq. km	415	415	415	415	415	415
Released to Community Fishing	%	56.4	56.4	56.4	56.4	56.4	56.4
Fish Catch (from all sources)	tons	471	515	617	668	726	788
Forestry Cover	% of land area	59	57.59	57.99	58.39	58.79	59.19
Reforested (cumulative total from 1985)	ha	10.81	18.92	73	73	73	73
Fuel Wood Dependency	% of households	73	67	61	59	56	54
Forest Demarcation	m	321	228	413	500	500	500
Forestry Communities	no.	124	210	350	400	405	450

Source: NSDP Update 2009—13.

Table 2.2: Paddy Cultivation in Cambodia

Year	Paddy area (000 ha)	Production (000 ton)
2000	2,158	4,041
2001	2,241	4,099
2002	2,013	3,823
2003	2,314	4,170
2005	2,438	5,986
2006	2,541	6,264
2007	2,5886	6,727

Source: Ministry of Water Resources and Meteorology,“Irrigation Development in Cambodia,” (2010).

3. Investing in Agriculture

3.1. Government Investment in Agriculture

It should be noted that investment in agriculture requires a huge amount of money to get a positive impact. Cambodia has a small annual budget, about half of which is financed by external assistance. Hence, government investment in agriculture is limited due to budget constraints. Total budget disbursements in 2009 were US$989.5 million, an annual increase of 3.5 percent and equivalent to 9 percent of Gross Domestic Product (GDP). Grant support accounted for approximately two-thirds of total disbursements. Japan remains the largest single source of development assistance, disbursing US$148.4 million in 2009, an 18 percent increase from the previous year. China provided support of US$114.7 million to the infrastructure sector, which represents 13 percent of total aid and an annual increase of 20 percent.

Significant funds continue to be allocated to the social sectors, with the combined share of health, HIV/AIDS, and education support representing more than 30 percent of all assistance in 2009. The transportation sector recorded a significant increase, with support rising by 20 percent in 2009 to become the largest aid-supported sector. The agriculture sector also received an annual increase of nearly 60 percent, rising to US$91.2 million or 9.2 percent of the total. Rural development got only US$62 million or 6.2 percent of the budget.[4]

The financial sources for agricultural development are the national budget, foreign assistance, NGOs, and the private sector. Public investment program from 2001 to 2003 allocated for agriculture was US$210 million and investment in the sector, as stated in the Second Social Economic Development Plan (SEDP II), was US$500 million. In the Agricultural Sector Strategic Development Plan 2006—10, MAFF proposed the main prioritized programs/projects by sector and subsector with a budget package of US$153.27 million.[5]

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[4] According to the Aid Effectiveness Report 2010.
[5] MAFF 2005, 31.

Even with its limited budget, the government invested in agricultural R&D. The Cambodia Agriculture and Development Institute (CARDI) was established in 1999 to promote agricultural R&D, with special focus on rice. Donor funds are also used to promote CARDI activities (see box).

Box 3.1: Investing in R&D in Agriculture: The Case of CARDI

The Cambodian Agricultural Research and Development Institute (CARDI) was officially established as a semiautonomous institute with a professional staff of over 40 employees, experts, and researchers. Although CARDI's history may seem somewhat recent, it has, in fact, evolved from the 12-year, AusAID- funded Cambodia-IRRI-Australia Project (CIAP) and the purchase of 70 hectares of land at the Prateah Lang Commune in Dangkor District, 20 kilometers south of Phnom Penh. CARDI's studies focus on soil and water, socioeconomic science, plant breeding, agronomy and farming, agricultural engineering, and plant protection.

CARDI's mission of "Technology for Prosperity" is based on an analysis of how the agricultural sector in Cambodia is expected to evolve in the future. CARDI's vision of how it will respond to the future operational environment and achieve its mission has the following features:

- Assist the Royal Government of Cambodia (RGC) in achieving its rural development objectives;
- Focus on applying technology with major impact on poverty alleviation and living standards;
- Deliver high quality, highly valued R&D services;
- Work in partnership with extension, NGOs, and private sector agencies to increase the impact of improved technologies;
- Improve its capacity to deliver quality R&D services that meet client needs;
- Apply a businesslike approach to its operation; and
- Promote the impact and value of research for the development of Cambodia.

CARDI inherited an ongoing research program from CIAP involving rice production. It has already started broadening the base of its research programs to include other agricultural commodities. While CARDI recognizes that diversification of its research portfolio is a key step in assisting the RGC achieve its rural development objectives, the precise nature of CARDI's future research portfolio will be determined through a national agriculture research priority setting and funding process.

Aside from the diversification of CARDI's research profile into other crops, the focus may shift from yield to an increased emphasis on quality, including postharvest technology and practices. CARDI could well become a key provider of national priority research, contract research, technology packaging, training, consultancy, and quality seeds in Cambodia and abroad. Working towards that point, CARDI has already adopted a partnership approach to enhance its ability to provide the range and quality of agricultural R&D services required for the future.

Though agriculture and rural development are classified as priority areas, public investment in these sectors is still very low. According to the Public Investment Programme (PIP) 2010—12, the government planned to invest only 13 percent of the fund in agriculture.[6]

The government's National Poverty Reduction Strategy (NPRS) 2003—05 recognizes the need to deepen and accelerate reforms and to focus limited resources on four pillars: agriculture and rural development, education, health, and infrastructure. Although both the government's SEDP II and NPRS have identified general priorities for the rural sector, more work is needed to develop concrete programs to revitalize the rural economy. To maximize impact, these plans need to start with a clearer and more strategic articulation of priority actions that link reforms and investments to available resources, improve the focus on outcomes and results, and strengthen the coordination among stakeholders.[7]

Rural infrastructure in Cambodia was developed gradually. The Ministry of Rural Development and other government agencies, in cooperation with the private sector, built roads, health centers, pagodas, and schools; dug water wells for drinking water, and provided education on primary health care, among other interventions (see table 3.1).

[6] Public Investment Programme (PIP) 2010—2012.
[7] World Bank 2005.

Table 3.1: Main Statistics for Rural Development

	Unit	2008	2009	2010	2011	2012	2013
Rehabilitated roads (of total 28,000 km)	km	24,140	25,658	26,658	27,658	28,658	29,658
Access to improved drinking water (rural areas)	% of pop.	40.49	41.99	43.49	44.99	46.49	47.69

***Source**:* NSDP Update 2009—13.

Water is a critical natural resource. The appropriate use and management of water are key for rural development and poverty reduction in five ways: (1) as a key input to agricultural production to improve rural livelihoods, ensure food security, and promote better nutrition; (2) as the single most important source of hazard risk in the extremes of its availability (e.g., droughts and floods); (3) when safe or potable (e.g., for drinking, sanitation, bathing, and other domestic uses), it reduces the risk of contracting water-borne diseases and, in turn, reduces related costs of health care and the amount of time lost for work or school due to illness; (4) as the basis of the aquatic ecosystem, it helps sustain fisheries production; and (5) as an important mode of transportation for people and goods, particularly in isolated areas during the wet season.[8]

Cambodia has abundant water resources. It receives an estimated annual runoff of 475 billion cubic meters (BCM) from the Mekong system, which drains over 85 percent of the country. However, rainfall is concentrated within the six-month wet season, and there is very little reservoir storage to capture and regulate wet-season runoff. During the six dry months, evapo-transpiration far exceeds rainfall and river levels drop significantly, resulting in limited available surface water resources outside of the Mekong River mainstream and Tonle Sap. Floods are an annual occurrence and are virtually unmanaged, except for a dike that protects Phnom Penh. The floods benefit the plain by replenishing soil nutrients and moisture and dispersing fish for spawning. However, they also damage infrastructure, crops, and personal property as well as cause costly restrictions to economic and other activities. Groundwater resources are estimated to

[8] World Bank, Cambodia Rural Sector Strategy Note: Towards a Strategy for Rural Growth and Poverty Reduction, Report No. 32784-KH (Washington DC: World Bank, 2005).

be approximately 20 billion cubic meters overall, but the groundwater actually available for potential use is geographically uneven and is mostly uninvestigated and untapped. In many areas, aquifers are complexly layered. Furthermore, high arsenic levels are a serious problem in some areas near the Mekong mainstream.

As shown in table 3.3, Cambodia has many irrigation networks for agriculture, especially rice cultivation. Due to the lack of maintenance and natural causes, many irrigation systems have been abandoned and damaged. Some of them have been repaired by the government and the private sector.

Climate change and deforestation contribute to more frequent natural disasters in Cambodia. Drought and lack of water is the main concern for farmers. "I am concerned about not having enough water to supply to my rice seedlings this year ... because of drought and a lack of irrigation systems," said Kuch Veng, a farmer from Krakor district in Pursat province. Tan Soksan, a farmer in Kampong Chhnang's Rolea Phear district, agreed that it had been difficult to grow rice in 2010 due to water shortages. "I and other farmers in my village have serious concerns about the lack of rains," he said, "and some rice crops have died due to lack of water." [9]

Having seen the link between rural development and water resources, the government has made it a point to invest annually in these sectors. However, due to budget constraints, public investment in said sectors is still very low. As table 3.2 shows, only 10.54 percent of public investment was allocated to rural development and only about 4 percent to water and sanitation in the Public Investment Programme (PIP) 2010- 2012.

Table 3.2: Public Investment Program 2010—2012 (US$ thousands)

Sectors	Amount	%
Social Sectors		
Health	667,161	18.13
Education	497,446	13.52
Subtotal	1,164,607	31.65

[9] Ministry of Agriculture, Forestry and Fisheries, http://www.maff.gov.kh/en/

Economic Sectors		
Agriculture & Land Management	434,904	11.82
Crops	223,045	6.06
Noncrops	211,859	5.76
Rural Development	387,968	10.54
Manufacturing, Mining, and Trade	76,208	2.07
Subtotal	899,080	24.43
Infrastructure		
Transport	725,254	19.71
Water & Sanitation	146,315	3.98
Power and Electricity	155,259	4.22
Post and Telecommunication	87,419	2.38
Subtotal	1,114,247	30.28
Services and Cross-Sectoral		
Gender Mainstreaming	4,675	0.13
Tourism	41,336	1.12
Environment and Conservation	95.277	2.59
Community and Social Services	76,950	2.09
Culture and Fine Arts	31,509	0.86
Capacity Building, Governance and Administration	252,385	6.86
Subotal	502,066	13.64
Grand Total	3,680,000	100.00%

Source: PIP 2010—2012.from http://www.mop.gov.kh/Home/PIP/tabid/155/Default.aspx

Table 3.3: Number of Irrigation Systems and Area, By Province

		Irrigation System	
No	**Province**	Number	Area (ha)
1	Banteay Meanchey	125	35,576
2	Battambang	60	59,292
3	Kampong Cham	340	85,277
4	Kampong Chhnang	134	48,940
5	Kampong Speu	107	23,845
6	Kompong Thom	204	77,162
7	Kampot	75	69,707
8	Kandal	252	68,927
9	Koh Kong	13	5,307
10	Kratie	169	9,235
11	Mondul Kiri	18	3,001
12	Phnom Penh	10	6,328
13	Preah Vihear	94	30,366
14	Prey Veng	241	71,221
15	Pursat	64	25,435
16	Ratanak Kiri	32	6,997
17	Siem Reap	224	122,203
18	Sihanoukville	20	15,530
19	Stung Treng	25	5,693
20	Svay Rieng	43	102,256
21	Takeo	114	121,295
22	Oddor Meanchey	29	48,364
23	Kep	9	3,786
24	Pailin	1	520
	Total	2,403	1,046,263

Source: Ministry of Water Resources and Meteorology 2004.

Irrigation works with national budget (completed in 2008)

- rehabilitation/construction of irrigation systems for 328,305 ha
- repair of 794 small ponds (reservoirs) with dike length of 377 km by farmer participation
- repair of 1,266 canals with total length of 2,256 km by farmer participation
- rehabilitation of 270 gates, 377 culverts, 90 check structures, 29 spillways
- installation of new 12 pumping stations and repair of 78 pumping machines

Table 3.4: Foreign-Funded Irrigation Projects Completed in 2009

Irrigation Project Profile Number	Project Name/Title	Donor	Remarks
16-1	Colmatage Irrigation Rehabilitation Project (2,122 ha)	Japan	Completed in 2002
17-1	Stung Chinit Irrigation and Rural Infrastructure Project (3,000 ha)	ADB and AFD	Completed in 2008
24-1	Integrated Development in Battambang Province (1,950 ha)	FAO	Completed in 2008
27-1	Bassac Dam Rehabilitation Project in Battambang Province (20,000 ha)	Japan	Completed in 2006
34-1	Rehabilitation of the Kandal Stung Irrigation System in the Lower Prek Thnot Basin (1,950 ha)	Japan	Completed in 2007
MP-1	Study on Comprehensive Agricultural Development of Prek Thnot River Basin (River Basin No. 34)	Japan	Completed in 2005
MP-2	River Basin and Water Use Study for Northwest Irrigation Sector Project (River Basin No. 24)	ADB+AFD	Completed in 2006
MP-3	Master Plan on Water Resources Development in Cambodia (all 42 river basins)	Korea	Completed in 2008
MP-4	The Basin-Wide Basic Irrigation and Drainage Master Plan Study in the Kingdom of Cambodia (River Basin No 26, 27, 28,29)	Japan	Completed in 2009

Source: Ministry of Water Resources and Meteorology (March 2010). Irrigation development in Cambodia.

3.2. Private Sector Investment in Agriculture

Cambodia's private sector has grown rapidly with strong policy support from the government. It has been very active in investing in all sectors, including agriculture, for many reasons, one of which, obviously, is the profit they can gain from such investments. The number of local and foreign agricultural and agro-industrial companies is also rapidly increasing. Farmers in some areas have started using modern techniques and mechanization in farming, harvesting, milling, and storage. The government has also encouraged foreign direct investment (FDI) in the agriculture sector by providing an incentive package to investors. However, FDI in the sector is still very low due to many constraints. According to Council for the Development of Cambodia (CDC), FDI in the agriculture sector accounts for only about 5 percent of total FDI.[10]

The CDC recently approved agricultural investment projects worth more than US$230 million, involving rubber, palm oil, and sugar production and processing.[11] China's Yellow Field International Ltd and Great Field International are planning to invest US$74.6 million and US$66.4 million, respectively, to grow sugar cane and other crops. Viet Nam is planning to invest in two rubber plantations and processing factories. A Malaysian company is investing in a palm oil plantation. The United States-based Horizon Agriculture Development and Singapore and Malaysia's Mondul Agri Resources plan to invest $28.8 million and $30 million, respectively, to grow rubber trees.

Cambodia is an ideal location for investors looking to grow and process crops as it has plenty of land available for agricultural concessions. From 1993 to 2009, a total of 126 companies were granted land concessions for crop production, according to a report from the MAFF. Specifically, concessions for this period amounted to 1,335,724 hectares in sixteen provinces.

Cambodia is rich in farmland and keen to develop its rice exports. It therefore welcomes investors, especially those willing to work with small farmers. In return for investments such as credit and technical assistance, farmers would be contracted to sell their crops to the investor.

The private sector is also providing microcredit to farmers to buy fertilizers and other inputs for farming and irrigation. Capital, however, remains a big stumbling block for rice entrepreneurs. Lim Bun Heng, president of rice processors, and exporter Loran Import-Export Co. talked to Phnom Penh Post on December 21, 2010. They said, "We have seen that local rice growers and millers are likely to not have enough capital to buy the remaining rice during harvest season because most of them have insufficient capital. Given this lack of capital, we are able to buy only

[10] Chap and Chheang 2010, 17.

[11] Investing in Cambodia Magazine, accessed January 26, 2011, http://www.investincambodia.com/agriculture.htm.

a small quantity of [unhusked] rice compared with outside merchants from neighboring countries like Thailand and Vietnam."[12]

Many FDI projects involve contract farming and economic land concessions. However, some concessions are not successful for various reasons, such as land speculation and conflict with the local people about the land. As of April 2010, the MAFF has requested the government to cancel the contracts of 41 companies with a combined concession land area of 379,034 ha. At the present, there are 85 contracted and validated companies covering a total land area of 956,690 ha located in sixteen provinces.[13]

The private sector is also providing microcredit for farmers to help them buy fertilizers and other inputs for farming and irrigation.

Box 3.2: Soma Farm

Soma Farm in Bati District, Takeo province, was created to be part of an agricultural development program. Today, its focus has gone beyond that and into agritourism by paving the way for sustainable tourist development and multiple activities in rural areas. Soma Farm is a locally owned and -operated company that grows and sells (on wholesale basis) cattle, chickens, chicken eggs, fish, jackfruits, coconuts, mangoes, vegetables, paddy rice, paddy-rice seeds, and polished rice. The company seeks to enhance local agricultural production while emphasizing quality at the same time. The farm covers over 300 hectares of crop plantations, livestock farms, and orchid farms. The pilot rice field at Kirivong district with an approximate area of 350 hectares is used to grow paddy seeds and paddy rice using modern techniques. It also produces high-quality perfume rice as a showcase for farmers in the areas. Soma Farm is a Khmer company and a member of the One Village One Product (OVOP) program.

Source*: Soma Farm Co., Ltd brochure, www.somagroup.com.kh.*

[12] Phnom Penh Post, December 21, 2010

[13] MAFF, accessed March 12, 2011, http://www.elc.maff.gov.kh/overview.html.

3.3. NGO Investment in Agriculture

With about 2,000 local and international NGOs operating in many areas in the country, Cambodia is considered “NGO heaven.” As a stakeholder in the country’s development, NGOs have been playing significant roles in the development process and in poverty reduction. They are not only the catalysts for democratization and governance but also a bridge linking the public and private sectors.[14]

A number of civil-society organizations focus their activities on rural development, rural credit, small-business initiatives, health promotion, and technical know-how in agriculture and handicrafts while others have expanded to advocacy of democracy, human rights, capacity building and education in governance, and legal framework, among other concerns. The work of NGOs at the grassroots level; the think tanks in R&D; and the media disseminating information, technology, and education all play a big impact on the process of economic development in Cambodia. There are also many NGOs in Cambodia investing in agricultural development, CEDAC being one of the successful ones (see box 3.4).

Box 3.3: CEDAC (Centre d’Etude et de Développement Agricole Cambodgien)

Established in August 1997, CEDAC (Cambodian Center for Study and Development in Agriculture) envisions a Cambodian society where small farming households enjoy good living conditions and strong mutual cooperation, with the right and the power to determine their own destiny, and the ability to play an important role in supplying healthy food for the whole society. CEDAC was established with initial support from the French NGO Group for Research and Exchange of Technology (GRET). In the beginning, CEDAC had only seven staff to support farmers in two villages in Kandal province. As of November 2010, CEDAC had 297 staff, including 95 women (263 of whom, or 88.55 percent, work as technical staff and another 34, or 11.45 percent, work as administrative/supporting staff) providing direct assistance to about 124,000 families from 3,471 villages, 609 communes, and 101 districts in twenty provinces of

[14] Chap 2006.

Cambodia. More than 700 students and more than 4,000 rural development practitioners have benefitted from CEDAC's training and exchange program. More than 100 community, national, international, and multilateral organizations and foreign government agencies have cooperated with CEDAC during its twelve years of operation.

Source: CEDAC, www.cedac.org.kh.

3.4. Agricultural Support from Donor Communities

International donor agencies have supported Cambodia's agricultural development through different programs and projects. The Japan International Cooperation Agency (JICA) cooperates with MAFF on the "Agricultural Productivity Promotion Project in the West Tonle Sap" (APP Project). This project focuses mainly on productivity improvement and the marketing of agricultural products in the West Tonle Sap region through the provision of technical support to the provincial departments of agriculture in Battambang, Pursat, and Kampong Chhnang provinces. JICA has been implementing another technical cooperation project in the same region since September 2009. This particular project targets the improvement of agricultural river basin management by developing the capability of engineers in the Technical Service Center (TSC) of the Ministry of Water Resources and Meteorology.

Australia, under AusAID, started implementing the Cambodia Agricultural Value Chain Project (CAVAC) in 2009. The project, which will run until 2013, aims to deliver practical benefits, including improved food security, increased income, and reduced vulnerability of poor farmers engaged in rice-based farming systems. The project will promote market-oriented agricultural development and product diversification, with an initial focus on the production of rice, vegetables, and fruits in three provinces—Kampong Thom, Takeo, and Kampot. The program may be expanded to other provinces and value chains in the future.

With funding from the European Union (EU), the second package of €6.9 million (about US$10 million) was awarded to three NGOs (Gret, ZOA, and Helen Keller International) and an international development agency (Deutsche Gesellschaft für Technische Zusammenarbeit GmbH or the GTZ) to implement a food security project starting 2010. **Gret** uses the funds to improve the economic and nutritional situation of 15,000 family-scale farms and to increase the resilience of farming families in withstanding distressing situations. It does this by providing safety net mechanisms (e.g., rice banks, health insurance) in ten provinces—Battambang, Kampot, Kampong Cham, Kampong Speu, Prey Veng, Siem Reap, Svay Rieng, Takeo, Kandal, and Kampong Thom. EU contribution is over €1.9 million for one and a half years. **ZOA** works to improve access of 3,500 families to irrigation and agricultural inputs. In addition, it will build ten rice-seed stores and help 500 semiurban, land-poor families develop income-generating activities in Oddar Meanchey province (€1.25 million for one and a half years). **Helen Keller International** received a grant (more than €1.7 million for nearly two years) to use in improving the food security and livelihoods of 6,000 vulnerable farming households in Prey Veng and Pursat provinces. **GTZ** received EU support of €2 million for about two years and is working to improve food security and access to essential services of poor households in the rural areas of Cambodia. To achieve this, it is developing more efficient mechanisms for targeting poor households to support the rapid implementation of poverty-alleviation measures and the delivery of specific services and assistance.

The United States Government, through the United States Agency for International Development (USAID), has awarded a five-year, multimillion dollar contract designed to improve Cambodia's food security through enhanced agricultural development and better management of natural resources. The five-year contract was awarded to Fintrac, a United States-based agribusiness consulting firm that develops agricultural solutions to end hunger and poverty. The project, "Helping Address Rural Vulnerabilities and Ecosystems Stability" (HARVEST), will harness the cooperation of public and private entities and civil society to strengthen food security through the following means: increasing agricultural productivity; raising the incomes of the rural poor; preparing the country to adapt to climate change; and reducing the number of Cambodians, especially women and children, suffering from malnutrition. The interventions will be designed in close coordination with the government, with local stakeholders, and with other development partners in order to maximize the collective impact of sustainably reducing hunger and poverty. A "focus on food" approach to rural income diversification and value-chain strengthening will help the Cambodian agricultural sector become a major contributor to stable and sustainable economic growth for Cambodia and the region. The improved management of land and other resources will conserve and maintain the economic value of Cambodia's sensitive ecosystems and rich biodiversity as well as reduce the vulnerability of agriculture and rural communities to climate change. Permanently reducing hunger and maintaining the sustainable use of natural and communal resources are the central goals of HARVEST.

4. Regional Cooperation in Agricultural Development

Cambodia's economic growth has been strongly driven by external factors—namely, globalization and the regionalization process. Being part of the ASEAN since 1999 and the WTO since 2004 provides Cambodia with opportunities to expand its market to the region and the world. Most FDI in Cambodia focuses on the external market.

With the state leadership emphasizing agricultural development, domestic and international private companies have stepped up investments in agro-industry and business. Land concessions have been developed to attract large-scale investors. Domestic rice-exporting companies are mushrooming to explore markets in Europe, the United States, and China.

Regional cooperation in Southeast Asia and the Mekong region has helped provide a more favorable condition for regional policy coordination and joint development of the agricultural sector. The ASEAN Free Trade Area (FTA) and the Greater Mekong Subregion (GMS) cooperation scheme laid the foundation for better trade and infrastructure connectivity in the region. The cost reduction in production and transportation also help increase the competitiveness of agricultural products in entering larger regional markets like China and continental markets in Europe and the Americas.

Regional cooperation in agricultural development engendered by the ASEAN and the GMS scheme has benefitted member countries, especially those exporting mainly agricultural products. Regional cooperation and integration can also help Cambodia further develop its agriculture sector and improve its exports through policy coordination, better access to market information, and better infrastructure and institutional connectivity.

4.1. ASEAN regional cooperation

The food, agriculture, and forestry sectors were given special attention in the ASEAN Economic Community Blueprint:

1. **Enhance intra- and extra-ASEAN trade and the long-term competitiveness of ASEAN's food, agriculture, and forestry products/commodities.**

   Actions:

   - Monitor the implementation of the Common Effective Preferential Tariff (CEPT)-AFTA schemes for agricultural and forest products;
   - Develop and apply fisheries quality-management systems that ensure food safety and support the competitive position of ASEAN fisheries products on world markets. This is to be achieved through: (1) the implementation, validation, and verification of the Hazard Analysis Critical Control Point (HACCP)-based systems and improved laboratory practices and (2) the adaptation of quality and safety management systems that can be applied to small enterprises in the ASEAN by 2009;
   - Establish Good Agriculture / Aquaculture Practices (GAP), Good Animal Husbandry Practices (GAHP), Good Hygiene Practices (GHP), Good Manufacturing Practices (GMP), and HACCP-based systems for agricultural and food products with significant trade / trade potential by 2012;
   - Harmonize the quarantine and inspection/sampling procedure by 2010 and the sanitary and phytosanitary (SPS) measures for agricultural, food, and forestry products with significant trade / trade potential in accordance with international standards/guidelines, where applicable, by 2015;
   - Harmonize the Maximum Residue Limits (MRLs) of commonly used pesticides for widely traded crop products in accordance with international standards/guidelines, where applicable, by 2010;
   - Harmonize the regulatory framework for agricultural products derived from modern biotechnology in accordance with international standards/guidelines, where applicable, by 2015;

- Harmonize the safety and quality standards for horticultural produce and agricultural products of economic importance in the ASEAN region in accordance with international standards/guidelines, where applicable, by 2015;
- Harmonize animal (both terrestrial and aquatic) health control measures for the safety of food of animal origin through common biosecurity management standards scheme in accordance with international standards/guidelines, where applicable, by 2015;
- Harmonize guidelines for the use of chemicals in aquaculture and measures to eliminate the use of harmful chemicals in accordance with international standards/guidelines, where applicable, by 2009; and
- Develop a regional reference framework on a phased approach to forest certification by 2015.

2. **Promote cooperation, joint approaches, and technology transfer among ASEAN member countries and international and regional organizations as well as the private sector**.

   Actions:

   - Develop joint strategies / positions on issues of related interest to ASEAN with international organizations such as the WTO, the Food and Agriculture Organization of the United Nations (FAO), World Organisation for Animal Health (OIE), International Plant Protection Convention (IPPC), CODEX Alimentarius, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and dialogue partners;
   - Promote collaborative research and technology transfer in agriculture, food, and forestry products;
   - Establish strategic alliances and joint approaches with the private sector in promoting food safety, investments, joint venture opportunities, agricultural products, and market access;
   - Strengthen efforts to combat illegal logging and its associated trade and forest fires and their resultant effects; and
   - Strengthen efforts to combat illegal fishing.

3. **Promote ASEAN agricultural cooperatives as a means to empower and enhance market access of agricultural products, build a network mechanism linking agricultural cooperatives, and fulfill the purpose of agricultural cooperatives for the benefit of farmers in the region.**

   Actions:

   - Strengthen the strategic alliance among agricultural cooperatives in the ASEAN through bilateral, regional, and multilateral cooperation;
   - Establish business linkages among agricultural cooperatives within the ASEAN; and
   - Promote direct investment and strategic partnership with ASEAN agricultural cooperatives, producers, consumers, and traders.

Agriculture is one of the main industries in the Southeast Asian region, the world's leading rice producer. Thailand and Viet Nam alone account for more than half of the global rice trade, collectively producing about 30 million tons of milled rice a year. In 2010, ASEAN member countries produced 155.5 million metric tons of rice, 3.6 percent higher than that produced in 2009. The increase in the rice supply in 2010 was due mainly to the greater volume of stocks carried over from previous year.[15]

So far, ASEAN member countries have adopted and implemented various cooperation projects on agriculture and food security. Agreements on agriculture adopted by ASEAN leaders include Agreement on the ASEAN Food Security Reserve in 1979; Declaration on Objectives regarding the ASEAN Agriculture Development Planning Center in 1980; ASEAN Declaration on Specific Animal Disease Free Zone in 1981; ASEAN Declaration to Eradicate Foot and Mouth Disease in 1981; ASEAN Ministerial Understanding on the Standardization of Import and Quarantine Regulation on Animal and Animal Products in 1982; ASEAN Ministerial Understanding on Fisheries Cooperation in 1983; ASEAN Ministerial Understanding on ASEAN Cooperation in Agricultural Cooperatives in 1984; ASEAN Ministerial Understanding on Plant Pest Free Zone in 1984; Ministerial Understanding on ASEAN Cooperation and Joint Approaches in Agriculture and Forest Products Promotion Scheme in 1994; Program of Action for ASEAN Cooperation in Food, Agriculture, and Forestry 1995-1999; Memorandum of Understanding on ASEAN Sea

[15] ASEAN Agricultural Commodity Outlook 2010, http://afsis.oae.go.th/ACO_No_4_report.pdf

Turtle Conservation and Protection in 1997, Agreement for the Establishment of ASEAN Animal Health Trust Fund in 2006; and ASEAN Statement on Strengthening Forest Law Enforcement and Governance in 2007.[16] In addition, the ASEAN ministers of agriculture and forestry convene an annual meeting to discuss and issue a joint statement on agricultural development concerns. At the 32nd meeting in 2010 in Cambodia, the ministers reaffirmed the role and progress of agriculture in the realization of the ASEAN Community and the Millennium Development Goals (MDGs).

The sharp increase in international food prices in 2007—08 brought serious concerns on the possible socioeconomic impacts of such price hikes on ASEAN member countries. Cooperation among ASEAN member countries is needed to address the problem, especially by strengthening existing ASEAN initiative/measures. To address the issue of long-term food security in the ASEAN region, the ASEAN Integrated Food Security (AIFS) Framework for 2009—13 was developed to provide scope and joint pragmatic approaches for cooperation among ASEAN member countries. The goal of the Strategic Plan of Action on Food Security (SPA-FS) is to ensure long-term food security and to improve the livelihoods of farmers in the ASEAN region. The following objectives are meant to help to achieve that goal:

a) increase food production
b) reduce postharvest losses
c) promote a conducive market and trade for agriculture commodities and inputs
d) ensure food stability
e) promote the availability of, and accessibility to, agriculture inputs
f) operationalize regional food emergency relief arrangements

In August 2010, the major ASEAN rice producers (Thailand, Viet Nam, Laos, Cambodia, and Burma) decided to form a rice millers' association to create a sustainable system for trading and production. The association focuses on price stabilization, regional food security, and rice development. Its members aim to upgrade the quality of the milling process, strengthen rice management, and create an integrated rice-production network among ASEAN members. The initiative will strengthen the role of millers, traditionally middlemen in the rice-production

[16] ASEAN Secretariat, http://www.aseansec.org/19822.htm

process. It will also tap the capacities of rice millers among the ASEAN member countries that produce 25 percent of the world's total output of 448 million tons of rice and supply up to 65 percent of the world's 29-million-ton global rice trade.[17] In the context of the ASEAN's CEPT scheme, the member countries can export rice to one other under a tariff range of 0 percent to 5 percent (see table 4.1).

[17] ASEAN Affairs 2010. ASEAN Rice Alliance Formed. http://www.aseanaffairs.com/asean_news/agriculture/asean_rice_alliance_formed

Table 4.1: ASEAN Tariff Scheme in Rice

	Rice	Status 2007	Status 2008	MFN Tariff	Tentative CEPT[a] rates			
	- Rice in the husk (paddy or rough):				2007	2008	2009	2010
1006.10.10	- - Suitable for sowing	N[b]	N	0	0	0	0	0
1006.10.90	- - Other	N	N	7	5	5	5	5
	- Husked (brown) rice:							
1006.20.10	- - Thai Hom Mali rice	N	N	7	7	7	7	5
1006.20.90	- - Other	N	N	7	7	7	7	5
	- Semi-milled or wholly milled rice, whether or not polished or glazed:							
	- - Fragrant rice:							
1006.30.11	- - - Whole	N	N	7	5	5	5	5
1006.30.12	- - - Not more than 5% broken	N	N	7	5	5	5	5
1006.30.13	- - - More than 5% but not more than 10% broken	N	N	7	5	5	5	5
1006.30.14	- - - More than 10% but not more than 25% broken	N	N	7	7	5	5	5
1006.30.19	- - - Other	N	N	7	7	7	7	5
1006.30.20	- - Parboiled rice	N	N	7	6	6	5	5
1006.30.30	- - Glutinous rice (pulot)	N	N	7	7	7	5	5
1006.30.40	- - Basmati rice	N	N	7	6	5	5	5
1006.30.50	- - Thai Hom Mali rice	N	N	7	7	5	5	5
	- - Other:							
1006.30.61	- - - Whole	N	N	7	6	5	5	5
1006.30.62	- - - Not more than 5% broken	N	N	7	6	5	5	5
1006.30.63	- - - More than 5% but not more than 10% broken	N	N	7	6	5	5	5
1006.30.64	- - - More than 10% but not more than 25% broken	N	N	7	7	5	5	5
1006.30.69	- - - Other	N	N	7	7	5	5	5
1006.40.00	- Broken rice	N	N	7	7	5	5	5

Source*:* ASEAN Secretariat, http://www.aseansec.org/18137.htm

Note*:* [a] CEPT refers to the ASEAN Common Effective Preferential Tariff Scheme
[b] N = Normal track of the inclusion list

The ASEAN has forged free trade agreements (FTAs) with China, Japan, and South Korea under an extended form of ASEAN regionalism. The ASEAN-China FTA started in January 2010. One component of said FTA is the Early Harvest Program, which, in the case of Cambodia, will assist agricultural development and economic growth through export opportunities for products such as fresh fruits, livestock, fish, shrimps, and prawns. However, Cambodia cannot yet enjoy the full potential of the program due to the absence of macroeconomic stability, a sound business climate, adequate legal framework, sufficient infrastructure, and effective government institutions. Cambodia has not yet fulfilled these prerequisites.[18] In addition, the lack of information on regional markets, lack of government support in facilitating exports, and lack of capacity on the part of export entities are the main constraints in promoting Cambodian agricultural exports to the region.[19]

4.2. Mekong Subregional Cooperation

The Mekong Subregion is heavily reliant on agriculture for economic development and livelihood. The Mekong River is the main and largest water source in the region; it supports the production of various agricultural crops, especially rice. Thailand is the world's biggest rice exporter, exporting about 8 million tons per year. Viet Nam exports approximately 6 million tons per year. Cambodia exports much less than Thailand and Viet Nam, about 100,000 tons per year. The Cambodian government has committed to increasing its exports to 1 million tons by 2015. Land expansion and the introduction of agricultural machinery transformed agriculture in the Mekong Subregion from traditional subsistence to commercial farming, a trend that encourages regional leaders to cooperate and find markets for their products.

However, climate change and the decreasing water flow in the Mekong River are threatening agricultural development in the region. In early 2010, the Mekong River had its lowest water flow in fifty years. A study done by the Mekong River Commission (MRC) revealed that this phenomenon was caused mainly by extreme weather conditions that prevailed in the country—very low rainfall in the 2010 dry season following a particularly wet season in 2009.

According to Jeremy Bird, chief executive officer (CEO) of the MRC, this phenomenon is sending many people to the brink of serious poverty. "Difficulties in access to water make

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[18] Hing Vutha and Noun Keosothea, 2006 Early Harvest Programme: Implications for Cambodian Agriculture, CDRI Special Report, May 4, 2006, http://www.cdri.org.kh/webdata/download/sr/ehpe.pdf

[19] Chap and Chheang. "Trade liberalization under ACFTA and Its Possible Impacts on Cambodian Industries" (unpublished research paper, Asian Development Bank, Manila, 2010b).

farming and fishing livelihoods more precarious for affected communities and raise the risk of contracting diseases from the use of polluted sources. Low water levels have also severely disrupted river transport both for trade and tourism, further affecting livelihoods of people who depend upon the river." [20] Scenario studies done by the MRC research team have predicted that Cambodia and Viet Nam would be hardest hit by climate change, rising sea levels, and a series of hydropower dams being constructed upstream. The agriculture sector will be seriously hit by seasonal change, lack of rain, and lack of water.

Mekong regional leaders held a meeting in Phnom Penh in November 2010 called the Ayeyawady-Chao Phraya-Mekong Economic Cooperation Strategy (ACMECS) Summit. During this meeting, Cambodian Prime Minister Hun Sen proposed a regional agreement to boost rice production and exports. He said that the aim of ACMECS in creating a rice-export association is "to ensure the stability of food in the world and at least in the region, which is suffering from climate change." [21]

5. Trade in Agriculture

5.1. Global Agricultural Trade: Unfair but Improving

Agricultural Market Access

While opportunities for trade in industrial goods are normally clear and competition relatively fair, that cannot be said of agricultural trade. The global trading system is now fragmented by regional, bilateral, and preferential trading arrangements. As a least developed country (LDC) and a member of the ASEAN FTA, Cambodia benefits from many such arrangements. Market-access barriers are often high. Subsidies in developed countries seriously distort markets, and food-safety standards are increasingly complicating export opportunities for poorer suppliers. [22]

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[20] Jeremy Bird, "Low River Levels Caused by Extreme Low Rainfall," news release, March 16, 2010, http://www.mrcmekong.org/mrc_news/press10/Op-Ed-13-3-10.htm.
[21] Kong Sothearith, interview on Voice of America (VOA), Khmer Phnom Penh, Thursday, 18 November 2010.
[22] Sok Siphana. "Breaking into the World Markets for Cambodian Agriculture Products." (policy discussion paper, Supreme National Economic Council, November 2009).

For nearly fifty years, farm goods were excluded from the normal disciplines of world trade. The General Agreement on Tariffs and Trade (GATT) maintained a series of special conditions that permitted the growth of subsidies as well as high and unpredictable market protection. The world markets for many important agricultural products are completely artificial. Special rules allowed the European Community (EC) to develop its complex systems of market protection, domestic subsidization of farmers, and export subsidies called the ”Common Agricultural Policy” (CAP). The United States sheltered long-standing farm subsidy programs. Japan, Switzerland, Scandinavian countries, and most other developed countries were able to maintain highly protected agricultural sectors.

Tariff Quotas

The WTO outlaws the use of quotas on imports and exports. Customs duties are the main legal form of protection, but there are two important exceptions: the garments and agricultural sectors. The permitted use of quotas in the agricultural sector is termed “tariff quotas” because they allow a certain volume of access to the market at low or zero customs duty. All imports outside the tariff quota are subjected to a much higher tariff, usually so high that imports cannot compete. The system of tariff quotas in the WTO is in place largely to ensure that very high tariffs cannot completely eliminate imports. Around 1,400 tariff quotas are currently in place, affecting access in about forty-three WTO member countries. Cambodia itself does not use tariff quotas under the WTO, but agribusiness exporters in Cambodia will often encounter them directly or indirectly.

Cambodia already benefits from many favorable trade relationships. The influence of WTO accession on the further opening of the Cambodian market is limited. Where they do not enjoy preferential access terms, Cambodian exporters seldom have to pay duties above the local “most favored nation” (MFN) applied rates. The principal market-access advantage for Cambodian producers in export markets will be the security of the bound tariffs committed by all other WTO members. In almost 150 countries, Cambodian exporters will have a guaranteed ceiling to the duties they can be charged by customs authorities.

The availability of tariff advantages under the Generalized System of Preferences (GSP) will continue to be important for Cambodian exporters, especially for some major industrial country markets like the United States. GSP benefits cannot be guaranteed in the WTO, and their application is often subject to arbitrary decisions by the importing countries. Although all developing countries can qualify for most GSP schemes, there is increasingly a view in the industrial world that it should be the poorest nations that receive the most benefits.

Dealing With Nontariff Barriers:

Once favorable customs duties are identified as market opportunities, other obstacles called "nontariff barriers," will affect whether or not Cambodian products succeed. WTO membership has proven especially useful in dealing with these barriers. In joining the WTO, Cambodia has had to take on the requirements of a series of agreements on nontariff measures. But these rules and a range of others also apply to Cambodia's main trading partners in the WTO. The rules are meant to restrict the ability of WTO member governments to block Cambodian imports unfairly.

Technical Standards as a Trade Barrier:

An area in which nontariff barriers can hit Cambodian exports is the use of technical standards. International agreements usually recognize a difference between compulsory standards and voluntary standards. In the WTO, compulsory standards are usually referred to as technical regulations. However, to meet real market needs, Cambodian exporters will usually have to try to meet all relevant standards, whether they are voluntary or compulsory. By doing so, a variety of testing, certification, and conformity assessment procedures as well as mutual recognition arrangements need to be understood.

Market Conditions for Rice Exports:

The rice sector is heavily protected and subsidized; hence, the relatively low level of international trade compared with demand. Some rice-growing traditions often retain an almost religious significance. There is also the issue of national food security; rice is a politically sensitive commodity. Bound tariffs on rice in key markets are usually very high, often over 100 percent. Special treatment on market access applies particularly to Japan, Korea, and the

Philippines. Taiwan has avoided the "tarrification" of the rice sector by providing access through tariff quotas amounting to 8 percent of consumption. Tariff quotas are in place, under WTO commitments, for Colombia, Costa Rica, Indonesia, Morocco, Thailand, and Venezuela. China opened a large tariff quota of up to 4 million metric tons a year at 1 percent duty rate when it joined the WTO. The EU's "Everything but Arms (EBA)" preferential arrangement initiative has, since 2009, given rice imports a completely duty-free and quota-free treatment.

The market access conditions for rice in the ASEAN are almost as complicated as those under the WTO. Rice is covered under AFTA terms for sensitive products. This applies to Indonesia, Malaysia, the Philippines, Viet Nam, and Cambodia itself. Indonesia has bound an MFN rate for rice at IDR 430 per kilo. Malaysia, as a large importer, offers access at zero CEPT rate (although importers need permission from the Malaysian authorities to secure this rate). Singapore is tariff free. Thailand has a bound rate at THB 3 per kilo and a CEPT applied rate of 5 percent. Vietnam maintains MFN bound rates of 40 percent or 50 percent (for parboiled rice) with its 2004 CEPT rate applied at 15 percent (reduced to 5 percent for 2005). Rice is not included in the duty-free list under the "early harvest" arrangement with China.

Market Conditions for Cashew Export

Cashew nuts are a favorite snack food and confectionary ingredient in many countries, second to almonds in global tree-nuts market share. The cashew nut market is estimated at 350,000 tons of kernels and growing as consumer eating habits change toward more snack foods. The major consuming countries are the United States, European countries, India, and China. The United States alone consumes 73,000 tons per annum.[23]

The world market for cashew nuts is highly dynamic compared to other industries. The dramatic increase seen in recent years in the consumption of almonds is based on heavy promotion and consumer awareness of the health benefits of almonds. The market share of cashew nuts in the

[23] Sok Siphana "Operationalising the Rectangular Strategy for Growth: Towards Better Business Processes for Trade," (draft business process analysis, Economic and Social Commission for Asia and the Pacific, Cambodia, 2011).

snack sector has remained relatively stable in the West, with cashew prices remaining buoyant even during recession. This can continue as a function of diversified demand as markets like the Middle East, India, and China grow in importance. Viet Nam is now the biggest producer of cashew nuts worldwide, posting high growth rates in recent years. The other major producers are India, Brazil, and several African countries.

Market access conditions for the cashew nut industry throughout the world are favorable compared to the other industries. Tariffs for Cambodian cashew kernels in most regional markets are low, and Cambodia faces the same tariffs as its main competitors. Overall Cambodia's tariff advantage is 0.2 percent. The major importing countries (United States, the EU, Australia, Canada, Japan, and India) apply a zero MFN tariff for raw cashew nuts (RCN) and kernels. Some ad valorem tariffs in percent are (MFN / preferential tariff for Cambodia): China (MFN - 10 percent/Cambodia–5 percent), Indonesia (MFN–5 percent/Cambodia–free), Japan (Cambodia–free), South Korea (MFN–8 percent/Cambodia–free), Lao PDR (MFN–30 percent/Cambodia–10 percent), Malaysia (Cambodia–free), Thailand (MFN—40 percent/ Cambodia–free), Viet Nam (MFN—40 percent/Cambodia—5 percent).

Tariffs for RCN are relevant only for countries that have a processing industry, notably Viet Nam and Thailand. Viet Nam applies a 10 percent tariff to Cambodia, but it is not clear whether this is actually paid as the trade is informal. India, the world's biggest RCN importer, applies an MFN tariff of 30 percent.

Standards and SPS measures apply, which will become an issue for Cambodia once processing and direct exports to consuming countries start. As a luxury product, cashew nuts require careful attention to product quality, not just organic certification. Traceability is fast becoming a requirement for most food products going to developed-country markets, a trend accelerated by recent chemical and salmonella contamination disasters in China and the United States, respectively.

Farmers selling to local collectors who sell to middlemen who, in turn, sell to export traders are typical. In fact, this is the experience in every country that lacks its own indigenous shelling operations. The long chain usually inhibits returns to growers. Cambodia has a distinct advantage over other exporting countries due to its proximity to the market for in-shell cashews.

The Asian regional markets so far identified are Thailand, which imported 1,775 metric tons in 2007 (mainly from Viet Nam); Singapore, a small market importing about 1,000 metric tons per year, but in which organic products are becoming significant; and China, which may become a very important market.

Box 5.1: Agriculture is important for sustaining growth and reducing poverty

Progress in agriculture has been historically impressive. There is still more room for yields improvement (compared to yields achieved in neighboring countries), which can be realized by investing in physical infrastructure, especially irrigation systems; increasing agricultural productivity; and promoting agricultural diversification. The government has given serious thought to the factors of production costs and output as well as capacity in purchasing, stockpiling, and processing Cambodian rice....in 2008, the government provided a special credit line amounting to US$12 million (through the Rural Development Bank) to help private rice millers collect paddy rice to ensure domestic supply.... In 2009, the government offered a budget amounting to US$18 million to the Rural Development Bank to continue the activities....the government will convert the budget to establish an “Agriculture Support and Development Fund” to support the private sector, especially small and medium enterprises, on a number of targets including (1) providing short-term credit for collecting paddy rice from farmers at an appropriate price to maintain price stability and ensure food security and (2) providing medium-term credit to rice millers to increase their capacity in stockpiling, drying, and processing... the government will continue to enforce a zero-tariff policy on the importation of agricultural materials such as seeds, fertilizers, pesticides, and agricultural equipment, etc. ... the government has also been working to streamline procedures in rice exports and to gradually strengthen the rice-export management mechanism while improving domestic capacity in rice purchasing, processing, distribution, and export.... the government is drafting legal procedures for investment projects in agriculture… These projects are to be considered high-incentive priority projects within the existing investment law framework.... the government is trying to strengthen the partnership between smallholder farmers and large-farm owners as well as with agriculture enterprises and between social land concessionaires and economic land concessionaires, with emphasis on establishing farmers associations and partnerships with companies involved in rice purchasing, processing, distribution, and export.

Source*: Selected excerpts from the keynote address of Samdech Akka Moha Sena Padei Techo Hun Sen at the Third Cambodia Economic Forum organized by the National Supreme Economic Council on February 5, 2009 in Phnom Penh.*

5.1. Cambodia's Trade in Agriculture

Domestic Condition

Context for Diversification: Despite some initial signs of recovery from the recent global financial crisis, Cambodia felt the need to enhance its competitiveness. Maintaining competitiveness is important given the social implications of the agricultural sector in which rice exports alone, if it reaches 3 million metric tons, could make up approximately 20 percent of GDP.

Policy Direction: The government has adopted a three-pronged strategy to realize the vision of agricultural development—***productivity enhancement, diversification, and agricultural commercialization*** (i.e., from subsistence to commercial agriculture).

Rice Export Policy: The promotion of milled rice exports is the first step to catalyzing the export of other agricultural products such as cashew, rubber, and other crops. Parallel to this, the success of the implementation of the rice export policy will send a strong political message, with the effect of encouraging and paving the way for the export promotion of other agricultural crops.

Priority and potential of export products: The government has identified nineteen products with good export potential, most of which are in agriculture (rice, cashew nuts, cassava, maize, fish, livestock, rubber, silk, soybeans, fruits and vegetables—including organic, mango, palm, pepper—and wood products).

- Rice production shows strong potential for a significant increase in yields and in volume.
- Cassava is a promising crop, with yields recently reaching 23 tons/ha (volume similar to Thailand's and Viet Nam's), but only 3 percent of cultivated land is devoted to cassava.
- Rubber (with exports of around US$175 million in 2006) has posted accelerated growth in recent years, with recent significant investment in new rubber plantations.
- Fruits and vegetables are grown only on a small scale despite significant potential as an import substitute to support the increasing demand fueled by the tourism industry.
- Silk, now accounting for US$10 million worth of exports, also has the potential to develop with the expansion of the local tourism industry along with growing export potential.
- Livestock, which has posted a steady stock increase of an average of 2 percent per annum over the past decade, has strong export potential if many SPS issues are addressed.
- Fisheries exports (around US$100 million worth annually of pond-reared fish such as catfish and tilapia estimated at between 500,000 tons and 1 million tons annually) are constrained by the absence of SPS standards.

Market Access: As an LDC, Cambodia benefits from preferential access through the General System of Preferences (GSP) Schemes with the United States, Japan, and about twenty other developed countries. Moreover, Cambodia is a member of the WTO, ASEAN, and a number of regional trade agreements between ASEAN and its development partners (e.g., China, India, Australia, and New Zealand).

Everything But Arms (EBA) initiative: The EU is a major destination for Cambodia's rice exports. Preferential access to the EU is provided under the EBA initiative launched by the EC in 2001 to replace the previous GSP system. Under the EBA initiative, most products from LDCs, including Cambodia, get duty-free access to European markets with greater predictability.

Cambodia's utilization of preferential access to the EU market has grown vigorously since the phasing in of rice in the program in September 2009. Almost all of Cambodia's exports to the EU are eligible for preferential access. Cambodia's utilization of its quota for "wholly obtained long-grain rice" stood at 78.9 percent in 2005. Under these trade preferences, the company can export rice to the European market with special tax preferential treatment of about €140 per ton compared to exporters from Thailand and Viet Nam.

Challenges

There are different interrelated challenges facing agricultural development in Cambodia. These are poor performance in regional trade, speculative land price distortions, underperforming economic land concessions, brain drain, finance shortage, lack of market information, and weak infrastructure.

Poor performance in regional trade: Cambodia has not benefited as it should have from regional markets (only 13 percent of its trade is intraregional against an average of 49 percent). There remains a tremendous potential for further integration into the Asian region with preferential market access to development partner countries like China, India, Australia, New Zealand, Japan, and South Korea.

Weak cross-border trade facilitation: In the World Bank "Doing Business" rankings for 2010, Cambodia is ranked 22nd out of 24 East Asia and Pacific nations in the overall index and 21st out of 24 in the "trading across frontiers" index.

Speculative land price distortions: Cambodia still suffers from the perverse effects of land price distortions arising from the speculative bubble that happened in the years prior to the global financial crisis, which is diluting Cambodia's perceived comparative advantage as a country with relatively abundant land, natural assets, and inexpensive labor.

Underperforming Economic Land Concessions (ELC): The ELC approach has not delivered the expected results. Out of some 60 ELCs, only a small fraction has active investments while many others are still entangled in numerous conflicts with indigenous communities over the traditional use of land and forest and, by law, a right to the use of these land concessions).

Reversing the brain drain: In the labor market, the major challenge is to entice those that have benefited in recent years from exposure to jobs outside of agriculture with high labor productivity (e.g., in industry and services) to be "reallocated" back to agriculture, a move which may have a significant impact on growth and provide the necessary incentive for reverse migration back to the rural areas.

The intractable sanitary and phytosanitary issues: Cambodia does not currently have a compliant basic SPS management system in place that would allow entry of its livestock and fisheries exports to key markets like the EU and China.

Finance shortage: There are four main challenges for Cambodia's rice exports: (1) lack of capital to buy unmilled rice surplus from farmers; (2) lack of rice storage capacity; (3) low level of drying capacity for unmilled rice; and (4) inadequate number of middlemen. In 2010, Cambodia's local middlemen could buy only 0.5 million tons while about 3.8 million tons of rice were exported to Thailand and Viet Nam for further processing and packaging. Some exporters say that an additional US$800 million is needed in order to buy all unmilled rice surplus from local farmers.[24] The government-run Rural Development Bank provided only US$18 million in credit for rice millers in 2010. The government later offered US$36 million (up from $18 million) for rice millers to buy paddy rice from farmers, according to the Ministry of Economy and Finance. This sum, however, is a small amount compared to market demand of US$350 million.[25] Unregulated cross-border rice trade in places like Kompong Trabek causes the vast majority of Cambodia's roughly 3.5 million tons of annual rice surplus to slip away unprocessed to Viet Nam and Thailand. Farmers said they could sell their rice at a higher price to Vietnamese traders. One farmer said, "I don't think the government policy will be successful because the rice millers are not hungry to buy our rice." [26]

[24] Radio France Internationale (Khmer Service) broadcast on January 3, 2010.

[25] Phnom Penh Post, January 17, 2011, http://www.phnompenhpost.com/index.php/2011011746118/Business/government-doubles-rdb-miller-lending.html

[26] Cambodia Daily, December 31, 2010 (1, 30).

Lack of market information: Cambodian farmers do not get access to updated, accurate market price data for their products. For instance, Cambodia produces about 60,000 tons per year from its 166,600 productive rubber plantations. However, Cambodia's rubber is being undersold at about US$4,500 per ton, or about 10 percent less than the price in other rubber-producing countries like Malaysia. For example, on December 28, 2010, at the Malaysian Rubber Exchange, the price was US$5,011.50 per ton while at the Tokyo Commodity Exchange, it was US$5,000 per ton.[27]

Weak production infrastructure

- ***Lack of irrigation facilities:*** Approximately 7 percent of cropland is irrigated, the lowest in all of Southeast Asia. The dependence of Cambodia's agriculture sector on rainfall makes it vulnerable to the vagaries of weather.
- ***Inadequate fertilizer usage:*** Fertilizer usage in Cambodia is significantly lower than in neighboring countries at about 5 to 6 kg/ha, much lower than the average in the region. Only 27 percent of rainfed farms use inorganic fertilizers, compared to 70 percent of dry-season farmers who have access to irrigation.
- ***Weak collective action:*** Currently, no credible private sector organization for collective action exists in the agriculture sector as a whole or at the sectoral (e.g., rice sector, cashew nut sector) level, although there are numerous rice-milling associations whose membership is diffuse both geographically and politically.

6. Conclusion and Recommendations

6.1. Conclusion

The potential for growth in agriculture is significant due to efforts by the government, private sector, local community, NGOs, and development partners to promote agriculture and rural development. If the government can solve the issues related to rice exports in the same way that it did for the garments sector, substantial value added will be retained in the country and the

[27] Cambodia Daily, December 29, 2010 (1, 36).

gains generated from the process could directly contribute to economic growth in the form of employment for more than 70 percent of rural people, an increase in income, and, in particular, better living conditions and reduction in poverty for farmers and most Cambodian people engaged in economic activities in the rural areas. Additionally, the sector could provide a mechanism for equitable redistribution of economic gains, which would then have spillover effects on broader economic activities. In turn, this could lead to a complete change in the image of Cambodia's rural economy.

Cambodia can be a model for LDCs that use agriculture as a springboard for economic development with assistance from related ministries/institutions, local authorities, development partners and agencies, national and international NGOs, the private sector, and the community. The full cooperation and support of these entities is needed to formulate and implement action plans aimed at increasing efficiency, improving quality, and accelerating progress in the sector. Such collaborative efforts can serve as a catalyst in realizing the agricultural sector's vision for development.

Due to budget constraints, government investment in agriculture is still limited although the sector has benefited from investments done by the private sector, NGOs, and various development partners (i.e., donors). All partners have contributed to increasing productivity in agriculture and effecting rural development.

While Cambodia has potential to become a major agro-products exporter, especially in rice, it will take a great deal of time and work to make the transition from subsistence production to being a major exporter. It will also be a daunting task to change people's behavior and mindset from running their livelihoods as a private or family business to managing it as a commercial, corporate, or community production enterprise.

6.2. Recommendations

Focus on rural development

More investments should be directed toward rural development in general and agricultural development in particular since the bulk of Cambodia's poor live in remote rural areas. Some examples of support measures are the construction of irrigation networks and the provision of low-interest credit to help farmers procure inputs such as fertilizers and seeds.

Irrigation networks and roads have to be built or improved to increase multicropping and improve access to local and international markets. The forthcoming royalty from offshore gas/oil exploration as confirmed by government could be partly utilized to improve education in the rural areas and develop Cambodia's agricultural sector. Irrigation, roads, agriculture R&D, and rural education have proven to be the most important productivity-enhancing and poverty-reducing mechanisms in Cambodia.

Large-scale production of world class-quality rice

The use of dry-season rice must be promoted throughout the country, especially in areas near water sources. It is important for farmers to know the rice varieties and quality that are in demand in the local and international markets so that rice production can be geared to meet that demand. The Institute of Standards of Cambodia (ISC) should finalize the national standards in the different categories of rice to enable the country to have its own standards, which can help it gain access to markets. It has been contended that exporting paddy rice may be easier because it would remove the need to fulfill customs or trade procedures. However, exporting paddy rice results in loss of value-added byproducts such as rice bran, husks, and various broken parts, which also results in loss of jobs. It has been estimated that approximately US$600 million would be lost if 3 million tons of paddy rice were to be exported. It would, therefore, be more advantageous to retain value-added byproducts in the country.

Diversification into new markets and new products

The potential of the rice sector could be comparable to that of the garments sector in terms of gross export value and value added generated throughout the supply chain, including employment. Cambodia needs to build on its existing capabilities and develop new ones as a step toward diversifying its economy. The remarkable economic growth of the past decade can be sustained only if Cambodia increases its competitiveness and diversifies its currently narrow growth base.

Need for complementarity with new sectors

Agriculture will continue to be important, but needs to be complemented by development in other sectors.

- Agro-industries in rural areas (i.e., nonfarming activities like rice milling and trade) should be major sources of growth.
- Foreign investors can bring access to global value chains, technology, and finance and should thus be encouraged to invest in contract farming.
- Highlight market linkages for fish products, fish-processing technology and investment, and the ability to produce international certificates for food safety.
- Secure additional sources of financing for production and export. Cambodia's financing comes primarily from foreign savings, so tight conditions in international markets have an adverse impact on Cambodia's growth.

Need for multipronged partnerships

It is crucial to manage agricultural resources in a way that will create opportunities for growth in the sector. This has to be supported by good policies and governance and stimulus from foreign investors.

- ***With foreign-equity partners:*** Large investments are difficult to undertake without partnership with foreign investors. Serious and credible foreign involvement has begun to emerge in the rice export sector.
- ***With national dialogue partners:*** The recent adoption of the rice export policy lays the foundation for a partnership between the government and the rice milling industry.
- ***Government-Private Sector Forum:*** Cambodia can simulate successful sector-specific or product-specific arrangements that have helped other sectors (e.g., garments sector) achieve rapid growth. Collective-action arrangements under the Government-Private Sector Forum can give the private sector a sense of security for their investments in the agriculture sector.

Need to integrate Cambodian products in the global, or at least in the regional, value chain

Geography is a major driver of development, and Cambodia has the opportunity to harness the dynamism of neighboring countries. Regional integration can also help generate economies of scale for the supply chain and help Cambodia discover what it can produce. The short-term outlook is less encouraging given the global trade environment and the impasse in the current WTO Doha Development Round. However, the slowdown in global trade lends a sense of urgency to the need to deepen Cambodia's integration, particularly in East Asia.

- There are opportunities to increase subregional trade within GMS, making Cambodia the bridge between two of the largest cities in Southeast Asia—Ho Chi Minh and Bangkok.
- Efforts should focus on connecting Cambodia's agribusiness firms to subregional supply chains by encouraging Vietnamese, Thai, and Chinese businesses to relocate their processing factories in Cambodia. The rice export sector can take advantage of the zero-tariff EBA initiative to export to the EU.
- Implement existing cross-border transport agreements with neighboring countries to further stimulate cross-border trade flow.

Capacity building

Build capacities of firms on export procedures: The capability of human resources, or lack thereof, is the main constraint for majority of Cambodia's medium-sized exporting firms.[28] In the area of capacity building, there is a clear need to train medium-sized provincial rice millers on the actual process of international trade, particularly on the specifics of export procedures. With the possible exception of the top ten rice millers, most of the 300 rice millers in the country have only a vague idea of the export process. What most of them possess is the misconception that export is such a complicated process that only large and sophisticated rice millers can successfully engage in it. This misconception reinforces the existing marketing practices of paddy-rice buyers from neighboring countries who constantly state that it is too complicated to mill paddy rice and then have to go through the "hassle" of exporting the milled rice.

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[28] Sok Siphana "Operationalising the Rectangular Strategy for Growth: Towards Better Business Processes for Trade," (draft business process analysis, Economic and Social Commission for Asia and the Pacific, Cambodia, 2011).

Capacity-building strategies should be practical, hands-on, and network based. All the institutional actors, both public and private, should attend a training session to explore the entire hypothetical scenario surrounding a few export cases. The role of practitioners in particular government agencies as well as those of shipping agents/freight forwarders and port authorities is crucial in order to address issues surrounding export procedures and documentation. Efficient and effective information exchange will help the trade and transport community benefit from faster time-to-market, substantial cost-savings, and increased firm-level competitiveness.

Capacity building on market access conditions: Regional institutions such as the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), the International Finance Corporation (IFC), and the Asian Development Bank (ADB) should implement more trade projects to support Cambodia's promising export firms by helping them understand (1) concrete export opportunities arising from numerous regional and subregional trade agreements and (2) export rules and regulations and other procedural aspects of international trade.

Mobilization of private-sector rice actors

Rice farmers should form "farmers' associations" or "rice production communities" to achieve economies of scale and ensure consistency in seed quality. Groupings like these will also facilitate access to bank loans. There is a clear need to mobilize in a more formal manner the myriad private-sector representative bodies (e.g., provincial rice miller associations or groupings and the Federation of Cambodia Rice Millers Associations led by Okhna Phou Puy, *le Rassemblement des producteurs du riz* driven by Green Trade), which would be better situated to present the common position and interest of their members and to deal with the government regarding specific trade-facilitation issues and the development of the rice export industry as a whole.

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Chapter 3

Assessing the Impact of Agricultural Policies on Cambodian Economy and Poverty – A Computable General Equilibrium (CGE) Analysis

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CHAPTER 3

Assessing the Impact of Agricultural Policies on Cambodian Economy and Poverty –
A Computable General Equilibrium (CGE) Analysis

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1. Introduction

In the last ten years, Cambodia has made significant socioeconomic achievements. Higher economic growth, on average, 8.5 percent per annum from year 2000 to 2009, has benefited the population in both urban and rural areas. The country's two-digit economic growth rate from 2004 to 2007 was hailed as a success story, with Gross Domestic Product (GDP) rising 10.3 percent in 2004, 13.3 percent in 2005, 10.8 percent in 2006, and 10.2 percent in 2007, before slowing down to 6.8 percent in 2008 and hitting as low as 0.1 percent in 2009 due to the global economic crisis. The economy is expected to recover back to 5.5 percent growth in 2010 and is projected to further expand by 6.8 percent in 2011, according to Naron (2010) and the International Monetary Fund (IMF, 2011). As a result, the number of people living below the poverty line has fallen from 35 percent 2004 to 25 percent in 2010, the latest estimate in the National Strategic Development Plan (NSDP, 2010) show. However, the economy is built on a narrow base. Growth is still concentrated in the urban areas,

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specifically in the garments, tourism, and construction sectors. These three sectors are vulnerable to external shocks.

The Royal Government of Cambodia (RGC), through its “Rectangular Strategy II,” has reaffirmed critical reform areas to sustain high growth and to diversify these narrow growth sectors in the economy. Since agriculture continues to play a pivotal role in growth diversification and poverty reduction, the government has set out priorities on the rehabilitation, construction, maintenance, and efficient management of irrigation infrastructure, water reservoirs, canals, pipes, drainages, flood and sea protection levees, and water-pumping stations to increase the number of irrigated areas and boost agricultural production (Hun Sen 2008). The government recently released its “Policy Document on the Promotion of Paddy Rice Production and Export of Milled Rice,” which is envisioned to help transform Cambodia into a “rice basket” and a major milled rice-exporting country in the global market by the year 2015. The goal is to attain a surplus of paddy rice of more than 4 million tons and achieve milled-rice exports of at least 1 million ton. To realize this goal, a three-pronged strategy**—*productivity enhancement, diversification, and agricultural commercialization*—**has been adopted with concrete short- to medium-term policy measures.

To enrich further discussions on the set policies, this paper seeks to provide a quantitative assessment by applying the computable general equilibrium (CGE) model for Cambodia. Specifically, it examines the magnitude of the implications of an increase in investment in agriculture and productivity enhancement. It will also examine the inverse effect on poverty and on the economy of the demand pressures for labor for the booming agricultural sector. The simulations are productivity growth and an adverse effect of real-wage pressures from demand surge for labor in agriculture due to an imbalanced investment growth in non-agricultural sectors. The rest of paper is organized as follows. Sections 2 to 4 provide a brief overview the CGE model of Cambodia and its database. Section 5 is a discussion of the implications of these critical areas of reform on the country’s economy and poverty. Section 6 features the conclusion.

2. Theoretical Structure of the Cambodian CGE Model

The starting point of the core model is constructed based on ORANI, the Australian static CGE model. The main theoretical features of the model can be found in Horridge (2000), and the detailed description of the model is provided by Dixon et al. (1982) and Oum (2009). The model consists of equations describing, for some time period:

- producers' demands for produced inputs and primary factors;
- producers' supplies of commodities;
- demands for inputs to capital formation;
- household demands;
- export demands;
- government demands;
- the relationship of basic values to production costs and to purchasers' prices;
- market-clearing conditions for commodities and primary factors;
- numerous macroeconomic variables and price indices; and
- a set of income-mapping equations for households, government, and the foreign sector.

Demand-and-supply equations for private-sector agents are derived from the solutions to the optimization problems (cost minimization, utility maximization, etc.) which are assumed to underlie the behavior of the agents in conventional neoclassical microeconomics. All markets are cleared and the agents are assumed to be price takers, with producers operating in competitive markets that prevent the earning of pure profits. Following Johansen (1960), the model is solved by representing it as a series of linear equations relating percentage changes in model variables using GEMPACK developed by Harrison and Pearson (1996).

The model was calibrated with our estimated input–output dataset for Cambodia (Oum 2007). The data represents the economy in 2004. All relevant elasticises are taken from the Global Trade Analysis Project (GTAP) due to the lack of data specific to Cambodia for econometrically estimated parameters.

2.1 Production Structure

We assume that producers minimize their input costs given the level of output with nested Leontief/constant returns to scale (CES) production functions. Production is assumed to be separable in order to reduce the dimension of parameter space in the optimization problem. At the aggregate level, commodity composites, a primary-factor composite, and 'other costs' are combined using a Leontief production function. Consequently, they are all demanded in direct proportion to output. Each commodity composite is a CES production function of a domestic good and the imported version of the same commodity following Armington's imperfect substitution (Armington 1969). The supply of imports to Cambodia is assumed to be infinite, and import prices were thus set exogenously. The primary-factor composite is a CES aggregate of land, capital, and composite labor, of which land and capital stock are assumed to be industry-specific. Composite labor is a two-stage CES aggregate of occupational labor types and region.

2.2 Final Demands

The demand for investment goods is derived from two-part cost-minimization. First, the total cost of each imported and domestic commodity is minimized subject to the CES function. At the aggregated level, the total cost of commodity composites is minimized subject to the Leontief production function. No primary factors are used directly as input to capital formation.

The household demand is modelled similar to that of the investment demand. The only difference is that commodity composites are derived by a Klein–Rubin utility maximization subject to its aggregate budget constraints and leading to the linear expenditure system (LES). The imported and domestic commodities substitute for each other according to a CES aggregation. The aggregate demand of each household is simply allowed to respond proportionately to the household's disposal income from wages, capitals, land rentals, and transfers.

Government spending is assumed to be exogenously determined. Finally, export demands are modelled as a reverse function of their price in foreign currency and the constant own price elasticity of demand. Exports are not identical with domestically sold commodities. In each industry, the two are produced by a transformation process with a constant elasticity of transformation (CET).

2.3 Simple Dynamic Features

In order to capture intertemporal changes in the main variables in question, additional recursive dynamics are needed to accommodate stock-flow relations in physical capital accumulation and real wage-employment adjustment. There are three main mechanisms added into the core model: (1) a stock-flow relation between investment and capital stock, which assumes a one-year gestation lag; (2) a positive relation between investment and the rate of profit; (3) a relation between wage growth and employment. The formal mathematical forms of these features are found in Horridge (2002).

Annual rates of growth of capital stocks are linked to investment; investment, in turn, is guided by rates of return. Starting point of each computation represents the economy as it was both at the end of the previous period and at the beginning of the current period. Similarly, the "updated" data base produced by each computation represents the economy as it will be both at the end of the current period and at the beginning of the next. Changes in variables compare their values at the end of the current period with those at the beginning of the current period.

We allow for real wages to adjust to employment levels as follows: If end-of-period employment exceeds some trend level, then real wages will rise. Since employment is modelled as negatively related to real wages, this mechanism causes employment to adjust towards the trend level, which may be thought of as the level of employment corresponding to the natural rate of unemployment (NAIRU) hypothesis.

3. Database

Our CGE model is calibrated with our estimated input–output dataset for Cambodia (Oum 2007). The data represents the economy in 2004. All relevant elasticises are taken from the GTAP due to the lack of data specific to Cambodia for econometrically estimated parameters. However, in order to capture income distribution in the economy, a social accounting matrix

(SAM) is required to map flows of factorial incomes and others (e.g., taxes, transfers) from producing industries to households and other agents.

Figure 1 is a schematic representation of the model's input-output database. It reveals the basic structure of the model. The column headings in the main part of the figure (an absorption matrix) identify the following agents:

1. domestic producers divided into *I* industries;
2. investors divided into *I* industries;
3. *H* groups of households;
4. an aggregate foreign purchaser of exports;
5. government expenditure; and
6. changes in inventories of domestically produced goods.

The entries in each column show the structure of the purchases made by the agents identified in the column heading. Each of the *C* commodity types identified in the model can be obtained locally or imported. The source-specific commodities are used by industries as inputs to current production and capital formation, are consumed by households and governments, are exported, or are added to or subtracted from inventories. Only domestically produced goods appear in the export and inventory columns. *M* of the domestically produced goods are used as margins services (wholesale and retail trade and transport), which are required to transfer commodities from their sources to their users.

Figure 1. Structure of the input–output table

		Absorption Matrix					
		1	2	3	4	5	6
		Producers	Investors	Household	Export	Government	Change in Inventories
	Size	← I →	← I →	← H →	← 1 →	← 1 →	← 1 →
Basic Flows	↑ C×S ↓	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS
Margins	↑ C×S×M ↓	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	n/a
Taxes	↑ C×S ↓	V1TAX	V2TAX	V3TAX	V4TAX	V5TAX	n/a
Labour	↑ O ↓	V1LAB					
Capital	↑ 1 ↓	V1CAP					
Land	↑ 1 ↓	V1LND					
Production Tax	↑ 1 ↓	V1PTX					
Other Costs	↑ 1 ↓	V1OCT					

C = Number of commodities
H = Number of household types

I = Number of industries
S = 2: 1 for Domestic, 2 for Imported

O = Number of occupation types
M = Number of commodities used as margins

	Joint Production Matrix
Size	← I →
↑ C ↓	MAKE

	Import Duty
Size	← 1 →
↑ C ↓	V0TAR

Commodity taxes are payable on the purchases. As well as intermediate inputs, current production requires inputs of three categories of primary factors: labor (divided into O

occupations), fixed capital, and agricultural land. Production taxes include output taxes or subsidies that are not user-specific. The “other costs” category covers various miscellaneous industry expenses.
Each cell in the illustrative absorption matrix in figure 1 contains the name of the corresponding data matrix. For example, V2MAR is a four-dimensional array showing the cost of *M* margins services on the flows of *C* goods, both domestically produced and imported (S), to *I* investors.

In principle, each industry is capable of producing any of the *C* commodity types. The MAKE matrix at the bottom of figure 1 shows the value of output of each commodity by each industry. Finally, tariffs on imports are assumed to be levied at rates that vary by commodity but not by user. The revenue obtained is represented by the tariff vector V0TAR.

4. Income Distribution and Poverty Analyses

In order to capture income distribution and poverty, factorial incomes are mapped to each household category using results from the socioeconomic survey in 2004. The mapping provides disaggregated information on income distribution across socioeconomic household groups as well as the factorial sources of income of each household category as presented in figure 2. It is the schematic macro SAM. The receipts (income) are recorded in rows and the payments (expenditures) are listed in columns.

The entries in the first row show the purchases of domestically produced commodities by domestic producers and margin services to facilitate the flow of domestically produced goods to domestic producers, households, and other demand. The second row reveals factor incomes, which include wage income, rental on capital and agricultural land. The third row shows the sources of household income, which comprise income from factors of production and transfers from other households, transfers from government, and transfers from the rest of the world (ROW). The fourth row identifies government income coming from various taxes imposed on agents plus transfers from ROW. The fifth row records the sources of ROW income, which come from the usage of imported goods and services for intermediate inputs, for household consumption, for government consumption, and for capital creations. This aggregate SAM satisfies the convention that the totals of corresponding rows and columns are equal. A balanced SAM implies that: (1) for each commodity, demand equals supply; (2) expenditure plus savings equals income for each agent; and (3) costs equals revenue for each producer.

Having established the income mapping and modelling expenditure for fifteen household categories, we use a methodology proposed by Oum (2009) to take into the account the variation (variance) in intragroup income distribution. We calculate expenditure elasticities of the subgroup households within each household category using the socioeconomic surveys in 1994 and 2004. Using these elasticities, we can calculate the changes in expenditure (income) of each subcategory household in response to changes in the household category's mean expenditure (income) supplied by the model's simulations. We then compare the poverty levels obtaining in the post-simulation case with those in the pre-simulation case using FGT index of Foster, Greer, and Thorbecke (1984).

Figure 2. Schematic representation of Cambodian macro social accounting matrix

		Production Cost	Factor Expenditure	Household Expenditure	Government Expenditure	Investment	Inventory	Rest of the World (ROW)	Row Total
		1	2	3	4	5	6	7	8
Usage of Locally Produced Goods and Services	1	V1BAS(c,1) V1MAR		V3BAS(c,1,h) V3MAR	V5BAS(c,1) V5MAR	V2BAS(c,1) V2MAR	V6BAS(c,1)	V4BAS(c,1) V4MAR	SALE
Factor Income	2	V1CAP, V1LAB, V1LAND							V1PRIM
Household Income	3		V1CAP(h) V1LAB(h) V1LAND(h)	Transfer	Transfer			Transfer	VHOUINC
Government Income	4	V1TAX, V1PTX, V1OCT		V3TAX Direct Taxes	V5TAX	V2TAX		V4TAX, V0TAR Transfer	VGOVINC
ROW Income	5	V1BAS(c,2)		V3BAS(c,2,h) Transfer	V5BAS(c,2) Transfer	V2BAS(c,2)	V6BAS(c,2)		V0IMP
Column Total	6	COST	VPRIMEXP	V3TOT	V5TOT	V2TOT	V6TOT	VROWEXP	

Gross Saving or Residual (8 -6)	□	~	0	Household Saving	Government Saving (budget balance)	Aggregate Investment	Changes in Inventory	ROW Saving	

5. Impact of Productivity Growth and Adverse Wage Pressure for Labor Demand in Agricultural Sectors on Cambodian Economy and Poverty

5.1 Simulations

The focus of the simulations is to examine the implications of the main critical areas of reform on the Cambodian economy, including the distributional impacts on income and poverty. The simulations are conducted for two main agricultural sectors, paddy rice and other crops, a 20 percent increase in productivity improvement (S1), and an adverse effect of real-wage pressures from demand surge for labor (S2) due to imbalanced investment growth in non-agricultural sectors.

Our first simulation (S1), the 20 percent improvement in productivity coming from an assumed public investment in irrigation system, is in line with the projection in the "Policy Document on the Promotion of Paddy Rice Production and Export of Milled Rice" that by 2015, the total paddy rice production is realized mainly by an increased in dry-season cultivation (tables 1 and 2). In other words, the projected 100,000-hectare increase in the dry-season cultivated area in 2015 is equivalent to about 20 percent increase in total productivity. For other crops, we also assume a 20 percent growth in productivity.

Table 1. Projection of Paddy Rice Production in Cambodia 2010—2015

	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Cultivated areas of wet-season paddy rice (million hectare)	2.34	2.35	2.36	2.37	2.38	2.39
-*Average yield (ton/hectare)*	2.70	2.78	2.86	2.95	3.04	3.04
Cultivated areas of dry-season paddy rice (million hectare)	0.38	0.38	0.41	0.42	0.45	0.48
-*Average yield (ton/hectare)*	4.43	4.75	5.10	5.47	5.50	5.55
Production loss (million metric ton)	0.72	0.75	0.78	0.81	0.85	0.86
Total production (million metric ton)	**7.30**	**7.62**	**8.09**	**8.44**	**8.85**	**9.08**

Source: Policy document on the Promotion of Paddy Rice Production and Export of Milled Rice 2010.

The second simulation (S2) is the counterfactual assessment of the likelihood of wage pressures on a surge in demand for labor in the agriculture sector. The fastest expansion in the other crops sector, especially in rubber and sugarcane, would require a higher wage to lure workers. We expect that in the medium term, higher investment in the non-agriculture sector would lead to a demand for higher wages to attract more workers to these sectors. Based on our back-of-the-envelope estimate, a 10 percent increase in non-agricultural investment would require a 20 percent increase in real wages for the other crops and paddy rice sector. We will assess their implications on the economy and on poverty.

Table 2. Irrigation Investment Projects 2010—2015

Funding Source	Name of Project/ Program	Project Cost (US$ million)		Implementation Period
		Grant	Loan	
A. Japan International Cooperation Agency (JICA)	1. West Tonle Sap Irrigation and Drainage Rehabilitation and Improvement Project		60,000,000.00	2010—2015
	2. Kandal Stung - Bati Irrigation Rehabilitation Project		22,000,000.00	2011—2014
	3. Upper Slakou River Irrigation Rehabilitation Project		24,200,000.00	2011—2014
	4. Small-Scale Infrastructure Project (Japanese Irrigation Sector Loan Project)		59,300,000.00	2010—2013
B. Asian Development Bank (ADB)	1. Northwest Irrigation Sector Project		30,000,000.00	2008—2010
	2. Tonle Sap Lowland Irrigation Rural Development Project		20,000,000.00	2009—2013
	3. Water Resources Management Sector Project		20,000,000.00	2010—2015
C. International Monetary Fund (IMF)	1. Eastern Water Resources Development Project (Phase I)	33,380,000.00		2008—2010
	2. Eastern Water Resources Development Project (Phase II)	19,500,000.00		2011—2013
D. French Development Agency (AFD)	Northwest Irrigation Sector Project	3,700,000.00		2008—2010
	Water Resources Management Sector Project	10,000,000.00		2010—2015
E. Korean International Cooperation Agency (KOICA)	Bantheay Flood Control Project	2,200,000.00		2008—2009
	Kraing Ponley Water Resources Development Project		26,700,000.00	2008—2013

	Stung Dauntry Water Resources Development Project		36,000,000.00	2009—2015
F. KUWAIT	Feasibility Study for Stung Sen Water Resources Development Project	1,200,000.00		2009—2010
	Stung Sen Water Resources Development Project		360,000,000.00	2010—2015
G. QATAR	VAICO Irrigation Rehabilitation Project		200,000,000.00	2009—2013
H. CHINA	Kainghot Irrigation Rehabilitation Project		55,000,000.00	2009—2011
	Kampong Trabek Flood Control Project		35,000,000.00	2009—2011
	Stung Keo Water Resources Development Project		40,000,000.00	2009—2012
H. INDIA	Stung Sreng Water Resources Development Project		5,000,000.00	2009—2010
	Stung Tasal Water Resources Development Project		15,000,000.00	2009—2011
J. AUSTRALIA (Ausaid) (AU$43.262 million)	Cambodian Agricultural Value Chain (CAVAC)	10,000,000.00		2009—2013
K. ITALIA	Kamping Pouy Irrigation Rehabilitation Project (Phase I)	2,000,000.00		2008—2009
	Kamping Pouy Irrigation Rehabilitation Project (Phase II)	4,500,000.00		2010—2012
L. Poverty Reduction and Growth Operation	Bamnak Irrigation Rehabilitation Project and other project	8,000,000.00		2009—2010
GRAND TOTAL		**94,480,000.00**	**1,008,200,000.00**	

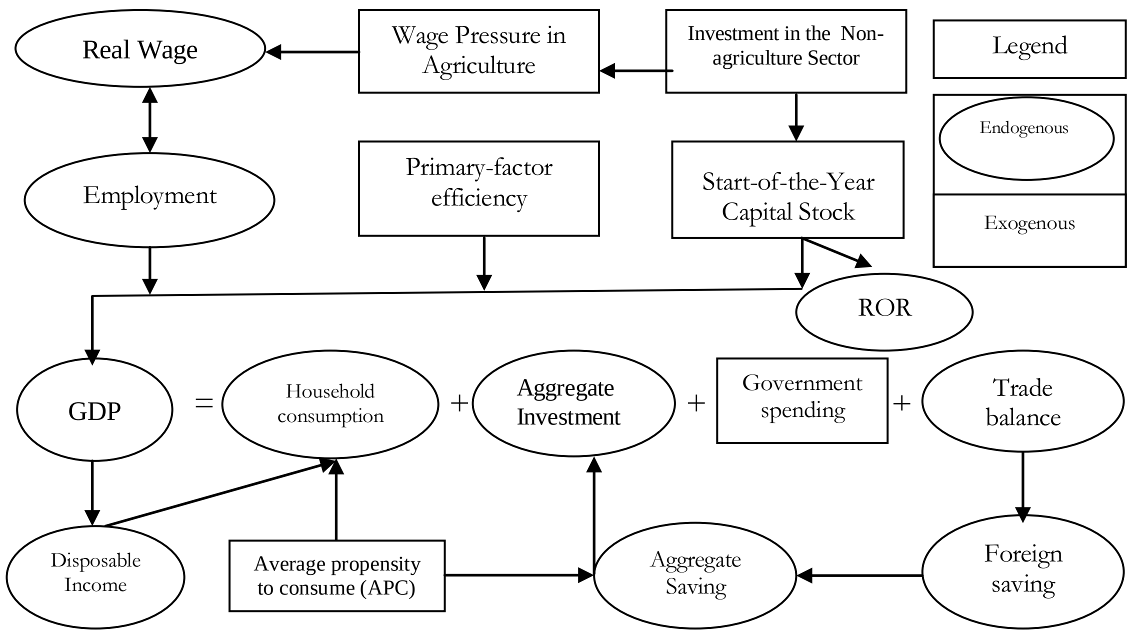
Source**:** www.sea-user.org/download_pubdoc.php?doc=4913 accessed January 31, 2011.

5.2 Model Closures

In our simulations, we apply closures as summarized by figure 4 below. As briefly discussed, start-of-the-year capital stock is exogenously determined by previous-year investment. Simulations endogenously determine an end-of-the year investment through changes in the real rate of return (ROR) for the following-year capital stocks. Employment is endogenously determined by real wage. Agricultural land and primary-factor efficiency are exogenously set to baseline. The bidirectional arrow between real wage and employment means that the real wage is assumed to adjust slowly in the short run and be flexible in the long run. A stylized model to understand the results is given in the appendix.

On the expenditure side, real consumption and real aggregate investment are endogenous. Real government spending is assumed to be unaffected by the policy reform, allowing it to maintain its level in the baseline. Foreign currency prices of imports are naturally exogenous. However, the nominal exchange rate is used as numeraire so changes in domestic prices relative to world prices are accommodated by changes in the domestic price level rather than changes in the exchange rate. Other exogenous variables in this closure are taxes, tariffs, and shift variables. The real trade balance is allowed to adjust. In essence, a trade deficit accompanied by an increase in aggregate investment continues to be financed by both foreign and domestic savings. The gains in GDP income will lead to high disposable income and household consumption (average propensity to consumer is exogenous, with all disposable income being spent).

Figure 4. Causation in the simulations



5.3 Simulation Results

5.3.1 Macroeconomic Results

The macroeconomic results from our simulations are summarized in table 3. The main features of these results are presented as the percentage deviations from the baseline. The simulations were conducted for the period 2010 to 2015.

Underlining these results are the facts that in the short run, the real wage is sticky and the real cost of hiring labor (the marginal product of labor) depends on the consumer price index (CPI) and output prices at factor costs (difference between CPI and GDP deflator). A one-off productivity enhancement *A* in 2010 results in a higher marginal product of labor and as prices of outputs are higher than CPI, it is cheaper for producers to hire more workers, leading to an increase in employment *L* and higher real wage. However, in the long run, an increase in employment would exert long-run pressure for capital stock *K* to increase. This long-run result would require a short-run increase in investment *I*. In the short run, *K* is sticky and *ROR* is endogenous, so an increase in *L* leads to higher *ROR*. This causes *I* to rise, which, in turn, translates to a higher *K*, gradually reaching a long-run equilibrium.

For the first simulation S1, the results show that the productivity improvement started in 2010 leads to an increase of 1.3 percent in aggregate employment and a minor change in capital stock, all of which jointly contribute to a 2.9 percent increase in GDP. But whenever there is a positive deviation of employment from the base level, there is pressure exerted on wage to rise. Moreover, a faster expansion in *L* than in *K* leads to a lower *K/L* ratio; thus, higher *ROR* causes investment for the next period to rise. The improvement in the *K/L* ratio in later periods with higher *K* leads to higher marginal product of labor and thus higher *W* and decreasing *ROR* starting 2011. Exports expand faster than imports, leading to a slight deterioration in *TOT*. By 2015, GDP is expanding by 2.4 percent while real consumption is increasing by only 2.7 percent. Meanwhile, investment is increasing by only 0.6 percent, exports by 0.9 percent, and imports by 0.6 percent. Again, by 2015, aggregate employment moves back to the base period, slightly increasing by 0.2 percent and capital stock by 0.1

percent. The *L* and *K* results are reflected by an assumption of the factor-neutral productivity enhancement.

The second simulation S2 of the 10 percent increase in investment in the non-agricultural sector and the 20 percent increase in real wage demand for labor in the other crops and paddy rice sector was conducted using an inward shift in the labor supply curve for these sectors. It is as if the workers demanded 20 percent higher real wage for them to work in said sectors. In the simulation, the 10 percent additional investment in the non-agricultural sector in 2010 led to an increase in aggregate investment by 9.4 percent and capital stock by 6.9 percent.

Table 3. Macroeconomic Results (accumulated percentage changes)

		Productivity S1					
	Main Indicators	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
1	Real GDP	**2.9**	**2.7**	**2.6**	**2.5**	**2.4**	**2.4**
2	Aggregate real investment	0.3	0.4	0.5	0.6	0.6	0.6
3	Aggregate household consumption	**3.0**	**2.9**	**2.8**	**2.8**	**2.8**	**2.7**
4	Aggregate real government demands	0.0	0.0	0.0	0.0	0.0	0.0
5	Export volume	2.1	1.7	1.4	1.2	1.1	0.9
6	Import volume	1.2	1.1	0.9	0.8	0.7	0.6
7	Total factor productivity	**2.3**	**2.3**	**2.3**	**2.3**	**2.3**	**2.3**
8	Aggregate land	0.0	0.0	0.0	0.0	0.0	0.0
9	Aggregate employment	1.3	0.8	0.5	0.4	0.2	0.2
10	Aggregate capital stock	0.0	0.0	0.0	0.1	0.1	0.1
11	Capital/labor ratio	-1.3	-0.8	-0.5	-0.3	-0.2	-0.1
12	Average real wage	1.0	1.6	2.1	2.4	2.6	2.8
13	Rate of return index	3.9	3.1	2.5	2.0	1.6	1.3
14	GDP deflator	0.6	0.7	0.7	0.6	0.6	0.5
15	Consumer price index	0.5	0.5	0.4	0.4	0.3	0.2
16	Real devaluation	-0.7	-0.8	-0.7	-0.7	-0.6	-0.5
17	Terms of trade	-0.1	0.0	0.0	0.0	0.0	0.1
		Investment and Labor Shock S2					
	Main Indicators	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
1	Real GDP	**0.1**	**1.4**	**2.3**	**2.8**	**3.1**	**3.3**
2	Aggregate real investment	**9.4**	**9.4**	**9.4**	**9.4**	**9.5**	**9.5**
3	Aggregate household consumption	**0.6**	**1.2**	**1.7**	**2.1**	**2.5**	**2.7**
4	Aggregate real government demands	0.0	0.0	0.0	0.0	0.0	0.0
5	Export volume	-1.2	1.1	2.5	3.3	3.8	4.1
6	Import volume	1.9	3.1	3.9	4.5	4.9	5.2
7	Total factor productivity	0.0	0.0	0.0	0.0	0.0	0.0
8	Aggregate land	0.0	0.0	0.0	0.0	0.0	0.0
9	Aggregate employment	0.1	0.7	0.9	0.9	0.8	0.6
10	Aggregate capital stock	0.0	2.3	3.9	5.1	6.1	6.9

11	Capital/labor ratio	-0.1	1.6	3.0	4.3	5.3	6.3
12	Average real wage	0.1	0.6	1.3	2.1	2.8	3.4
13	Rate of return index	-1.1	-2.3	-3.6	-5.0	-6.2	-7.4
14	GDP deflator	1.1	-0.3	-0.8	-0.9	-0.9	-0.8
15	Consumer price index	0.6	0.0	-0.3	-0.3	-0.3	-0.2
16	Real devaluation	-1.1	0.3	0.8	1.0	1.0	0.9
17	Terms of trade	0.1	-0.3	-0.5	-0.6	-0.7	-0.8

The expansion in GDP leads to an increase in real consumption. A large component of investment and household consumption comes from imports. Moreover, the deviation in investment exceeds the deviation in the real GDP. As a result, imports expand faster than exports, accompanied by deterioration in *TOT* and real appreciation. Therefore, the trade balance moves to deficit. By 2015, real consumption is increasing by 2.7 percent, exports by 4.1 percent, and imports by 5.2 percent. These increases are accompanied by -0.8 percent deterioration in the *TOT* and 0.9 percent appreciation of the real exchange rate from the baseline level.

5.3.2 Sectoral Investment, Capital Stock, Employment, and Output

The sectoral results for both simulations largely follow from the macroeconomic results. With higher GDP growth along with higher investment and household consumption, sectors that sell largely to households and capital-creation industries tend to gain significantly in the simulations.

Table 4 shows expansion in most sectors of the economy. However, some sectors gain more than the others due to the underlying input-output linkages, factor intensity, and their sale patterns.

For the simulation S1, the top winners are obviously paddy rice and other crops, their suppliers and buyers, and those that sell predominantly to household consumption, including food products; food, beverage, and tobacco products; chemical, rubber, and plastic products (mainly fertilizers); and various services sectors. Since we assume fixed government spending, the output of public administration, health, and education expand marginally.

For simulation S2, investment in the non-agricultural sectors leads to the expansion of most of these sectors. The top winners are obviously those that sell predominantly to capital formation. These include construction; mining; nonmetal mineral products; basic fabricated metal products; transport and electronic equipment; and machinery. Due to higher wage demand, paddy rice and other crops contracted significantly as did their suppliers and buyers (e.g., food products; beverage and tobacco products; chemical, rubber, and plastic products). Government-related industries also stand to lose.

Table 4. Sectoral Capital Stock, Employment, and Output (% deviation from base case forecast in 2015)

	Industry	Simulation S1			Simulation S2		
		L	K	Output	L	K	Output
1	Paddy Rice	13.2	3.0	29.0	-22.7	0.0	-16.5
2	Other Crops	-10.6	-2.8	8.6	-4.5	0.0	-3.4
3	Livestock	4.0	0.6	1.4	1.4	7.1	2.5
4	Forestry	0.5	0.2	0.3	5.3	6.3	4.6
5	Fishery	2.3	0.6	1.1	1.9	6.2	2.5
6	Mining	0.7	-0.1	0.4	18.0	8.6	8.6
7	Food Products	4.8	1.0	2.6	-0.3	6.2	1.9
8	Beverage and Tobacco	4.9	1.1	3.9	-3.0	6.4	0.5
9	Textiles	-1.8	-0.4	-1.6	6.5	6.0	6.4
10	Apparel	-2.0	-0.3	-1.7	5.8	7.1	6.6
11	Leather Footwear	-3.9	-0.8	-3.1	5.3	5.8	5.8
12	Lumber and Wood Products	-3.1	-0.1	-0.6	3.3	6.0	5.1
13	Paper and Printing Products	-0.7	-0.2	-0.5	3.5	6.0	5.8
14	Oil and Gas Products	0.8	0.3	0.3	4.5	6.5	6.1
15	Chemical, Rubber, and Plastic Products	10.3	2.3	9.2	-9.6	6.5	-3.1
16	Nonmetal Mineral Products	-1.4	-0.1	-1.4	7.6	7.2	8.0
17	Basic Fabric. Metal Products	-1.0	-0.1	-1.1	7.1	6.8	7.2
18	Motor and Vehicles	-0.1	0.1	-0.5	6.2	6.7	6.7
19	Transport Equipment	-0.7	0.1	-0.1	8.7	7.6	8.9
20	Electronic Equipment	-0.9	-0.1	-0.7	7.6	6.9	7.4
21	Machineries	-0.9	-0.1	-1.1	7.8	6.9	7.6
22	Other Manufacturing Products	-3.7	-0.6	-2.8	0.3	6.7	2.9
23	Electricity	4.2	0.9	1.3	0.9	5.5	4.2
24	Water	2.7	0.6	0.7	2.2	5.5	4.4
25	Construction	0.5	0.1	0.6	8.9	7.7	9.3
26	Wholesale Trade	5.1	1.0	1.6	1.2	6.3	4.2
27	Retail Trade	4.2	0.6	1.7	2.7	7.0	4.2
28	Repair Services	3.7	0.8	1.2	2.4	6.3	4.7

29	Hotel and Restaurant	-1.5	-0.3	-1.6	4.8	5.7	5.4
30	Land and Supporting Transport Services	2.2	0.5	0.6	2.9	6.2	5.2
31	Water Transport	2.8	0.6	0.6	2.9	5.9	5.4
32	Air Transport	1.4	0.3	0.2	3.1	6.0	5.2
33	Post and Communication	-1.3	-0.3	-1.1	4.7	5.3	5.2
34	Financial Services	4.2	0.7	1.1	2.3	6.5	4.7
35	Real Estate &Other Businesses	5.4	1.0	2.7	1.3	6.6	3.2
36	Public Administration	0.5	0.4	0.2	0.5	6.1	0.5
37	Education	0.4	0.4	0.1	0.5	6.1	0.6
38	Health	0.5	0.4	0.2	0.5	6.1	0.5
39	Other Services	2.8	0.7	1.3	1.7	6.1	3.6
40	Dwellings	3.6	0.8	0.8	4.2	6.1	6.2

5.3.4 Household Income, Consumption, and Poverty Implications

Economic policy influences the distribution of income across households due mainly to the changes in returns on primary factors. The owners of primary factors will receive more income if the price and quantity of their owned primary factor increases. Since each regional household controls a different combination of primary factors, the result on income also varies across households. The percentage deviation of real household income from the baseline is shown in table 5.

As briefly discussed, the mechanisms through which economic policy influences distribution of income across households come from the direct effects of income due to the changes in returns on primary factors and other income transfers. The owners of primary factors will receive more income if the price and quantity of their owned primary factor increases. Higher rate of return relative to inflation will lead owners of capital goods to gain in real terms. Since each household controls a different combination of primary factors, the result on income also varies across households.

Table 5. Accumulated Changes in Real Household Income by Sources in 2015 (percentage deviation from baseline)

Household	Simulation S1					Simulation S2				
	Land	Wage	Capital	Others	All	Land	Wage	Capital	Others	All
1 Banteay Mean Chey	4.5	3.6	4.7	2.7	3.9	-0.4	2.5	-1.2	2.6	1.5
2 Battambang	4.1	1.7	2.2	2.8	2.1	0.8	3.3	0.5	2.8	2.3
3 Kampong Cham	4.9	1.4	1.3	3.1	1.6	1.5	3.3	1.1	2.5	2.6
4 Kampong Chhnang/Pursat	5.2	3.5	4.6	2.9	4.1	2.6	3.3	-1.6	2.5	1.9
5 Kampong Speu	5.5	3.7	4.4	3.0	4.0	5.0	2.9	-1.1	2.4	2.2
6 Kampong Thom	4.9	3.9	4.2	3.0	4.2	5.7	2.8	-0.9	2.4	2.2
7 Kampot	5.2	2.9	3.9	2.9	3.4	3.8	2.7	-1.1	2.5	2.0
8 Kandal	4.9	2.2	0.3	3.6	1.4	2.9	4.8	1.9	2.4	3.3
9 Phnom Penh	4.7	1.8	0.7	3.4	1.4	3.2	7.1	2.0	1.4	4.5
10 Prey Veng	5.0	4.2	5.1	2.9	4.4	0.6	2.0	-1.6	2.5	1.4
11 Siem Reap	4.8	3.3	3.7	2.5	3.6	3.7	3.4	-0.3	3.6	2.5
12 Sihanouk/Kep/Koh Kong	4.9	2.5	3.0	2.5	2.8	3.7	6.5	0.4	2.5	4.8
13 Svay Rieng	5.6	4.1	5.1	2.9	4.6	1.5	2.9	-1.9	2.4	1.6
14 Takeo	4.4	4.0	3.7	2.7	4.0	0.7	1.8	-0.7	2.6	1.0
15 Others*	4.9	3.3	4.8	3.2	4.1	8.9	3.3	-1.5	2.0	3.4

*Kratie, Mondul Kiri, Preah Vihear, Ratanak Kiri, Strung Treng, Oddar Meanchey, and Pailin

Under simulations S1 and S2, households see their income increase, though to varying extents. As expected, all households' real income in all regions increases. For simulation S1, households in the provinces where agriculture predominates (i.e., except for the capital Phnom Penh, Kandal, and Sihanouk/Kep/Koh Kong) enjoyed the largest gains. These areas gained more than others because of the higher rate of returns from all factors.

If these average gains are applied to the base income (expenditure) of every household in each region, the poverty rate and the other two indices fall dramatically. However, results from the previous surveys suggest that the changes in income/expenditure are not uniform for all the household categories identified. There is a large variation in income distribution within each group. To address this problem, an arbitrary theoretical income distribution function was imposed to derive poverty indices of consequences from the policy changes. However, we used a simple method of applying a constant variation in income distribution within the group on the previous data. We assumed that each household belongs to the group with constant elasticity to change the group's mean income. We derived the household's income by regions and deciles using the elasticity of decile-household consumption in response to changes in the mean consumption of the household category they belong to as shown in table 6.

Table 6. Real Household Consumption by Categories and Deciles in 2015 (percentage deviation from baseline)

	Household											
			Simulation S1									
	Household	**Mean**	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**
1	Banteay Mean Chey	**3.9**	0.6	1.4	1.7	2.1	2.6	3.1	3.6	3.9	4.8	5.8
2	Battambang	**2.1**	0.3	0.7	0.9	1.1	1.4	1.7	1.9	2.1	2.6	3.1
3	Kampong Cham	**1.6**	0.2	0.6	0.7	0.9	1.1	1.3	1.5	1.6	2.0	2.4
4	Kampong Chhnang/Pursat	**4.1**	0.6	1.4	1.8	2.2	2.7	3.2	3.7	4.1	5.1	6.1
5	Kampong Speu	**4.0**	0.6	1.4	1.7	2.2	2.6	3.1	3.7	4.0	4.9	5.9
6	Kampong Thom	**4.2**	0.6	1.4	1.8	2.2	2.7	3.2	3.8	4.1	5.1	6.1
7	Kampot	**3.4**	0.5	1.2	1.5	1.8	2.2	2.7	3.1	3.4	4.2	5.0
8	Kandal	**1.4**	0.2	0.5	0.6	0.8	0.9	1.1	1.3	1.4	1.7	2.1
9	Phnom Penh	**1.4**	0.2	0.5	0.6	0.7	0.9	1.1	1.2	1.4	1.7	2.0
10	Prey Veng	**4.4**	0.7	1.5	1.9	2.4	2.9	3.5	4.0	4.4	5.4	6.5
11	Siem Reap	**3.6**	0.5	1.2	1.5	1.9	2.4	2.8	3.3	3.6	4.5	5.4
12	Sihanouk/Kep/Koh Kong	**2.8**	0.4	1.0	1.2	1.5	1.9	2.2	2.6	2.8	3.5	4.2
13	Svay Rieng	**4.6**	0.7	1.6	2.0	2.5	3.0	3.6	4.2	4.6	5.6	6.8
14	Takeo	**4.0**	0.6	1.4	1.7	2.2	2.6	3.1	3.7	4.0	4.9	5.9
15	Other	**4.1**	0.6	1.4	1.8	2.2	2.7	3.2	3.7	4.1	5.0	6.0
			Simulation S2									
		Mean	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**
1	Banteay Mean Chey	**1.5**	0.2	0.5	0.6	0.8	1.0	1.2	1.4	1.5	1.9	2.2
2	Battambang	**2.3**	0.3	0.8	1.0	1.2	1.5	1.8	2.1	2.3	2.8	3.4
3	Kampong Cham	**2.6**	0.4	0.9	1.1	1.4	1.7	2.0	2.3	2.6	3.2	3.8
4	Kampong Chhnang/Pursat	**1.9**	0.3	0.6	0.8	1.0	1.2	1.5	1.7	1.9	2.3	2.8
5	Kampong Speu	**2.2**	0.3	0.8	1.0	1.2	1.5	1.7	2.0	2.2	2.7	3.3

6 Kampong Thom	**2.2**	0.3	0.7	0.9	1.2	1.4	1.7	2.0	2.2	2.7	3.2
7 Kampot	**2.0**	0.3	0.7	0.8	1.1	1.3	1.5	1.8	2.0	2.4	2.9
8 Kandal	**3.3**	0.5	1.1	1.4	1.8	2.1	2.6	3.0	3.3	4.1	4.9
9 Phnom Penh	**4.5**	0.6	1.5	1.9	2.4	2.9	3.5	4.0	4.4	5.5	6.6
10 Prey Veng	**1.4**	0.2	0.5	0.6	0.8	0.9	1.1	1.3	1.4	1.7	2.1
11 Siem Reap	**2.5**	0.4	0.9	1.1	1.3	1.6	1.9	2.3	2.5	3.1	3.7
12 Sihanouk/Kep/Koh Kong	**4.8**	0.7	1.6	2.0	2.5	3.1	3.7	4.3	4.7	5.9	7.1
13 Svay Rieng	**1.6**	0.2	0.5	0.7	0.8	1.0	1.2	1.4	1.6	1.9	2.3
14 Takeo	**1.0**	0.2	0.4	0.4	0.5	0.7	0.8	0.9	1.0	1.2	1.5
15 Other	**3.4**	0.5	1.2	1.4	1.8	2.2	2.6	3.1	3.4	4.2	5.0

Table 7 shows the percentage-point deviation in the poverty indices from the baseline level for both the proportionate and elasticity methods. As expected, the percentage-point deviation in the poverty headcount indices from the base period is higher for the proportionate method than for the elasticity method in both simulations.

Simulation S1, which used the proportionate method, revealed that the poverty headcount index for the whole country will go down by 2.1 percentage points from the baseline level by 2015. Should the gain be distributed according to the elasticity method, the index will go down by only 1.4 percentage points.

The poverty indices for simulation S2 are lower compared to the variable balance of trade. The poverty headcount index for the whole country will go down by only 1.7 percentage points from the base case forecast by 2015 using the proportionate method and by 1 percentage point using the elasticity method.

Table 7. FGT Poverty Indices in 2015 (percentage – point deviation from baseline)

		Base Year			S1						S2					
					The Proportionate Method			The Elasticity Method			The Proportionate Method			The Elasticity Method		
	Household	P0	P1	P2	P0	P1	P2	P0	P1	P2	P0	P1	P2	P0	P1	P2
	Cambodia	**34.7**	**9.0**	**3.3**	**-2.1**	**-0.8**	**-0.4**	**-1.4**	**-0.3**	**-0.1**	**-1.7**	**-0.6**	**-0.2**	**-0.9**	**-0.2**	**-0.1**
1	Banteay Mean Chey	37.2	9.8	3.6	**-2.8**	-1.0	-0.5	-1.9	-0.4	-0.1	**-1.4**	-0.4	-0.2	-0.7	-0.1	-0.1
2	Battambang	33.7	7.9	2.6	**-0.6**	-4.6	-0.2	-0.1	-0.2	-0.1	**-0.6**	-0.6	-0.2	-0.1	-0.2	-0.1
3	Kampong Cham	37.0	9.3	3.3	**-1.2**	-6.5	-0.2	-0.7	-0.2	-0.1	**-1.8**	-0.7	-0.3	-1.0	-0.2	-0.1
4	Kampong Chhnang/Pursat	39.6	10.3	3.8	**-3.3**	-6.6	-0.5	-1.8	-0.4	-0.1	**-1.2**	-0.5	-0.2	-1.1	-0.2	-0.1
5	Kampong Speu	57.2	17.0	6.7	**-2.9**	-12.3	-0.8	-1.9	-0.5	-0.2	**-2.1**	-0.9	-0.4	-1.1	-0.3	-0.1
6	Kampong Thom	52.4	15.5	6.2	**-3.5**	-10.3	-0.7	-2.4	-0.5	-0.2	**-2.4**	-0.8	-0.4	-1.4	-0.3	-0.1
7	Kampot	30.0	6.6	2.3	**-3.4**	-2.5	-0.3	-2.2	-0.3	-0.1	**-2.2**	-0.4	-0.2	-1.1	-0.2	-0.1
8	Kandal	22.2	4.8	1.7	**-0.7**	-2.5	-0.1	-0.4	-0.1	0.0	**-1.9**	-0.5	-0.2	-1.0	-0.2	-0.1
9	**Phnom Penh**	**4.6**	**1.2**	**0.5**	**0.0**	**-0.2**	**0.0**	**0.0**	**0.0**	**0.0**	**-0.5**	**-0.1**	**-0.1**	**-0.5**	**-0.1**	**0.0**
10	Prey Veng	37.3	8.1	2.7	**-5.3**	-5.5	-0.4	-3.8	-0.5	-0.1	**-2.9**	-0.4	-0.1	-1.4	-0.2	0.0
11	Siem Reap	51.8	17.3	7.5	**-1.3**	-12.1	-0.7	-0.9	-0.4	-0.2	**-0.9**	-0.8	-0.5	-0.7	-0.3	-0.1

12	Sihanouk/Kep/Koh Kong	23.2	4.6	1.4	**-1.9**	-0.6	-0.2	-1.3	-0.2	-0.1	**-4.0**	-0.8	-0.3	-1.7	-0.4	-0.1
13	Svay Rieng	35.9	8.3	2.8	**-2.3**	-5.1	-0.5	-1.6	-0.4	-0.1	**-1.0**	-0.4	-0.2	-0.4	-0.2	-0.1
14	Takeo	27.7	6.3	2.1	**-2.7**	-3.1	-0.3	-1.9	-0.3	-0.1	**-1.2**	-0.2	-0.1	-0.9	-0.1	0.0
15	Others	46.1	13.2	5.0	**-2.3**	-8.8	-0.6	-0.8	-0.5	-0.2	**-1.4**	-1.1	-0.5	-0.6	-0.4	-0.2

6. Conclusion and Policy Implications

The paper examines magnitude of the implications of agricultural development on the Cambodian economy and their distributional impacts on income and poverty. The simulations were conducted based on assumptions of 20 percent productivity growth and an adverse effect of real-wage pressures from the demand surge for labor in the agriculture sector due to higher investment in the non-agriculture sector. The potential gain in GDP growth is 2.4 percent in simulation S1 and 3.3 percent in simulation S2.

However, these results have very interesting and different poverty implications. On the surface, it appears that there is a lower gain in GDP growth even when productivity in the agriculture sector is enhanced or improved. However, when the mean income of regional households is applied to every individual household in the group, the poverty rate deviations from the base period are higher in the scenario where agricultural productivity is enhanced. Specifically, the poverty headcount was reduced by almost 2.1 percentage points from the 35 percent in the base year.

In contrast, it is generally believed that increasing investment in the non-agriculture sector coupled with higher wage demand in the agriculture sector could be a poverty-reducing mechanism. However, simulation S2 showed that this would reduce poverty by only 1.7 percentage points. Alternatively, by using a constant variation of income distribution within each group, the combined result in poverty reduction would be about half of the equal mean distribution method.

Therefore, agriculture-based growth in GDP is more pro-poor than expansion in the non-agriculture sectors. Well-targeted investments aimed at improving the productivity of the rural poor and the agriculture-based areas are an important and effective poverty-reduction strategy.

Moreover, in order to avoid potential setbacks in the labor market for agriculture, better information on the labor market at the national level is crucial for job matching. Conditional migration to areas with labor shortage should be considered. By far the most important indirect measures would be price stability, reduction in the nationwide cost of doing business, and investment and support for technology transfers to enhance productivity. Such measures are essential to deter high wage pressures and maintain the balanced and broad-based growth of the economy.

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APPENDIX – STYLIZED MODEL

To keep track of the causal relation between these variables, we use a strategy proposed by Adams (2005) to illustrate the mechanisms of the core model and a sketch model version by Dixon and Rimmer (2002). It is presented as follows:

Equations of the Stylized Model

(1) $Y = C + I + \bar{G} + X - M$

(2) $Y = \bar{A}\, F\,(\bar{K},\, L)$

(**3**) $C = \overline{APC} * Y$

(4) $M = H\,(Y,\, TOT)$

(5) $TOT = J\,(X,\, \bar{V})$

(6) $I\ / \bar{K} = N\,(ROR)$

(7) $\bar{K} / L = Q\,(ROR,\, \bar{A},\, TOT)$

(8) $W = U\,(\bar{K} / L,\ \bar{A},\, TOT)$

Equation (1) is the *GDP* (*Y*) identity in constant-price terms. Equation (2) is the economy's production function relating real GDP to inputs of labor (*L*) and capital (*K*) and to input-saving technology term (*A*). In writing (2) and elsewhere in the stylized model, we ignore the existence of agricultural land and the presence of distortions due to indirect taxes and subsidies. Equation (3) links total consumption *C* to GDP via average propensity to consume (*APC*). Equation (4) summarizes the determination of import volumes (*M*). In the absence of changes in preferences and tariffs, import volumes are positively related to GDP and the ratio of domestic to imported prices (represented here by *TOT,* i.e., the price of exports relative to the price of imports). Commodity exports are inversely related to their foreign currency prices via constant elasticity demand functions. This is summarized by equation (5), which relates the terms of trade to the volume of exports (*X*) (movements along foreign demand schedules) and a shift variable *V* (movements in foreign demand schedules). Equation (6) uses aggregate investment/capital ratio which is exogenous to determine the rate of return (*ROR*). With the constant returns to scale assumption, the marginal product functions are homogeneous of degree 0 and so can be expressed as functions of *K/L* and *A*. This accounts for equation (7) relating the profit-maximizing capital/labor ratio to the rate of return on capital, technological change (*A*), and the terms of trade (*TOT*). Similarly, the movement in the real consumer wage (*W*) can be related to changes in the capital / labor ratio, technology, and the terms of trade in equation (8).

Following Giesecke (2004), we derive (7) and (8) by solving the firm's profit maximization problem*:* $\Pi = P.Y - W_L.L - W_K.K$, subject to $Y = A\ f(L,K)$*;* where Π is profit, W_L is the wage rate, W_K is the rental price of capital, and P is the price of output Y. From this problem we have the f.o.c. $P_K = P.A.f_K - W_K = 0$, or $f_K = W_K/(A.P)$, or equivalently $f_K = (W_K/P_I)(P_I/A.P)$. Noting that f_K is a monotonically decreasing function of K/L, that (W_K/P_I) is the rate of return (*ROR*) and that P_I/P is a negative function of the terms of trade (since P_I – the investment price index – includes import prices but excludes export prices, while P – the price of domestic output – includes export prices but excludes import prices) provides (7). This implies that $Q_{ROR} < 0$, $Q_{TOT} > 0$, and $Q_A > 0$. By the same token, $\Pi_L = P.A.f_L - W_L = 0$, or $f_L = W_L/(A.P)$, or equivalently $f_L = (W_L/P_C\ )(1/A)(P_C/P)$. Noting that f_L is a monotonically increasing function of K/L, which (W_L/P_C) is the real consumer wage (W) and that P_C/P is a negative function of the terms of trade (since P_C – the consumer price index – includes import prices but excludes export prices) provides (8). This implies that $U_{K/L} > 0$, $U_{TOT} > 0$, and $U_A > 0$.

The stylized model can now be used to describe the main features of simulation closures. We assume that under both closures, G, A, and V are exogenous, depending on each closure and the rest of variables are endogenously determined.

Chapter **4**

Changing Food Consumption Pattern and Demand for Agri-based Industrial Products in China: Implications for Southeast Asia's Agricultural Trade

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CHAPTER 4

Changing Food Consumption Pattern and Demand for Agri-based Industrial Products in China: Implications for Southeast Asia's Agricultural Trade

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1. Introduction

China's economy has experienced remarkable growth since reforms were initiated in 1978 and pushed forward by a number of subsequent policy initiatives. The household responsibility reform that distributed lands to individual households increased farmers' incentives and agricultural productivity by about 50 percent in early 1980s (Lin 1989; Huang and Rozelle 1996; Jin et al. 2002). Other reforms that boosted China's economic growth since the mid-1980s include the development of rural township and village-owned enterprises, measures to provide a better market environment through domestic market reform, fiscal and financial initiatives, the devaluation of the exchange rate, trade liberalization, the expansion of special economic zones to attract foreign direct investment (FDI), reform in state-owned enterprises (SOE), agricultural trade liberalization, and many other policy efforts . As a result, the average annual growth rate of gross domestic product (GDP) between 1979 and 2009 was about 10 percent (NSBC 2010). Real GDP in 2010 was nearly 20 times that in 1978 (figure 1). Per capita GDP in nominal US dollars increased from US$224 in 1978 to US$4,230 in 2010.

Rising income, together with urbanization, population growth, and other dynamics of the economy, has brought about enormous changes in demand and consumption patterns and had significant effects on China's economic structure. Over time, while food expenditure went up, its share in total expenditure fell from 67.7 percent in 1978 to 41 percent in 2009 (food expenditure in rural areas) and from 57.5 percent to 36.5 percent in the same period (food expenditure in urban areas) (NSBC 2010 and 2009). The rising demand for nonfood commodities and services, in turn, formed part of the driving force that stimulated structural changes in the economy. Accompanied by rapid growth in demand for nonfood products, industrial and service sectors expanded faster than agriculture. The share of agriculture in GDP declined from about 40 percent in 1970 to 10 percent in 2009. Share of agriculture in employment also declined from 81 percent to 38 percent in the same period (table 1). Despite the overall increase in demand, export expansion always surpassed import expansion. The percentage of exports to GDP reached 34 percent in 2005 compared to imports, the percentage of which was only 30 percent (table 1). The decrease in imports and exports in 2009 reflects the impact of the global financial crisis.

Within the agricultural sector, considerable structural adjustments have also been observed as a result of changes in the demand and food consumption pattern. The Chinese consumed more meats and fewer food grains (Huang and Bouis 1996; Fan et al. 1997; Gao et al. 2000; Gould and Villarreal 2006). Consequently, the livestock and fishery sectors expanded rapidly. The shares of these two sectors increased from 16 (14+2) percent in 1970 to 44 (34+10) percent in 2009 (table 2). As Chinese consumers have been also increasing their consumption of fruits, vegetables, and edible oils (Gould and Villarreal 2006; Huang et al. 2010), the horticulture sector has also expanded rapidly (NSBC 2010) and soybean imports increased from nearly zero in the late 1990s to more than 50 million tons in 2010. On the other hand, more consumers are choosing food on the basis of quality, safety, and other factors in addition to price, which rapidly boosts increasing demand for food away from home and processed food products (Min et al. 2004; Ma et al. 2006; Wang et al. 2008; Yu and Abler 2009; Bai et al., 2010; Zhang et al. 2010). China's consumer base for nontraditional products (e.g., dairy products and wine) also widened (Fuller, et al. 2006; Ma et al. 2006). China's rapidly growing middle class, which is approximately as large as the total population of the United States, and its changing tastes have created challenges in China's domestic agricultural production but also significant opportunities for food exporters from major trade partners in the world.

While past changes in China's food economy have been wrenching for both China and the rest of world, these changes are expected to continue in the future. In some cases, the rate of these changes is expected to pick up speed. Continued growth, urbanization, and dynamism in China's economy will affect all segments of the economy and all regions of the nation. Because of China's size, continued growth, urbanization, and marketization are likely to have profound impact on the rest of the world. This raises several questions. How has the food consumption pattern changed over time in China? What have been the driving forces of these changes? Will these factors continue to drive food consumption changes in the future? Can China meet the growing demand? What happened in the past and what is likely to happen in the future? What are the implications of China's food economy and Southeast Asia's agricultural trade on the rest of world?

This paper is aimed at providing some answers to these questions. The overall goal of this paper is to identify major changes in China's food consumption pattern and demand for agri-based industrial products and their implications on Southeast Asia's agricultural trade. In order to achieve these goals, this paper has been organized as follows: (1) the second section discusses the changing food consumption patterns and major drivers of demand changes; (2) the third section presents the major drivers of agricultural supply, including domestic production and trade; (3) the fourth section describes a framework used to predict changes in supply and demand and trade and measured the implications on China, Southeast Asia, and the rest of world; and (4) the final section presents the conclusion.

2. Changing Food Consumption Patterns

As income increased, the consumption patterns in China showed significant changes after the mid-1990s. Between 1980 and 1995, per capita income and expenditure more than doubled but the average rural consumer spent about 55 percent to 60 percent of total expenditure on food consumption. This means that the rate of food expenditure increased nearly as fast as that of income (table 3). Similarly, the average urban consumer also spent more than 50 percent of expenditure on food consumption. Changes in the share of food expenditure (i.e., Engle coefficient) were gradual and moderate before 1990s. However, as income and total expenditure doubled after the mid-1990s, the share of food expenditure decreased at a faster rate. By 2009, the shares of food expenditure fell to 41 percent in rural areas and 37 percent in urban areas (last row, table 3).

2.1 Changing food consumption patterns and major driving forces in the past

Food consumption patterns in China have undergone significant changes since the early 1980s (Fan et al. 1995). These changes occurred at the national aggregate level as the urban sector expanded along with the share of the urban population (Huang and Bouis 1996). The changes were also noted in rural and urban areas as income went up and demand factors increased (Huang and Rozelle 1998; Halbrendt et al. 1994). Increasing income, urbanization, and market expansion have been identified as the major driving forces of the changes in China's food consumption patterns (Huang et al. 2010).

At the national aggregate level, the per capita consumption of rice and wheat, the two most important cereals in China, fluctuated wildly over the past three decades. For example, as income increased, the per capita consumption of rice increased from about 80 kg in 1980 to 96.1 kg in 1990 (first row, table 4). However, after reaching its peak in 1990, rice consumption has been on a downward trend. This reflects a negative income elasticity of the demand for rice in recent years. In 2009, the average consumer in China consumed only 72.4 kg of rice, which was about 22 kg less than rice consumption in 1990. There is also a similar change in the consumption pattern for wheat. Per capita consumption of wheat rose in the early 1990s and fell by 22 kg between 1990 and 2009 (second row, table 4).

The trend in the changes in the other food items has been consistent over time. Maize, sweet potato, and other coarse grains, all once important in Chinese diet, recorded a decline in total consumption from 57.7 kg (27.4+8.8+21.5) in 1980 to only 13.1 kg (6.0+2.1+5.0) in 2009 (third and fifth row, table 4). Except for grains, the consumption of other foods such as edible oils, sugar, vegetables, fruits, meat, eggs, milk, and fish increased substantially. Consumption of said foods increased by about 3 times (e.g., potato and sugar) to more than 10 times (e.g., fruits, meat, and milk).

In rural areas, the food consumption pattern has also been changing. The per capita food consumption in these areas increased for all products, except for maize, other coarse grains, and sweet potato (table 5). The decline in the consumption of coarse grains and sweet potato over three decades was already expected as the income elasticities of demand for these commodities were negative. Per capita consumption of rice and wheat earned the highest points (106 kg for rice and 87 kg for wheat) in the early and late 1990s, respectively (table 5). But these have been falling gradually since mid-1990s. The consumption of pork and nonstaple foods also increased rapidly during the 1980s, 1990s, and 2000s. For example, per capita pork consumption in the rural areas was less than 10 kg in 1980 but reached more than 20 kg in early 2000s (table 5).

While the amount of consumption of other meats such as beef, mutton, poultry, and aquatic products was small, the annual growth rate of in the consumption of such meats were much larger than the growth rate in the consumption of pork over the past 23 years. The consumption of horticultural products has also been on the rise. For example, the increase in fruit consumption was dramatic, jumping from less than 3 kg in 1981 to 30 kg in 2009. Our previous studies (Huang and Rozelle 1998; Huang and Bouis 2001) showed that income growth and food market development in rural areas were the key driving forces that underlined these changes in food consumption.

However, there has been a different scenario in cities. In urban areas, per capita grain consumption has been on the decline since the late 1980s (table 6). At the same time, however, the consumption of meats and nonstaple foods has grown rapidly. The most significant increases in demand are in milk, meat, fish, and fruit. Traditionally, the Chinese consume more soymilk than animal milk. In 1980, per capita consumption of milk was less than 5 kg even in urban China (table 6). However, by 2009, per capita consumption of milk reached 50.5 kg. Per capita consumption of pork and poultry reached 40 kg and nearly 18 kg in 2009, respectively—much higher than the consumption of said products in rural areas. Per capita fruit consumption increased by more than five times over the past thirty years, reaching a record high of 109 kg in 2009 (table 6).

As countries across Asia modernized, the behavior of consumers in these countries changed dramatically (Huang and Bouis 2001; Huang and David 1993). Urban dwellers consumed less grain and demanded more meats, milk products, fish, and fruits than their rural counterparts even after the difference in income and prices were accounted for. These behavioral patterns are also clearly evident in the comparison of per capita food consumption between rural and urban areas in China (tables 5 and 6). Tables 5 and 6 show that urbanization could lead to a substantial decline in direct food consumption of grains. But on the other hand, demand for meat (and feed grain) and other nonstaple foods is also likely to rise significantly with the increase in the ratio of the urban population in China's total population.

The ratio of China's urban population to its rural population is changing fast. Urban population, which made up 19 percent of the total population in 1980, increased to 26 percent in 1990, 38 percent in 2000, and 47 percent in 2009 (NSBC 2010 and table 1). The impacts of this population shift on food consumption patterns have been documented (Huang and Bouis 1996 and 2001) and shown in tables 5 and 6.

Modernization through expansion occurred not only in the urban areas but also within the rural sector. One such approach to modernization is the development of the rural food market. Table 7 shows how the development of the food market is related to food consumption in rural China. The development of the food market is proxied by the percentage of food consumed by rural households that is purchased from the rural market. Table 7 shows that the consumption of grains and vegetables, which are largely home-produced commodities, decreased with the development of the food market development while consumption of other foods increased with the expansion of food markets in rural areas.

The food consumption pattern has undergone rapid changes, thanks to increasing food consumption away from home (FAFH). Ma et al. (2006) and Bai et al. (2010) have shown that FAFH accounted for most of the increased consumption in recent years. The results of our recent survey in Beijing also show that FAFH has become an important part of Chinese diet. Figure 2 shows the share of food consumption at home (FAH) and FAFH in Beijing (measured in quantity). In the case of meats, urban consumers in Beijing in 2007 accounted for about 45 percent of total meat consumption through FAFH. Beijing FAFH consumers also accounted for a significant amount of drinks, beans, and fish (figure 2).

2.2 Major driving forces in the future

Despite the global economic crisis, China maintained an annual GDP growth of nearly 10 percent from 2008 to 2010 (NSBC 2011). Moreover, most analysts believe that China will continue to post an annual GDP growth of between 8 and 10 percent between 2011 and 2015 and more than 7 percent between 2016 and 2020. If this happens, the economy of China will grow by two to three times over the coming decade.

The trend in urbanization is expected to continue. An increasing number of people have moved to the cities over the thirty-year period between 1980 and 2010. By 2010, nearly 48 percent of China's population lived in cities, and this percentage is expected to increase even more within the next two years or so. It will come to the point where half of China's population will already be living in cities. By 2020, between 56 and 58 percent of the population is expected to be living in urban areas.

The rise in income and the movement of the nation's population from the countryside to urban areas have resulted in significant changes in China's consumption patterns. These changes are expected to continue with the sustained rise in income and urbanization. Specifically, rising incomes and urban expansion have boosted the demand for meats, fruits, and other nonstaple food items and have had a defining effect on the agricultural economy as producers shifted their production to meet demands. For example, the share of livestock output value rose 2.5 times from 14 percent to 35 percent between 1970 and 2005 (table 2). One of the most significant signs of structural changes in the agricultural sector is that the share of crops in total agricultural output fell from 82 percent in 1970 to almost half of agricultural output value in the late 2000s.

As for the crop sector, the share of the three major crops (rice, wheat, and maize) in total crop areas began to change The share of these three major grains in total crop areas has gradually declined from 57 percent in 1990 to about half by the later 2000s (NSBC 2010). The decrease is mostly attributed to the shrinking number of lands allotted for growing rice and wheat. In contrast, the number of lands for cultivating maize, China's main feed grain, has been on the rise, mainly due to the rapid expansion of the nation's livestock production during the same period. In addition to maize, the number of lands allotted for cash crops such as vegetables and fruits, edible oil, sugar, and tobacco have also expanded.

Interestingly, although the size of China's population makes China (in part) an important player in the international scene, population growth is expected to play an increasingly lesser role in the demand trend. The main reason for this is that population growth rates are falling fast. In recent years, the rate of population growth fell to about half of 1 percent. In the coming years, it is expected to fall further and approach zero by around 2030.

3. Changes in Agricultural Production and Trade

3.1 Agricultural production

Although the demand for food has grown rapidly in the past, China's agriculture has also recorded significant growth in the past three decades. After 1978, decollectivization, price hikes, and the relaxation of domestic trade restrictions on most agricultural products triggered the takeoff of China's food economy and allowed China's producers to meet the shifts in consumer demand (see discussion on this in the previous section). Between 1978 and 1984, grain production increased by 4.7 percent yearly while fruit production rose by 7.2 percent (table 8). The highest annual growth rates (between 1978 and 1984) were posted by cotton, edible oil, livestock, and the aquatic commodity sectors. Growth in these sectors was recorded at 8 percent to 19 percent. Consistent with the changes in demand, growth remained remarkable for all agricultural products, except for grain and cotton, during the period 1985 to 2000. Fishery production experienced the fastest growth among all agricultural commodities from 1985 to 2000, posting annual growth rates of 13.7 percent from 1985 to 1995 and 10.2 percent from 1996 to 2000 (table 8). Although the annual growth rate of the fishery sector fell between 2001 and 2005, it still posted a relatively high growth of 3.6 percent during that time (table 8). The annual growth rates of some agricultural products have declined in recent years but these growth rates are still significant at about 2 percent to 6 percent from 2006—2009. One major exception was soybeans, which posted growth of negative 1 percent because of the surge in the importation of soybeans.

Past studies have already demonstrated that there are a number of factors that simultaneously contributed to the growth in agricultural production during the reform period. The earliest empirical efforts focused on measuring the contribution of the implementation of the household responsibility system (HRS), a policy that gave individual farmers control and income rights in agriculture. These studies concluded that most of the rise in productivity in the early reform years resulted from institutional innovations, particularly the HRS (Fan 1991; Lin 1992). More recent studies show that since the HRS was completed in 1984, technological changes have been the primary engines of agricultural growth (Huang and Rozelle 1996; Fan 1997; Fan and Pardey 1997; Jin et al. 2002). In examining the sources of technological advancements, Jin et al. (2002) empirically demonstrate that the cross-province differences in government-initiated research and development (R&D) projects have had the largest effects on technological improvements. Between 1990 and 2005, investment in R&D nearly tripled. The growth in R&D investment increased further since the mid-2000s. China is the only country in the world where agricultural R&D expenditures as a share of agricultural GDP are increasing.

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Transportation and market infrastructure have also remarkably improved since the early 1990s, and this served to boost farmers' income at the farmgate. Huang and Rozelle (2006) report that China's food markets have become highly integrated since the late 1990s. Not only do integration measures show that prices in one region are highly linked to prices in other regions, the efficiency of moving commodities across the nation has also improved. In fact, when it comes to efficiency in terms of the percentage change in price for every 1,000 km from port (between 4 percent and 7 percent), China's agricultural marketing is comparable with that of the United States'.

Irrigation played a critical role in establishing the highly productive agronomic systems in China (Wang 2000). The number of cultivated areas under irrigation increased from 18 percent in 1952 to a level at which about half of all cultivated land had been irrigated after the early 1990s (NSBC 2001). However, the rising demand for water for domestic and industrial use poses a serious constraint to irrigated agriculture, and increasing water scarcity has become a major challenge to future food security and to the well-being of people, especially in the northern region.

Beginning 2004, China launched a new strategy for development. Instead of taxing farmers and charging them fees for basic services in their homes, the government took a decisive action to eliminate almost all taxes and fees. In addition, the government began to subsidize farmers at increasing rates, handing out CNY 14.52 billion in 2004. In 2009, the amount climbed to CNY 127.45 billion (or US$18.74 billion), which accounted for about 3.6 percent of agricultural GDP. According to a recent study by Huang et al. (2010), most of China's agricultural subsidies were decoupled and therefore cause little market distortion. Therefore, we did not include subsidies in our empirical analysis of the effect of policy on the agricultural supply, demand, or trade in China or the rest of the world.

3.2 Agricultural trade

The structure of China's trade in general and agricultural trade in particular has changed over the past decades. Between 1985 and 2009, trade (both exports and imports) grew dramatically. Specifically, exports of food products during the period increased more than tenfold (table 9). For example, exports of fish products grew by a factor of 66. Exports of fruits and vegetables rose by a factor of 28 (table 9). Total imports from 1985 to 2009 posted a substantial growth, rising by a factor of 25. Imports of some products were also noteworthy. For example, import of oilseeds (mainly soybean) grew by a factor of 175, making China the largest importer of oilseeds in the world. In addition, imports of agricultural fibers also increased, rising by a factor of 5 (which is significant, since it grew from a substantial initial base in 1985).

Agricultural trade significantly improved after the accession of China to the World Trade Organization (WTO). As shown in figure 3, both the growth rates of agricultural imports and exports grew much faster after China's accession to the WTO. The annual growth rate of agricultural exports increased from 3.7 percent for the period 1990 to 2001 to 11.8 percent for the period 2001 to 2009. Meanwhile, the annual growth rate of agricultural imports rose from 2.9 percent to 20.4 percent. As imports grew faster than exports, China's net agricultural trade status changed from surplus to deficit. In 2009, the agricultural deficit was about US$13.6 billion. However, this trade deficit is still small—the volume of agricultural net trade deficit in 2009 was only 0.5 percent of China's total exports.

The agricultural trade between China and Southeast Asia significantly increased after the China and ASEAN Free Trade Agreement (FTA) was signed in 2002. The bilateral agricultural trade grew rapidly from $3.7 billion in 2002 to $13.2 billion in 2009, with an annual growth rate of nearly 20 percent (UNCOMTRADE 2010). However, the highest trade posted was that of China's imports from Southeast Asia (figure 4).[1] The main commodities exported from Southeast Asia to China were palm oil and tropical horticultural products. In 2008, these two commodities accounted for nearly 80 percent of total agricultural exports from Southeast Asia to China (panel A, figure 4). Horticultural commodities and processed food are the two important commodities in China's exports to Southeast Asia, accounting for 45 percent and 41 percent, respectively, in China's total exports to Southeast Asia in 2008 (panel B, figure 4). Although China imports from, and exports to, Southeast Asia large quantities of horticultural commodities, the specific commodities that make up this category are quite different. China mainly exports temperate fruits and vegetables to Southeast Asia and imports tropical fruits and vegetables.

4. Prospects of China's Agriculture and Food Economy in the Coming Decade

4.1 Scenarios and major assumptions

Based on the preceding discussions, this subsection outlines prospects for China's economic growth in the second decade of the twenty-first century. While our prospects are focused on the most likely growth scenario (baseline—average of 8 percent annual growth in 2010—2020), we also formulated an alternative higher-growth scenario (or high-growth scenario where we assume the annual GDP growth rate will increase by 10 percent compared to that under the baseline scenario, which is 8.8 percent) because one of the objectives of this study is to examine the implications of China's rapid economic growth (table 9).

The results of analyses presented in this section are based on the Global Trade Analysis Project (GTAP). GTAP, a well-known multicountry, multisector computable general equilibrium model, is often used for international trade analysis (Hertel 1997). The recursive dynamic method is used to project China's economy and the world economy up to 2020. Such a method has been used for many similar researches (Walmsley et al. 2000; Tongeren et

[1]Free trade agreement (FTA) in agriculture was forged between China and the ASEAN member countries for political and economic reasons. The ASEAN economies had been weakened by the global economic crisis; thus, the process of integration within the regional and global context (Chirathivat 2002; Wang 2002) was started. Meanwhile, the bilateral trade agreement between China and the ASEAN grew much faster than those of other regions. In 2000, ASEAN became China's fifth-biggest trading partner and China became the sixth-largest trade partner of ASEAN. Both sides recognized the great interest and huge potential to enhance bilateral trade (Chirathivat 2002; Yang et al. 2007). Moreover, many national leaders and researchers on both sides believed in the complementarities in agriculture and mutual benefits brought by free trade (Lu 2001; Zhao and Liu 2002). As a result, the FTA in agriculture was signed quickly and implemented earlier than the FTAs for other sectors.

al. 2004; Yang et al. 2010). As the benchmark of the latest GTAP database (version 7) is 2004, three periods (2004—10, 2011—15, and 2016—20) were considered to construct the baseline and various macro assumptions (i.e., growth of GDP, labor supply, population, and capital) were made for different regions. These assumptions were based mainly on information from world development index (WDI), the world labor organization (WLO), outlook of the World Bank (WB) and the International Monetary Fund (IMF), and various other researches (Tongeren et al. 2004; Yang et al. 2010). Moreover, in order to reflect the changes in consumer preference in China, we made calibrated improvements on income elasticities in GTAP based on the econometrically estimated parameters in the Chinese Agricultural Policy Simulation and Projection Model (CAPSiM). The technology improvements (e.g., Total Factor Productivity) in different countries/regions, including China, are calibrated by given GDP growth rates. Such a method has been popularly used by many other similar researches (Tongeren et al. 2004; Yang et al. 2010). The main macro assumptions for different countries/regions during the research period are shown in appendix table 1.

4.2 Major results from the baseline scenario

In the presentation of the simulation results, the first item taken up was the prospects for China's food economy toward 2020 based on the baseline and the high-growth scenarios. The implications of China's rapid economic growth on domestic agriculture and food economy as well as on sustainable economic growth are examined through several key indicators (e.g., production, self-sufficiency, imports, exports, and net exports).

Baseline projections show that self-sufficiency in all land-intensive crops (except rice) will wane, but this will be very moderate for most commodities in the coming decade. This is expected as many land-intensive crops in China have less comparative advantage in the world market.

Under the baseline scenario, the most significant increase in imports will be in oilseeds. Oilseed self-sufficiency will fall further from 54 percent in 2010 to 47 percent by 2020. The increase in the importation of oilseeds will be mainly due to the rising domestic demand for both edible oils and feeds. This is not surprising, given China's experience in soybean importation in the past ten years. After China liberalized its soybean trade by eliminating nearly all its trade distortions (both tariff and nontariff measures), its annual import of soybean surged from virtually zero in the late 1990s to more than 42.5 million metric tons in 2009 (NSBC 2010) and is projected to reach 54.8 million metric tons in 2010.

The production of cotton and other plant-based fibers is also projected to expand over time mainly through productivity growth, but it will also fall behind domestic demand. Fiber imports will rise as a result of gradually falling self-sufficiency levels, just like other crops. Increasing the importation of fibers is required to meet the demand from China's rapidly expanding textile and apparel sector, which has created, and will continue to generate, employment for millions of people from rural areas.

Among cereals, feed grains will take the biggest slice in the imports pie (panel A, figure 5). By 2020, China will import about 14 percent of its coarse grains requirement (mainly maize) to meet increasing demand resulting from the expansion of the domestic livestock sector. Wheat imports will be minimal because per capita demand for wheat is projected to fall in the near future. Rice, the only cereal whose exportation will grow, will remain a net export commodity in the period 2010—20. However, rice exports are projected to be only moderate, accounting for about 1 percent to 2 percent of annual production in the coming years.

Meanwhile, China will export relatively labor-intensive products such as vegetables, fruits, fish, and processed foods. The largest exports will be processed foods (panel B, figure 5). While China may import a large volume of horticultural products, its exports will still exceed its imports.

In a nutshell, China's economic growth and trade liberalization will spur changes in the domestic agricultural structure. China's agriculture will gradually shift from land-intensive sectors with less comparative advantage to labor-intensive sectors with more comparative advantage. While China's self-sufficiency in many commodities will fall with economic growth under a more liberalized trade environment, self-sufficiency in food grains (excluding feed grains) and overall food self-sufficiency will remain high.

4.3 Major results from China's high-GDP growthscenario

The simulations show that a higher growth in China's economy will have moderate impact on the food and agricultural sectors. A higher growth is associated with a lower rate of self-sufficiency in nearly all agricultural and food commodities. An additional 0.8 percent annual growth in the period 2011—20 will generate about one-percentage-point decrease in self-sufficiency for all food commodities (table 11). An additional 1 percent increase in domestic food consumption will mean an increase in the importation of food commodities. However, the rate of domestic demand resulting from additional income growth in the future will be lower than what occurred in the past. Food income elasticities have been falling and will continue to fall with the rapid growth of China's economy.

With higher GDP or income growth, China will further restructure its agricultural and food economy in favor of commodities with a greater comparative advantage. For example, the export shares of land-intensive food and feed crops sectors in the world trade will decline and their import shares will rise (table 12). The high GDP growth scenario reduces the export share of animal products (1.9 percent in high GDP growth scenario compared to 2.2 percent in the baseline) because of their positive income elasticities. As a whole, the net export (or net import) of food and feeds will decline (increase) by about US$3.8 billion compared to the baseline in 2020.

5. Implications for Agriculture Production and Trade in Southeast Asia and the Rest of World

5.1 The baseline

Chinese economy has been increasingly integrated into the world economy since economic reforms were implemented. The integration has occurred in both commodity trade and FDI between China and the rest of the world. This section tackles the future impacts and implications of China's economic growth on Southeast Asia and rest of the world. The discussion will first focus on the implications of China's rapid growth on the economies of Southeast Asia and rest of the world based on our baseline analysis. The discussion will then take on the implications of higher GDP growth scenarios.

The main conclusions on the implications of China's rapid economic growth based on our baseline analysis are that China's growth will provide more opportunities than challenges to the rest of the world and that the world will, in general, gain from China's economic expansion. With regard to food and agriculture, China's economic growth under a more liberalized global economy will help countries with a comparative advantage in land-intensive agricultural products to expand their production and export of agricultural products to the Chinese market. China's economic growth will not affect the world's food security.

Our projection shows that bilateral trade will continue to expand to exploit the comparative advantage of both economies. As shown in figure 6, under baseline, China will continue to maintain its agricultural trade deficit with Southeast Asia if we do not consider processed foods. Rising exports from Southeast Asia will come mainly from tropical fruits and vegetable oils (mainly palm oil). Meanwhile, China's exports of temperate fruits and processed foods to Southeast Asia will expand rapidly.

5.2 The high-growth scenario

Under the high-GDP growth scenario, China will generate greater trade, and nearly all countries or regions will gain from the faster growth of China's economy. The signs and sizes of gains for each region from China's increased growth will depend on the nature of China's economic structure. Countries that are largely complementary to China's economy will gain more from such growth. In contrast, a country with a similar economic structure to China will have difficulty in benefitting directly from this growth. Detailed comparisons of the impact on output, trade, and corresponding welfare due to China's higher economic growth (compared to the baseline) are presented in tables 13 and 14.

Table 13 shows that all regions will gain in terms of food and feed production from China's rapid growth. The net export (or net import) of all agricultural commodities will fall (or rise; figure 7) if there is a 10 percent increase in the annual growth rate of China's GDP (e.g., from 8 percent to 8.8 percent) and if all other factors remain constant. China's net export (or net import) of food and feeds will increase (decline) by about US$3.8 billion in 2020 (not shown in figure 7). China's rising imports will push world prices upward and increase production of foods and feeds in all countries, particularly exporting countries (table 13).

Theagricultural sector in Southeast Asia will also benefit from China's higher economic growth. As shown in figure 8, China's imports of agricultural commodities from Southeast Asia will rise and exports will fall. The net export of agricultural commodities from Southeast Asia will increase by more than US$1 billion in 2020 in a high-growth scenario (compared with the baseline scenario). Increased agricultural exports from Southeast Asia will continue to be dominated by palm oil and tropical fruits.

While higher economic growth in China will generate increased domestic demand for final consumer goods, it will also result in increased export and import of textile and apparel products. The prices of these commodities on the world market are projected to fall accordingly. Consumers in large importing countries or regions (i.e., the United States, European Union, Japan, and Korea) will gain from lower world prices. Production in countries or regions that export manufactured products to China (e.g., Japan and Korea) will rise (table 13). However, countries with the same export structure as China may be hurt by lower prices. This may explain why South Asian countries will experience slightly negative effects from China's higher economic growth.

Our simulations also show that the production structure in other countries will adjust accordingly as China's economic growth accelerates. This is reflected in the differences of production changes across sectors in each region (table 13). Whether a country or region can reap gains from China's economic expansion as discussed in this section will depend on how flexible and efficient their economies are in responding to world market changes triggered by China's economic growth.

Welfare analysis was applied to gain a better understanding of the overall impact of China's rapid economic growth on the rest of the world. Table 6 shows that global welfare will increase by about US$296 billion in 2020 under China's high-growth scenario (compared to the baseline), of which approximately US$254 billion (85.8 percent) occurs in China and nearly US$42 billion in the rest of world (14.2 percent). In terms of GDP, the rest of world (whole world, excluding China) will have additional annual growth of 0.16 percent by 2020 (compared to the baseline). Therefore, rapid economic growth in China is an important engine in world economic development.

Table 14 also shows that nearly all regions, including Southeast Asia, can gain from China's economic expansion. The changes in welfare indicate that regions that are complementary with China will gain more from China's higher economic growth. For example, the social welfare of Australia and New Zealand will increase by US$3 billion (about 1.4 percent), which is higher than those of other countries, and that is because China's robust economy will stimulate increased importation of energy and minerals as well as many agricultural products. Exporting countries will gain from increases in both price and volume associated with China's commodities. This will further expand welfare gains by raising the return of endowments, enhancing efficiency of allocation, etc. South Asian nations are an exception. These countries are major exporters of textiles and apparel. Moreover, manufactured products exported from Asian countries have a high degree of substitutability with those from China. Therefore, these countries will encounter increasing competition from China in the world market in the coming years.

Southeast Asia will largely benefit from China's high economic growth. However, some sectors may have to face certain challenges. As shown in table 13, the production of all industries will increase except for the textile and apparel sector. Compared to baseline, the GDP of Southeast Asia will rise by 0.17 percent in China's high economic growth scenario. Meanwhile, the total social welfare will also gain about US$1 billion in 2020 (table 14).

6. Concluding Remarks

China has become one of the fastest-growing economies in the world since late 1970s. GDP grew at about 10 percent annually over the past thirty years. Over the course of the reform period, both rural and urban incomes increased noticeably. The rapid economic growth has brought about rapid urbanization and market liberalization.

Rising income, urbanization, and market liberalization have significantly changed Chinese diet and consumption patterns. While the demand for cereals and other grain as food has declined in recent years, per capita consumption of vegetables, fruits, edible oil, sugar, meat, milk, and fish in both rural and urban areas has increased steadily as income increased over the past three decades. Urbanization further stimulates the national average consumption of these commodities. Rising demand and changes in food consumption pattern have resulted in significant changes in domestic agricultural production. China's experience shows that the importance of both domestic and external policies in achieving sustainable growth. China's experience also shows that institutional innovation (particularly land tenure), technological changes, market reform, and infrastructure development are critical to meeting its growing demand and the improvement of the nation's food security.

However, despite an almost equal growth of domestic production and consumption, China has shifted from being a net food exporter to being a net food importer in recent years. This study shows that China's agricultural imports will continue to rise with income growth. China is expected to increase imports of land-intensive products (e.g., feeds, cotton, edible oils, sugar, dairy products, etc.), but it will also continue to be a major exporter of labor- and capital-intensive products (e.g., vegetables, fruits, some livestock products, fisheries, and processed foods).

The results from this study provide significant policy implications for many countries and regions (including Southeast Asia) that are currently China's major trade partners or those seeking greater economic and trade relations with China. China's growth will provide more opportunities than challenges for the rest of the world. Overall, the rest of the world will gain from China's economic expansion. However, this general conclusion may not hold true for all countries. China is set to play an increasing role in international trade, which should benefit both developed and developing countries.

For those countries whose economic structures are complementary to China, there will be emerging opportunities offered by China's increasing imports due to its rapid growth and integration into the world economy. On the other hand, countries with similar export structure to China's and are competing for the same export markets will have to put in extra effort to restructure their economies and invest more in domestic infrastructure to lower production and marketing costs.

Southeast Asia has recently emerged as one of China's important trade partners. It has also expected gains from the changes in China's food consumption patterns and China's economic expansion. Bilateral trade between China and Southeast Asia has been increasing rapidly and is expected to continue to rise significantly in future. As for agriculture, while Southeast Asia might not benefit much from China's rising imports of many land-intensive products, the region can gain significantly from China's increased demand for palm oils and tropical horticultural products. Under China's high economic growth scenario, China will provide even more opportunities for Southeast Asian countries to export their products to China.

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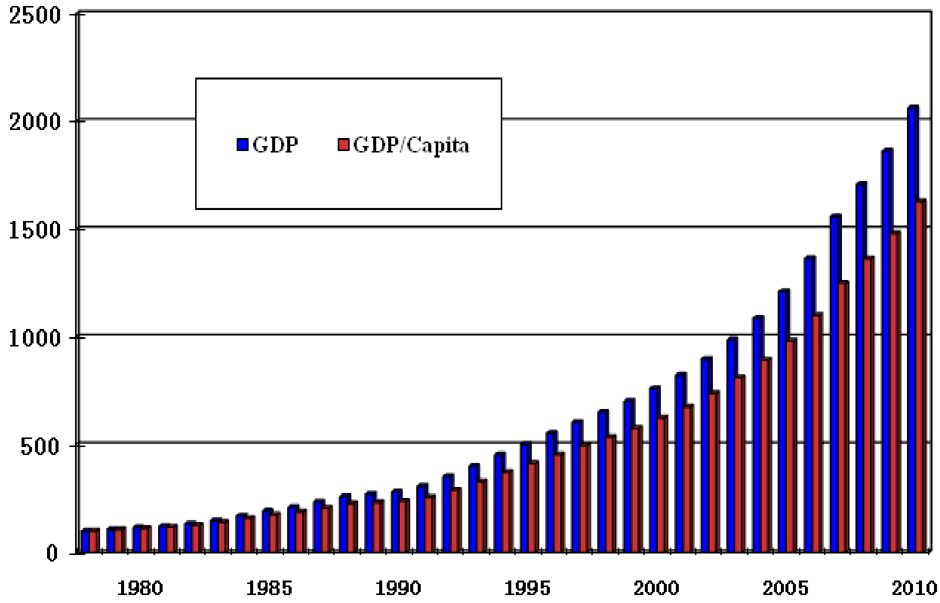
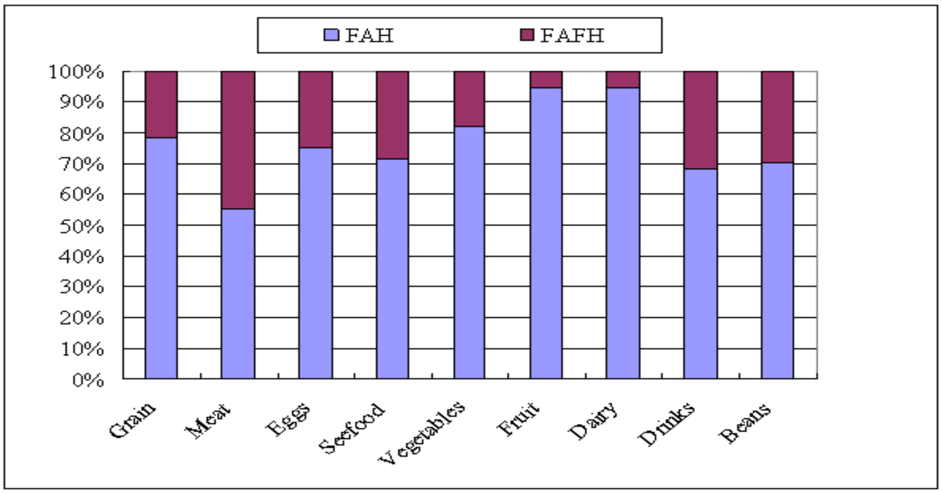
Tables and Figures

Figure 1. Trends of GDP and per capita GDP in China, 1978—2010 (real GDP and per capita GDP in 1978 = 100)



***Source*:** NSBC (2010).

Figure 2. Share (%) of food consumption at home (FAH) and food consumption away from home (FAFH) in Beijing, 2007 (measured in quantity)



***Source*:** CCAP, CCAP's urban consumer survey in Beijing, July 2007.

Figure 3. Agricultural export and import (billion US$), 1983--2009

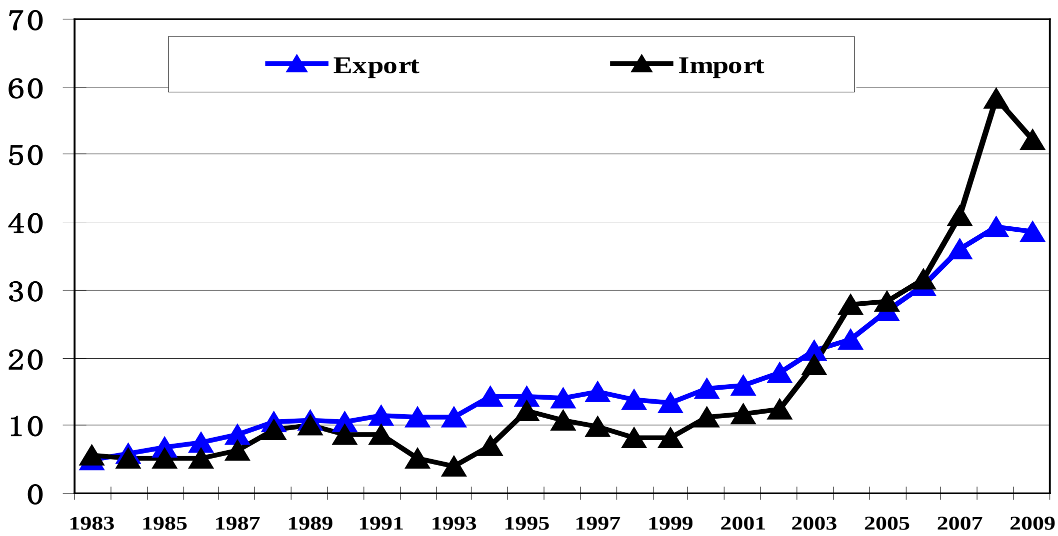
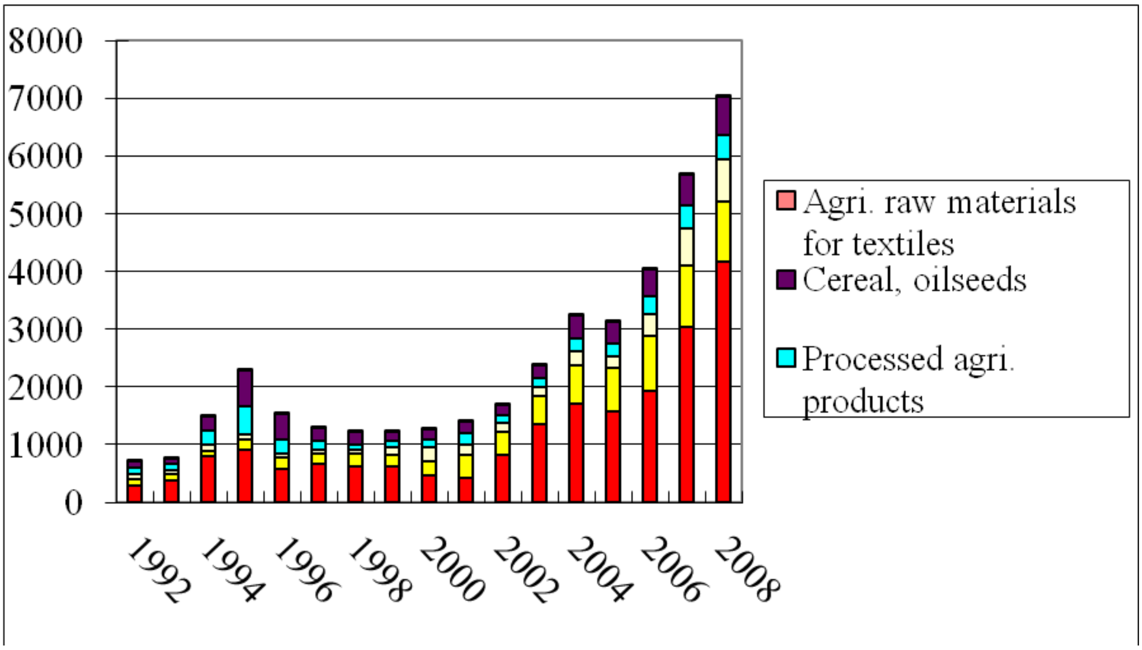
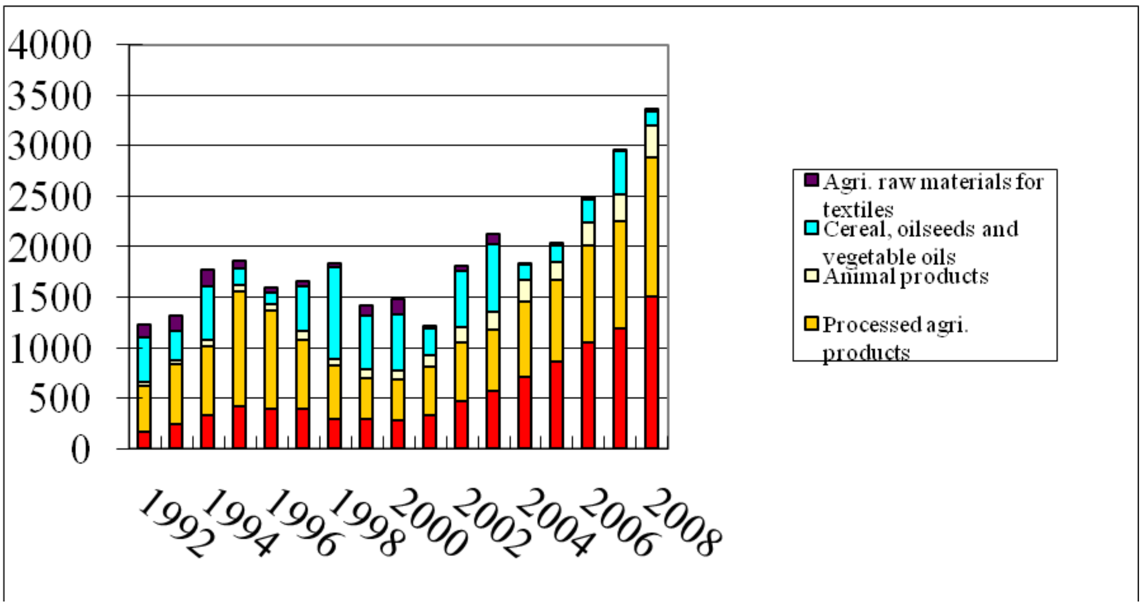


Figure 4. China's agricultural trade (US$ million, in 2000 prices) with Southeast Asia, by commodity, 1992—2008

Panel A: China's imports from Southeast Asia



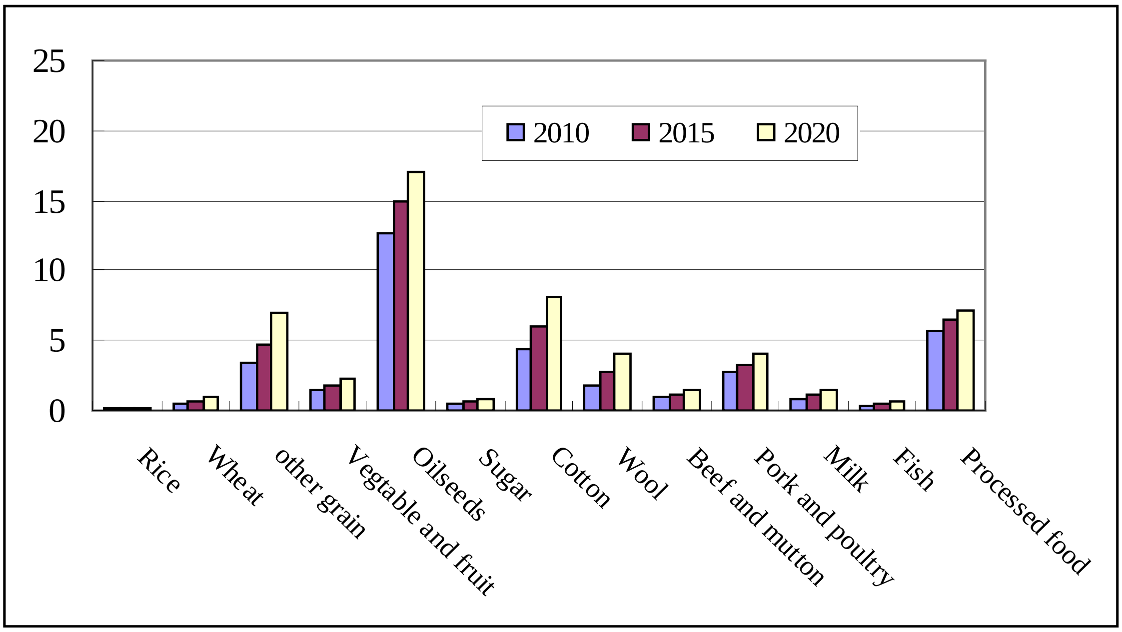
Panel B: China's exports to Southeast Asia



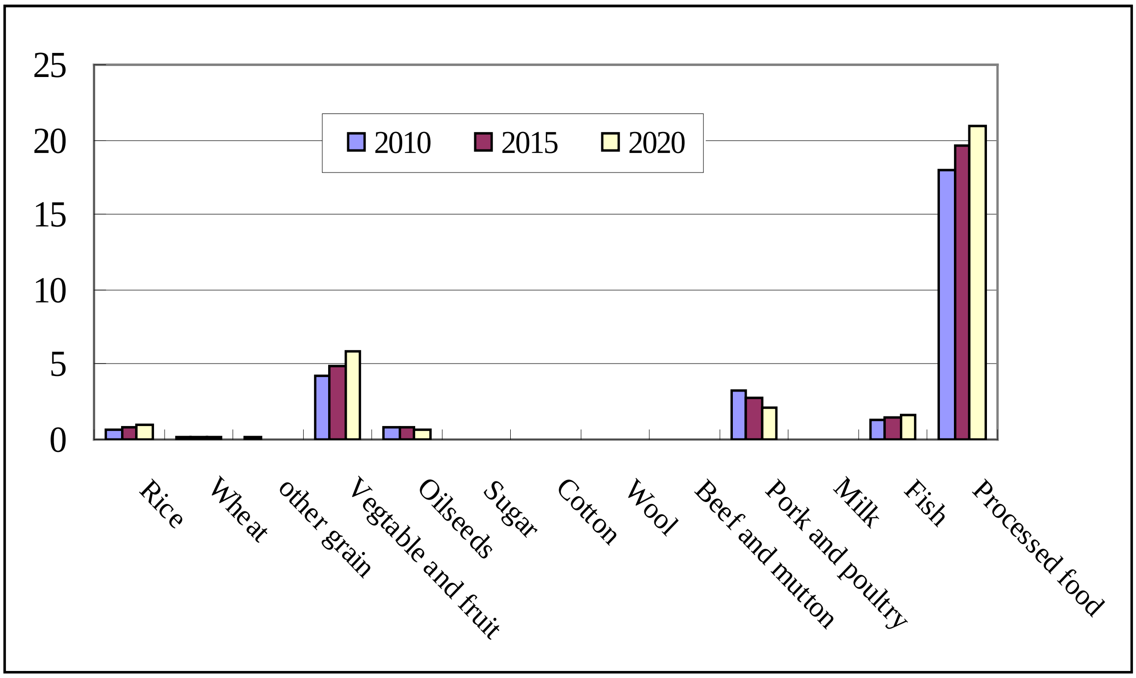
***Source*:** UNCOMTRADE

Figure 5. China's agriculture and food trade (US$ billion) under baseline, 2010—2020

Panel A: Imports



Panel B: Exports



Panel C: Net exports

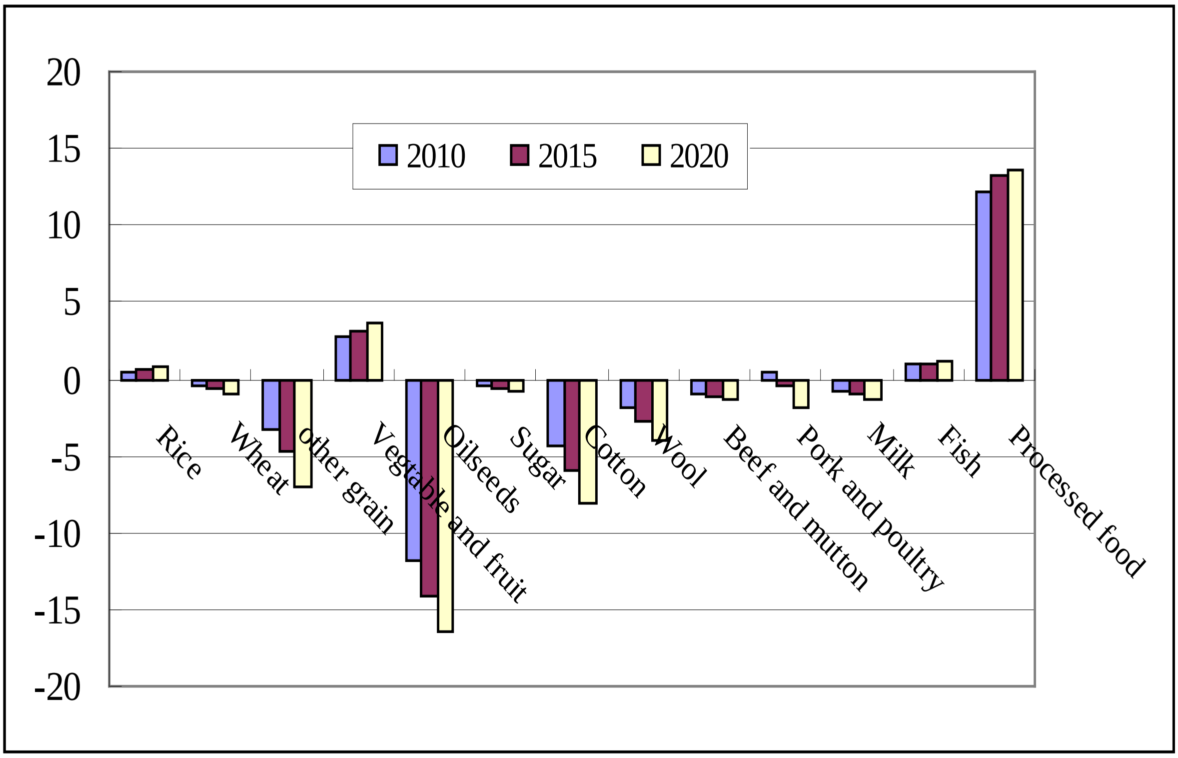
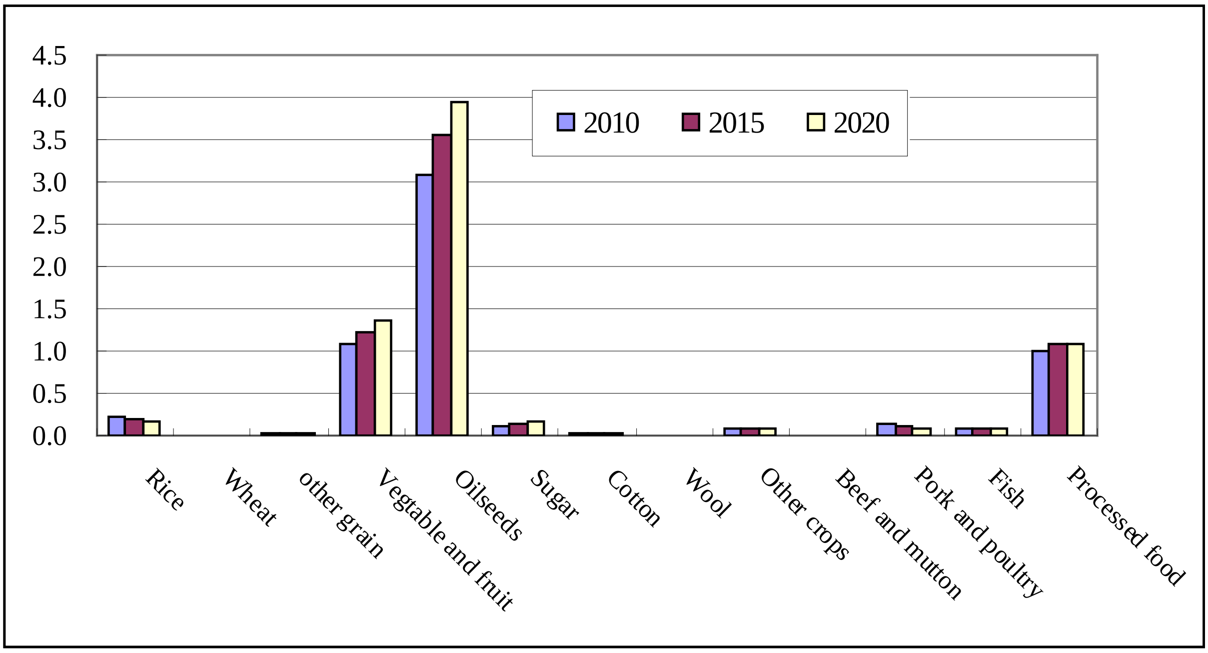
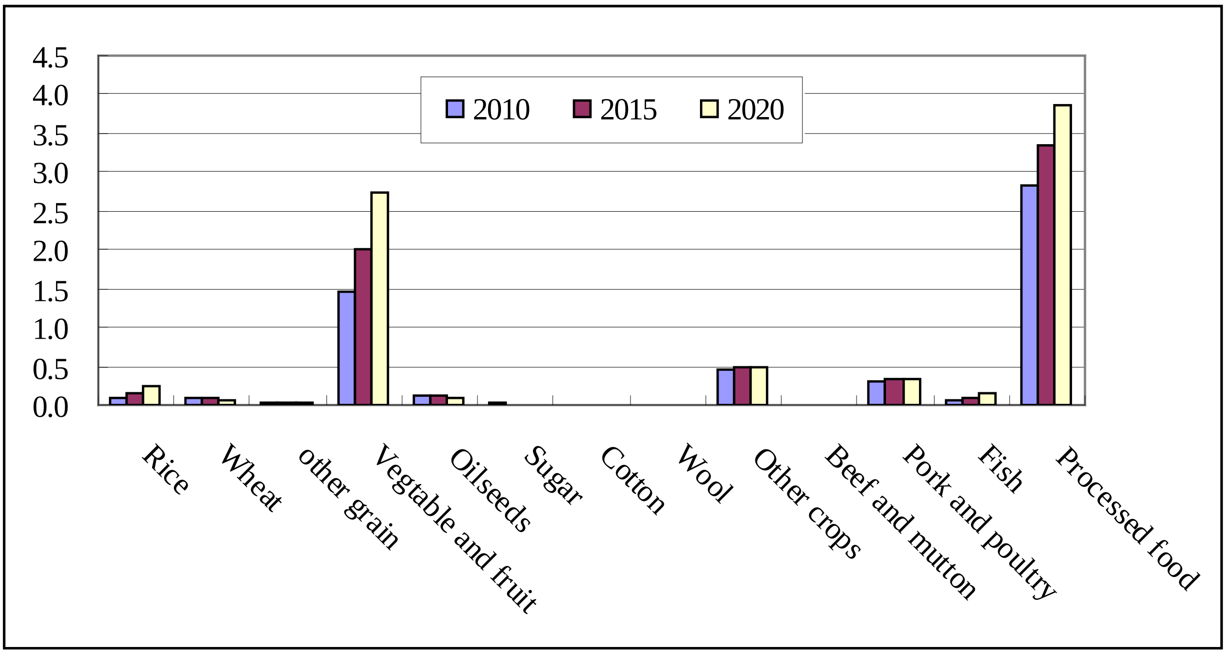


Figure 6. China's agriculture and food trade with Southeast Asia under baseline from 2010—2020, (US$ billion)

Panel A: Imports from Southeast Asia



Panel B: Exports to Southeast Asia



Panel C: Net exports to Southeast Asia

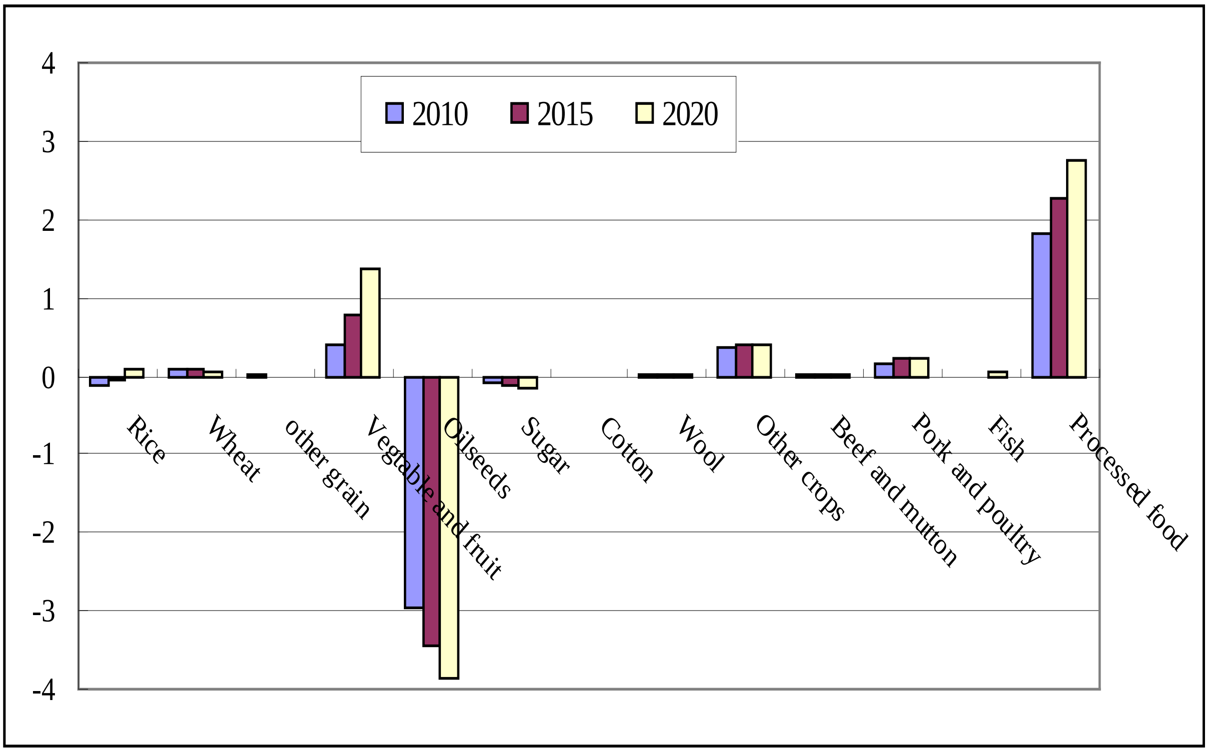


Figure 7. China's net export of agriculture and food under baseline and high GDP growth scenarios in 2020 (US$ billion)

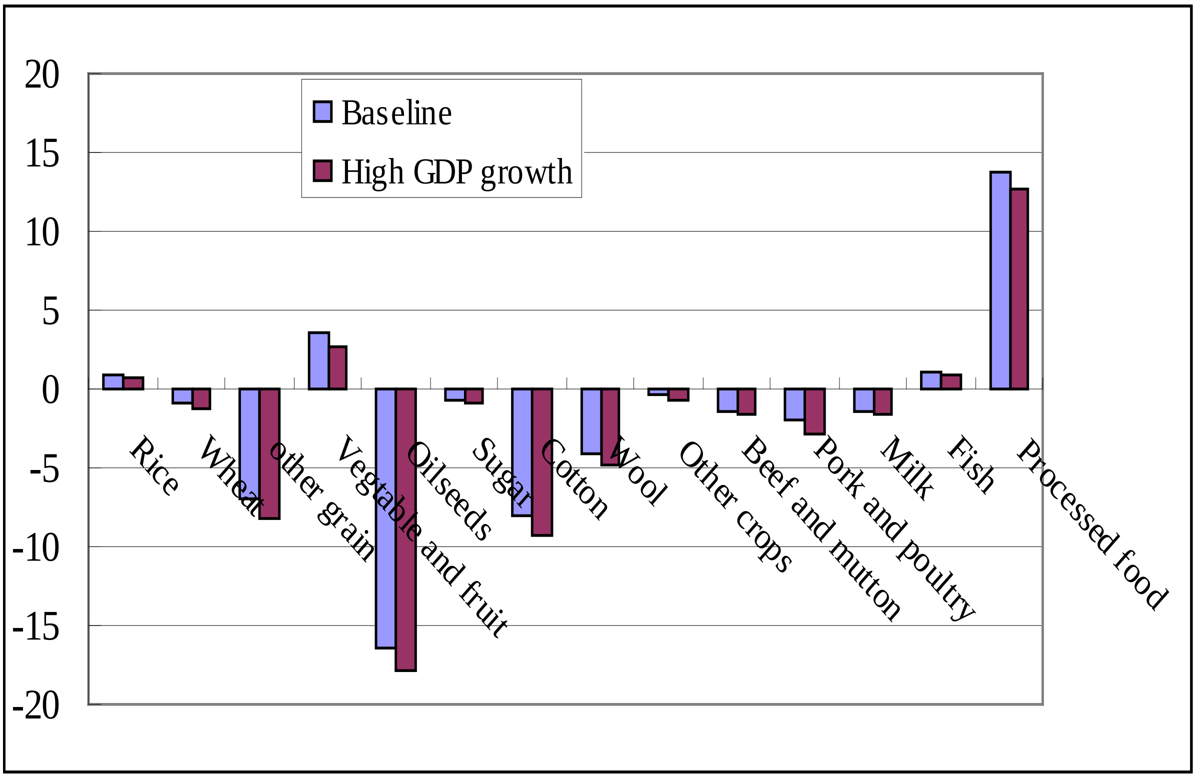
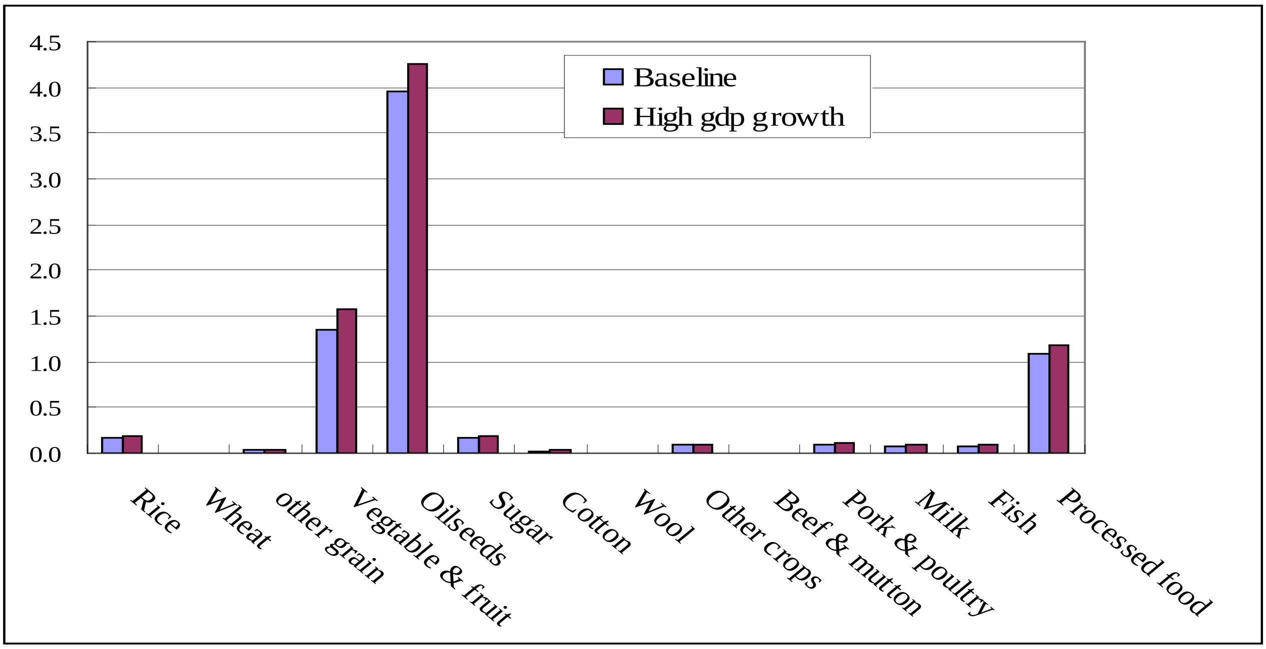


Figure 8. China's agriculture and food trade with Southeast Asia under baseline and high economic growth scenarios in 2020 (US$ billion)

Panel A: Imports from Southeast Asia



Panel B: Export to Southeast Asia

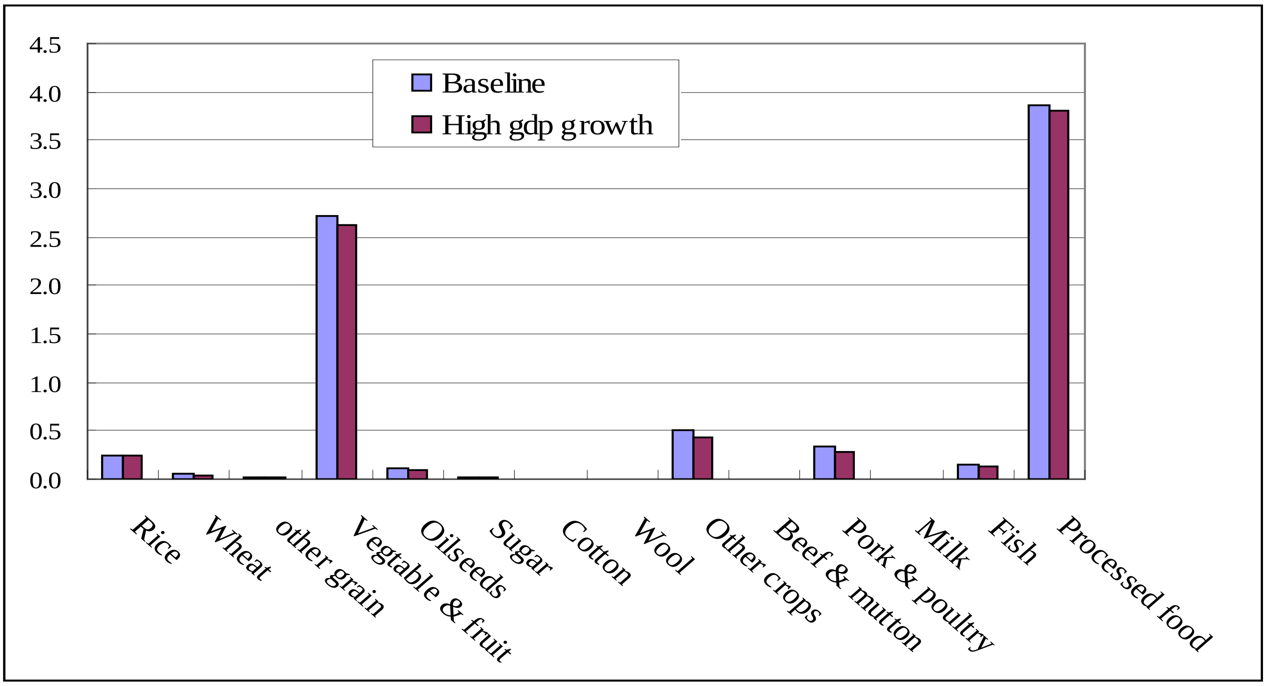


Table 1. Changes in Structure (%) of China's Economy, 1970--2009

	1970	1980	1985	1990	1995	2000	2005	2009
Share in GDP								
Agriculture	40	30	28	27	20	15	12	10.3
Industry	46	49	43	41	47	46	47	46.3
Services	13	21	29	32	33	39	41	43.4
Share in employment								
Agriculture	81	69	62	60	52	50	45	38
Industry	10	18	21	21	23	22	24	28
Services	9	13	17	19	25	28	31	34
Trade to GDP ratio	n/a	12	23	30	40	44	64	44
Export/GDP	n/a	6	9	16	21	23	34	24
Import/GDP	n/a	6	14	14	19	21	30	20
Share of rural population	83	81	76	74	71	64	57	53

Source**:** National Statistical Bureau, China Statistical Yearbook(various issues), and China Rural Statistical Yearbook(various issues)

Note**:** n/a = not applicable

Table 2. Share (%) in Agricultural Output (%) of China's Agricultural Economy, 1970--2009

	1970	1980	1985	1990	1995	2000	2005	2009
Crop	82	76	69	65	58	56	51	53
Livestock	14	18	22	26	30	30	35	34
Fishery	2	2	3	5	8	11	10	10
Forestry	2	4	5	4	3	4	4	5

***Source*:** NSBC, Chinas' Statistical Yearbook(various issues), and China Rural Statistical Yearbook (various issues)

Table 3. Per Capita Income, Expenditure (in real 2009 prices), and Share of Food Consumption in Rural and Urban China, 1980--2009

Year	Income (yuan)		Expenditure (yuan)		Engle coefficient or share of food expenditure (%)	
	Rural	Urban	Rural	Urban	Rural	Urban
1980	883	2436	749	2103	62	57
1981	1007	2490	860	2273	60	57
1982	1195	2613	974	2299	61	59
1983	1350	2702	1082	2421	59	59
1984	1506	3037	1161	2605	59	58
1985	1549	3075	1236	2801	58	53
1986	1556	3503	1311	3107	56	52
1987	1599	3582	1377	3162	56	54
1988	1603	3496	1402	3270	54	51
1989	1484	3500	1321	3085	55	55
1990	1619	3799	1379	3215	59	54
1991	1634	4070	1429	3480	58	54
1992	1727	4466	1452	3684	58	53
1993	1786	4892	1492	4006	58	50
1994	1918	5308	1597	4329	59	50
1995	2109	5567	1752	4598	59	50
1996	2386	5781	1948	4683	56	49
1997	2526	5979	1954	4850	55	47
1998	2639	6324	1941	5050	53	45
1999	2739	6914	1955	5494	53	42
2000	2795	7358	2072	5856	49	39
2001	2912	7982	2143	6177	48	38
2002	3059	9053	2267	7087	46	38
2003	3190	9868	2364	7584	46	37

2004	3408	10624	2536	8099	47	38
2005	3696	11646	2902	8816	46	37
2006	4014	12860	3165	9511	43	36
2007	4395	14427	3422	10462	43	36
2008	4746	15638	3649	11141	44	38
2009	5153	17175	3993	12265	41	37

***Source*:** National Bureau of Statistics of China(various issues)

Table 4. Per Capita Food Consumption (kg/person) in China, 1980--2009

Foods	1980	1985	1990	1995	2000	2005	2009
Rice	79.5	93.5	96.1	93.4	86.4	77.5	72.4
Wheat	50.9	71.2	77.5	74.3	71.2	60.3	56.5
Maize	27.4	14.6	14.8	11.3	8.1	6.2	6.0
Sweet potato	8.8	6.1	3.6	3.1	2.9	2.7	2.1
Other coarse grain	21.5	15.8	12.9	11.3	9.3	7.0	5.0
Potato	2.2	3.0	3.5	5.7	7.0	7.8	7.4
Edible oil	2.0	4.0	5.3	6.7	8.5	10.9	13.7
Sugar	1.6	2.2	2.3	2.4	3.1	4.0	5.2
Vegetables	n/a	n/a	n/a	139.1	157.7	166.6	178.5
Fruits	6.3	10.5	18.4	27.2	45.1	51.0	63.2
Pork	10.8	14.4	16.5	17.5	22.0	29.2	30.5
Beef	0.3	0.6	1.0	1.4	2.1	2.8	3.0
Mutton	0.4	0.6	1.0	0.9	1.4	2.0	2.1
Poultry	1.1	1.8	2.3	4.0	6.5	9.3	12.0
Eggs	1.8	3.6	4.4	6.4	9.3	9.9	12.2
Milk	1.3	2.8	3.6	4.6	7.3	19.4	26.7
Fish	2.0	3.7	5.3	7.1	9.2	13.5	17.5

***Source*:** Database of CAPSiM, CCAP, CAS.

***Note*:** n/a = not applicable

Table 5. Per Capita Food Consumption (kg/person) in Rural China, 1980--2009

Foods	1980	1985	1990	1995	2000	2005	2009
Rice	80.5	100.2	106.5	104.5	100.9	95.6	88.1
Wheat	49.1	75.6	84.2	87.4	87.7	76.3	67.4
Maize	33.1	18.4	19.1	14.7	11.2	9.0	8.5
Sweet potato	10.1	7.3	4.5	3.6	2.8	2.0	1.7
Other coarse grain	25.4	19.6	16.4	14.5	12.8	10.5	7.4
Potato	1.9	2.2	2.8	3.7	4.7	5.1	3.6
Edible oil	1.8	3.3	4.5	5.7	7.4	8.1	10.6
Sugar	1.2	1.8	2	1.9	2.2	2.3	2.6
Vegetables	n/a	n/a	n/a	134.1	155.5	155.0	160.8
Fruits	2.9	3.7	6.8	15.7	24.1	24	30.1
Pork	9.9	12	13	13.9	18.7	23.7	22.5
Beef	0.2	0.4	0.5	0.7	0.9	1.2	1.3
Mutton	0.4	0.4	0.5	0.5	1.0	1.4	1.6
Poultry	0.7	1.1	1.6	2.4	4.1	5.6	7.2
Eggs	1.3	2.3	2.8	3.9	6.0	6.3	8.0
Milk	0.6	0.9	1.8	2.4	3.2	5.1	7.2
Fish	1.5	2.1	3.1	4.2	5.2	6.9	8.3

Source**:** Database of CAPSiM, CCAP, CAS

Note: n/a = not applicable

Table 6. Per Capita Food Consumption (kg/person) in Urban China, 1980--2009

Foods	1980	1985	1990	1995	2000	2005	2009
Rice	74.9	71.8	67.1	65.8	60.1	52.9	53.1
Wheat	58.6	57	58.7	42	41.1	38.6	43.1
Maize	3.3	3.0	2.6	3.0	2.6	2.4	2.4
Sweet potato	3.4	2.1	1.3	1.9	3.0	3.6	2.5
Other coarse grain	5.3	3.4	3.1	3.5	3.0	2.1	2.2
Potato	3.3	5.5	5.5	10.7	11.2	11.4	11.9
Edible oil	2.8	6.6	7.7	9.0	10.5	14.8	17.6
Sugar	3.4	3.4	3.0	3.5	4.6	6.5	8.4
Vegetables	n/a	n/a	n/a	151.3	161.6	182.4	200.1
Fruits	20.2	32.4	50.9	55.6	83.3	87.8	108.8
Pork	14.5	22.2	26.4	26.5	27.9	36.6	40.2
Beef	0.6	1.5	2.5	3.3	4.3	4.9	5.1
Mutton	0.8	1.1	2.4	1.9	2.3	2.7	2.8
Poultry	2.4	3.9	4.4	7.9	10.9	14.2	17.7
Eggs	4.0	8.0	8.8	12.5	15.1	14.9	17.4
Milk	4.5	9	8.8	10.2	14.8	39	50.5
Fish	4.19	8.85	11.31	14.0	16.3	22.4	28.7

***Source*:** Database of CAPSiM, CCAP, CAS

Note: n/a = not applicable

Table 7. Market Development and Per Capita Food Consumption (kg) in Rural China, 1997--2001

	Percentage of food purchased from market (percent)			
Per capita consumption (kg)	<30	30-45	45-60	>60
Grain (unprocessed)	276.2	265.6	249.4	211.3
Edible oils	6.6	6.8	7.0	7.5
Meat	22.3	21.5	23.0	29.0
Aquatic products	1.8	3.1	4.2	8.5
Vegetable	131.0	119.6	111.5	102.2
Sugar	1.2	1.7	2.0	2.3
Fruits	14.5	18.0	22.0	28.6

***Source*:** Huang and Rozelle 1989.

Table 8. The Annual Growth Rates (%) of Agricultural Economy, 1970--2009

	Pre-reform	Reform Period				
	1970--78	1979--84	1985--95	1996--00	2001--05	2006--09
Agricultural GDP	2.7	7.1	4.0	3.4	3.9	4.5
Production						
Grain	2.8	4.7	1.7	-0.7	1.1	2.4
Cotton	-0.4	19.3	-0.3	-1.9	5.3	2.1
Soybean	-2.3	5.2	2.8	2.6	1.4	-1.0
Oil crops	2.1	14.9	4.4	5.6	0.8	1.6
Fruits	6.6	7.2	12.7	8.6	21.0	5.9
Meats	4.4	9.1	8.8	6.5	4.9	2.2
Fishery	5.0	7.9	13.7	10.2	3.6	3.6
Planted area						
Vegetables	2.4	5.4	6.8	6.8	3.1	2.0
Orchards (fruits)	8.1	4.5	10.4	1.5	2.4	2.7

***Sources*:** NSBC 1985--2010 and MOA 1985—2010.

***Note*:** Growth rates are computed using regression method. Growth rates of individual and groups of commodities are based on production data.

Table 9. China's Food, Feed, Fiber, and Nonagriculture Trade, 1985--2009 (US$ million)

	SITC	1985	1990	1995	2000	2005	2009
Exports							
Food and feed		3183	7515	10900	12804	23420	33299
Live animals and meat	00-01	429	1221	1822	1619	2234	2324
Dairy products	02	34	79	75	104	180	215
Fish	03	154	1370	2875	3661	7527	10233
Grains	04	917	614	281	1812	1836	1291
Fruit and vegetable	05	433	1760	3401	3362	7431	12352
Sugar	06	65	318	321	257	502	895
Coffee and tea	07	312	534	512	545	1061	1567
Animal feeds	08	225	758	351	303	497	1784
Other foods	09	62	82	286	608	1182	1903
Oilseeds and vegetable oils	22	552	780	975	533	971	735
Fiber	26	892	1096	753	1085	1186	1544
Nonagriculture		21557	53481	137126	235314	737347	1166804
Imports							
Food and feed		1437	4460	8825	8648	20747	35486
Live animals and meat	00-01	24	68	115	667	691	1820
Dairy products	02	29	81	63	217	461	1041
Fish	03	41	102	609	1217	2904	3653
Grains	04	829	2353	3631	662	1640	1893
Fruit and vegetable	05	16	83	185	516	1349	3131
Sugar	06	262	389	935	177	451	480
Coffee and tea	07	18	30	73	94	222	365
Animal feeds	08	79	305	423	909	1307	1861
Other foods	09	21	46	88	283	354	559
Oilseeds and vegetable oils	22, 04	118	1003	2702	3906	11368	20683
Fiber	26	1023	1975	4108	2846	6854	5590
Nonagriculture		37335	46911	119150	213599	632352	964479
Net export							
Food and feed		1746	3055	2075	4156	2673	-2187
Live animals and meat	00-01	405	1153	1707	952	1543	504
Dairy products	02	5	-2	12	-113	-281	-826
Fish	03	113	1268	2266	2444	4623	6580
Grains	04	88	-1739	-3350	1150	196	-602
Fruit and vegetable	05	417	1677	3216	2846	6082	9221
Sugar	06	-197	-71	-614	80	51	415
Coffee and tea	07	294	504	439	451	839	1202
Animal feeds	08	146	453	-72	-606	-810	-77
Other foods	09	41	36	198	325	828	1344
Oilseeds and vegetable oils	22, 04	434	-223	-1727	-3373	-10397	-19948
Fiber	26	-131	-879	-3355	-1761	-5668	-4046
Nonagriculture		-15778	6570	17976	21714	104996	202325

Source: UNCOMTRADE

Table 10. Past and Projected Annual Growth Rate (%) of China's Economy, 1985--2020

	1985--95	1996--00	2001--05	2006--10	2011--15	2016--20
Baseline						
GDP	9.7	8.2	9.9	11.2	8.0	8.0
Per capita GDP	8.3	7.2	9.1	10.6	7.6	7.6
High growth						
GDP	9.7	8.2	9.9	11.2	8.8	8.8
Per capita GDP	8.3	7.2	9.1	10.6	8.4	8.4

Table 11. Self-Sufficiency Level (%) in Different Scenarios in 2020

	Baseline	High GDP
Rice	102	101
Wheat	95	94
Coarse grains	87	86
Oilseeds	48	46
Sugar	78	77
Fiber	67	65
Horticulture	102	101
Beef and mutton	93	92
Pork and poultry	99	98
Milk	81	80
Fish	102	101
Processed food	106	105

Table 12. China's Trade Shares (%) in the World under Different Scenarios in 2020

	Export share		Import share		Net export share	
	Baseline	High GDP	Baseline	High GDP	Baseline	High GDP
Food + feed crops	2.6	2.3	12.3	13.6	-9.7	-11.3
Processed food	6.7	6.6	2.3	2.5	4.4	4.1
Animal products	2.2	1.9	4.2	4.8	-2.0	-2.9
Fiber	0.1	0.0	32.2	35.4	-32.1	-35.3
Energy/Mineral	0.1	0.1	19.9	22.6	-19.8	-22.5
Textile/apparel	39.8	41.0	6.5	6.7	33.3	34.4
Manufacture	13.1	14.2	9.3	9.7	3.7	4.5
Service	2.8	3.0	5.8	6.0	-3.0	-3.0
TOTAL	11.0	11.7	9.3	9.9	1.7	1.8

Table 13. Percentage Output Changes in Different Regions in 2020 (high GDP growth vis-a-vis baseline)

	Australia + New Zealand	Southeast Asia	Japan + Korea	South Asia	USA	EU	ROW
Food+feed crops	2.4	1.1	0.4	0.5	1.1	0.5	0.9
Processed food	0.5	0.4	0.1	0.8	0.3	0.1	0.4
Animal products	0.8	0.5	0.5	0.2	0.4	0.3	0.6
Fibre	1.9	1.0	0.2	0.8	3.8	1.0	1.9
Energy/mineral	6.4	6.3	7.9	6.1	7.0	6.2	5.8
Textile and Apparel	-1.6	-1.4	-0.9	-0.3	-1.8	-1.0	-1.3
Manufacture	-0.9	0.1	0.1	-0.4	-0.1	0.0	-0.6
Service	0.2	0.0	0.1	-0.8	0.2	0.1	0.3
TOTAL	0.4	0.2	0.2	-0.4	0.2	0.1	0.5

Table 14. Welfare Changes in Different Regions in 2020 (high GDP growth vis-a-vis baseline)

	Aggregate Welfare Effect (EV) US$ billion	Change in Welfare (%)
China	254	10.5
Rest of the World	42	0.3
Australia + New Zealand	3	1.4
Southeast Asia	1	0.3
Japan + Korea	6	0.4
South Asia	-7	-1.2
USA	4	0.1
EU	-5	-0.2
ROW	52	1.1
China	254	10.5
TOTAL	296	1.7

Appendix Table 1. Annual Growth Rates of Different Macro Variables in Different Countries/Regions Under Baseline, 2010--2010 (%)

	GDP	Population	Unskilled labor	Skilled labor	Capital
China	8.0	0.6	3.5	0.3	8.4
Australia + New Zealand	3.4	0.8	-0.4	0.7	4.0
ASEAN	5.4	1.3	3.6	1.2	5.2
Japan + Korea	2.7	0.3	-0.3	-0.6	2.3
South Asia	4.9	1.4	3.5	1.6	5.3
USA	2.7	0.7	-0.4	0.5	2.2
EU27	2.7	0.0	-1.0	-0.1	3.1
ROW	4.3	1.7	2.2	1.8	4.3

***Source*:** Estimated by authors based on researches by Walmsley et al. 2000, Tongeren et al. 2004, and Yang et al. 2010 and other information obtained from the world development index (WDI), world labor organization (WLO), outlook of the World Bank (WB), and the International Monetary Fund (IMF).

Chapter 5

The Impact of Palm Oil Plantations on Indonesia's Rural Economy

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CHAPTER 5

The Impact of Palm Oil Plantations on Indonesia's Rural Economy

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1. Introduction

Background

The word "agriculture" is closely associated with rural economy. The dynamics of rural economies rely on the performance of the agriculture sector. Thus, rural development is equated with growth in the agriculture sector and poverty reduction. The idea that the increase in income per capita would reduce poverty and enhance social development is a narrow concept and focuses only on the economic dimension of development. Nowadays, rural development indicates overall development of rural areas with a view to improving the quality of people's lives in these areas.

Rural development, a comprehensive and multidimensional concept, encompasses several factors: the development of agriculture and allied activities, village and cottage industries and crafts, socioeconomic infrastructure, community services and facilities; raising income levels of families below poverty line; increasing productivity; and development of human resources in rural areas. As a phenomenon, rural development is the end result of interactions between various physical, technological, economic, sociocultural, and institutional factors. As a strategy, it is designed to improve the economic and social well-being of a specific group of people; namely, the rural poor. As a discipline, it is multidisciplinary in nature, representing an intersection of agricultural, social, behavioral, engineering, and management sciences. An assessment of changes in the quality of life, it is broadly defined to include improvement in health and nutrition, education, environmentally safe living conditions, and reduction in gender and income inequalities (Upadhyay 2008).

Before the positive impacts related to agricultural growth are taken up here, the impacts of plantation agriculture are worth discussing because this sector can also cause negative implications. Environmentalists all over the world are concerned about the conversion of forests into plantations, especially for oil palms. In addition, international environmental groups like Greenpeace believe that the palm oil industry serves as a threat to the environment because its operations may endanger many protected species. They also argue that the expansion of the palm oil industry is a recipe for environmental destruction. Thus, many environmentalists are concerned over oil-palm plantations in rainforests. On the upside, oil-palm plantations offer an alternative means of empowering rural people and boosting rural economies. In 2004, 4.5 million people in Indonesia, especially those in the rural areas, relied on palm oil estates: 900,000 people benefitted through direct employment and 3.6 million people, through downstream processing (Sandker et al. 2007).

Between 1980 and 2000, global palm oil production increased by 360 percent to 20.9 million tons. The global demand for palm oil is expected to double in the next 20 to 30 years (Sandker et al. 2007), making oil-palm plantations a promising industry. In Indonesia and Malaysia, oil palm is an industrial plantation crop that can fulfill global demand for palm oil. Data from the Indonesian Ministry of Agriculture show that private companies own half of the total number of oil-palm plantations in Indonesia. The other half is owned by the state (10 percent to 15 percent) and smallholders (35 percent to 40 percent). Smallholders are farmers who own a few hectares of a company-owned plantation. They own oil palms but they mostly still depend on the company for inputs like pesticides and fertilizers, for marketing, and for the processing of palm oil.

On the global scene, Indonesia and Malaysia dominate the production and exportation of palm oil. In 2001, Malaysia and Indonesia accounted for 83 percent of palm oil production and 89 percent of global exports (Brown and Jacobson 2005). At present, these two countries continue to dominate palm oil production and exports. Indonesia, in particular, enjoyed a palm oil export boom during the last two decades. From 2004 to 2008, Indonesia recorded a 56.1 percent increase in palm oil production, from 12.38 million tons in 2004 to 19.33 million tons in 2008. It posted a 60.8 percent increase in palm oil exports in 2008 (14.47 million tons) compared to 2004 (8.99 million tons). This development has implications on the rural economy in particular and rural development in general.

Research Questions and Scope of Study

There are several fundamental questions that this research aimed to answer.

a) How is Indonesia's agricultural performance in terms of output and employment, trade, and sources of growth, including palm oil development?
b) What are the government policies related to palm oil development in Indonesia?
c) What are the ecological, social, and economic impacts of palm oil agriculture in Indonesia?
d) What are the effects of palm oil plantations as a concrete realization of rural development?

The data and empirical facts (figures) gathered from several reports on palm oil development in Indonesia will be used as bases for answering the questions. This paper covers all the research questions mentioned above. The questions were organized into several sections. The first section is a brief summary of Indonesia's agricultural performance, including output and employment, trade, and sources of growth. Then there is an overview of the palm oil development in Indonesia and various government policies, which are divided into several phases—the PIR-trans phase, deregulation phase, privatization phase, cooperatives phase, and decentralization phase. Recent government policies will also be dealt with, focusing especially on the government's ten-year plan and the Indonesian Sustainable Palm Oil (ISPO) certification.

The second section is a review of the impacts of palm oil agriculture in Indonesia. This section examines the ecological, social, and economic impacts of palm oil agriculture.

The third section identifies the effects of oil palm plantations on rural development, including employment and growth performance, basic infrastructure, poverty incidence, and migration.

The final section presents the conclusions and the implications on government policies and programs.

2. Indonesia's Agricultural Performance

Table 1 shows that from 2001 to 2007, the agriculture, livestock, forestry, and fishery (ALFF) sectors recorded the biggest contribution in terms of employment while the electricity, gas, and water (EGW) sector posted the smallest contribution to employment in the same period. This means that from 2001 to 2007, the farm sector, represented by ALFF, was the biggest employer in Indonesia's economy.

The manufacturing industry (MFG), the main component in the secondary sector, was the biggest contributor to total gross domestic product (GDP). Meanwhile, the EGW sector posted the smallest contribution to total GDP. The MFG sector proved to be very productive, with a total share to GDP of 27 percent to 29 percent. The employment share of the ALFF sector ranged from 42 percent to 47 percent. This sector was slightly efficient because it posted only 13 percent to 16 percent of GDP share for the period 2001—2007.

Table 1. Employment and GDP Share by Sector, 2001--2007 (in %)

Years	Agriculture, Livestock, Forestry, and Fishery		Mining and Quarrying		Manufacturing Industry	
	Employment	GDP	Employment	GDP	Employment	GDP
2001	43.77	15.54	0.79	11.68	13.31	27.65
2002	44.34	15.39	0.69	11.29	13.21	27.86
2003	46.26	15.24	0.80	10.63	12.04	28.01
2004	43.33	14.92	1.10	9.66	11.81	28.37
2005	43.97	14.50	0.96	9.44	12.72	28.08
2006	42.05	14.20	0.97	9.10	12.46	27.83
2007	43.67	13.83	1.05	8.73	12.39	27.40
Years	Electricity, Gas and Water		Construction		Trade, Hotels, and Restaurants	
	Employment	GDP	Employment	GDP	Employment	GDP
2001	0.20	0.63	4.23	5.56	19.24	16.20
2002	0.19	0.66	4.66	5.61	19.42	16.16
2003	0.17	0.66	4.52	5.68	18.56	16.26
2004	0.25	0.66	4.84	5.82	20.40	16.37
2005	0.21	0.66	4.86	5.92	19.06	16.77
2006	0.24	0.66	4.92	6.08	20.13	16.92
2007	0.26	0.69	4.51	6.21	19.91	17.26
Years	Transportation and Communication		Financial, Ownership and Business		Services	
	Employment	GDP	Employment	GDP	Employment	GDP
2001	4.90	4.88	1.24	8.56	12.12	9.30
2002	5.10	5.06	1.08	8.74	11.30	9.23
2003	5.48	5.42	1.43	8.90	10.74	9.20
2004	5.85	5.85	1.20	9.12	11.22	9.23
2005	6.02	6.24	1.22	9.21	10.99	9.18
2006	5.93	6.77	1.41	9.21	11.90	9.24
2007	5.72	7.28	1.28	9.35	11.23	9.27

***Source*:** CEIC Asia Database

A comparison between employment and GDP shares between the farm and the nonfarm sectors is presented in table 2. There was a fluctuation in the trend in employment share of the farm sector from 43.77 percent in 2001 to 43.67 percent in 2007. The trend in the employment share of the nonfarm sector also fluctuated from 56.02 percent in 2001 to 56.34 percent in 2007.

Table 2. Employment and GDP Share of Farm and Nonfarm Sectors, 2001--2007 (in %)

Years	Farm Activities/Sector		Non-Farm Activities/Sector	
	Employment	GDP	Employment	GDP
2001	43.77	15.54	56.02	84.46
2002	44.34	15.39	55.66	84.61
2003	46.26	15.24	53.74	84.76
2004	43.33	14.92	56.67	85.08
2005	43.97	14.50	56.03	85.50
2006	42.05	14.20	57.95	85.80
2007	43.67	13.83	56.34	86.17

***Source*:** CEIC Asia Database

Oil Palm Plantations in Indonesia

Indonesia is endowed with plenty of natural resources. Its agriculture sector plays a significant role in GDP. One of the commodities of great value in Indonesia's agriculture sector is palm oil. Oil palm plantations were first introduced in Indonesia in the early 20th century. Today, more than 600 companies have joined the bandwagon, and many plantations have become large-scale enterprises, covering about 7 million to 8 million hectares. Provinces with large-scale oil palm plantations are mostly in Sumatera and Kalimantan, specifically in North Sumatera, South Sumatera, West Sumatera, Bangka Belitung, Jambi, Bengkulu, Lampung, Riau, West Kalimantan, Central Kalimantan, East Kalimantan, South Kalimantan, West Sulawesi, South Sulawesi, Central Sulawesi, and Papua.

Sumatera produces the largest amount of palm oil in Indonesia, with Riau and North Sumatera, in particular, having the distinction of being the largest producers because of the large areas allotted for oil palm plantations in these provinces. Table 3 shows that Riau had around 1.5 million hectares of oil palm plantations in 2005 while North Sumatera had 1.1 million hectares. There are plans to expand the number of lands allotted for oil palm plantations to 20 million hectares within the next few years, starting with some provinces in Kalimantan followed by Papua and some provinces in Sulawesi.

Table 3. Area Planted to Oil Palms in 2005 (in hectares)

Province	**Area in 2005 (ha)**
Sumatera	
Aceh	222,389
North Sumatera	**1,093,033**
West Sumatera	489,000
Riau	**1,486,989**
Jambi	350,000
South Sumatera	416,000
Bangka Belitung	112,762
Bengkulu	81,532
Lampung	145,619

Java	
West Java	3,747
Banten	17,375
Kalimantan	
West Kalimantan	349,101
Central Kalimantan	583,000
South Kalimantan	391,671
East Kalimantan	303,040
Sulawesi	
Central Sulawesi	43,032
South Sulawesi	72,133
Southeast Sulawesi	3,602
Papua	
Papua	40,889
TOTAL	**6,059,441**

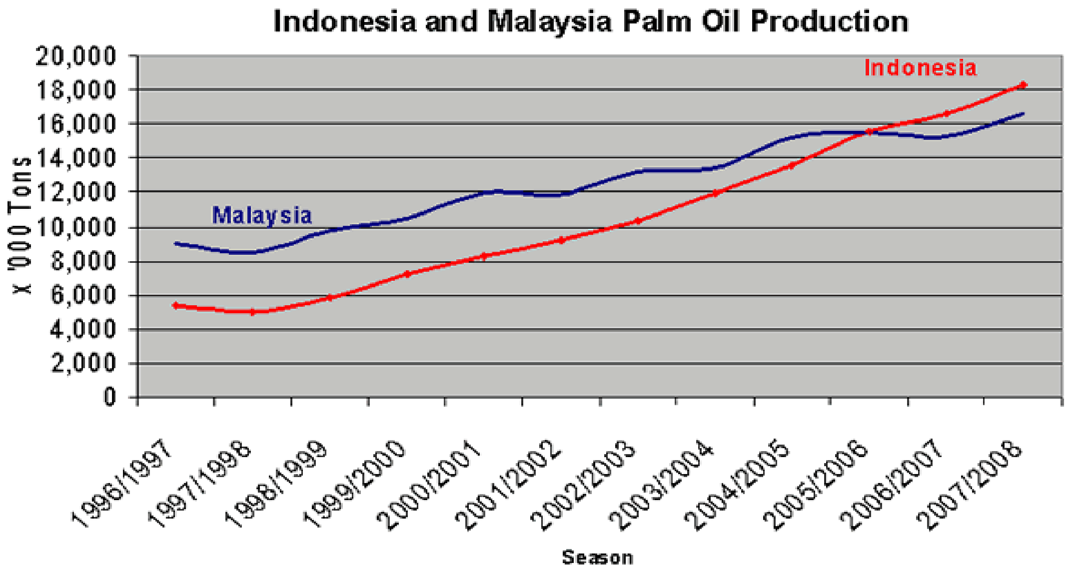
***Source*:** Marcus Colchester et al. *Promised Land* 2006.

The large-scale operation of oil palm plantations in the country has attracted a significant number of investors, both local and foreign. Most of these investors and palm oil companies are exploring the use of palm oil as raw material for biodiesel and as an important food ingredient. Some of the companies that have joined this industry are PT. Astra Agro Lestari Tbk, PT. Bakrie Group, Surya Dumai Group, Cargill, Robert Kuok's Wilmar International Limited, and Sinar Mas, among others.

Indonesia's Palm Oil Production

Compared to agricultural products from Southeast Asia, from other parts of the Asian region, and even from around the world, Indonesia's agricultural products, especially certain commercial products such as palm oil, have a comparative advantage. Since 2005, Indonesia has been in a tight competition with Malaysia in the production and export of palm oil. Other countries that also produce palm oil are Thailand, Colombia, and Nigeria. Figure 1 shows the trend in palm oil production of Indonesia and Malaysia. The graph shows that Indonesia surpassed Malaysia in the production of palm oil since 2005—2006. The substantial increase in palm oil production has also made Indonesia the most significant exporter of palm oil in the world as discussed further in the section "Indonesia's Palm Oil Trade."

Figure 1. Palm oil production, Indonesia vs. Malaysia,1996—2008



Source**:** US Department of Agriculture

Figure 1 also shows Indonesia's progress as a palm oil producer, with palm oil production steadily increasing from season to season. Indonesia produced about 18.3 million tons of palm oil in 2007—2008, which is a good sign because the world's demand for palm oil is expected to remain high and increase even further.

Table 4. Production, Export, and Consumption of Palm Oil in Indonesia, 2004—2008

2004	12.380	8.996	3.347
2005	14.100	10.436	3.546
2006	16.050	12.540	3.711
2007	17.100	12.650	4.105
2008	19.330	14.470	4.430

Source**:** Oil World Database

In Indonesia, around 75 percent of palm oil production is allocated for export; only 10 percent to 15 percent is distributed for domestic consumption. Table 4 shows Indonesia's palm oil exports to be consistently increasing since 2004, from 8.9 million tons in 2004 to 14.4 million tons in 2008. Domestic consumption has also slightly increased, from 3.3 million tons in 2004 to 4.4 million tons in 2008.

The price of palm oil on the world market has been high, especially between 2005 and 2007, but it has not always been on an upward trend. For instance, there was a drop in the international price of palm oil in 2008 because of the global economic crisis, which caused a fall in demand. It was only in 2009 and 2010 that prices started to pick up again, showing a positive trend as the global economy began to recover (see figure 2). Although Indonesia is the largest palm oil producer, global palm oil prices still influence domestic palm oil prices.

Figure 2. Global palm oil prices, 2000—2010 (in US$/metric ton)

***Source*:** www.mongabay.com/images/commodities/charts/palm_oil.html

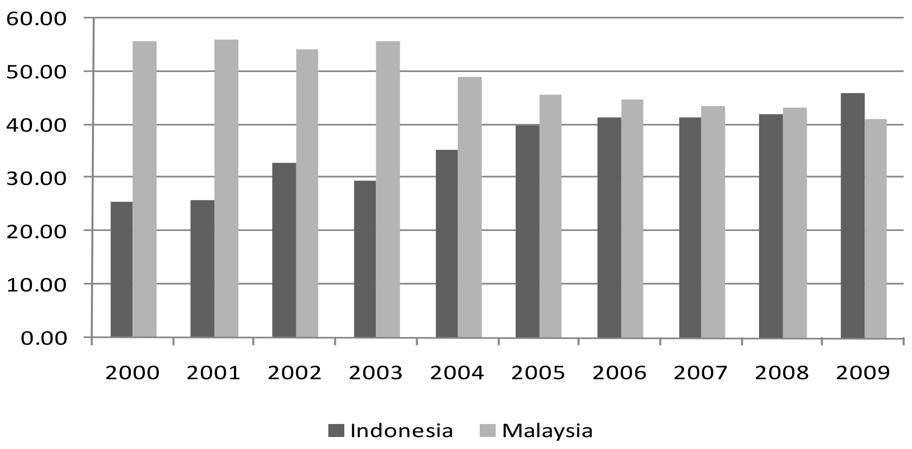
The government introduced two mechanisms to stabilize domestic palm oil prices: domestic market obligations (DMO) and export tax. DMO required high supervision cost and tended to be more difficult to enforce unlike export tax, which was easier to implement. Even though export tax did not have an immediate impact on the stabilization of palm oil prices, it created revenues for the government, which can be used to assist or subsidize poor palm oil farmers and consumers (World Bank 2010).

Indonesia's Palm Oil Trade

In the early years of palm oil production, palm oil was used primarily as an ingredient for food production and for frying. Many consumers preferred palm oil because it is low priced and heart friendly. Palm oil can also be used as raw material for cosmetics and consumer products such as soap, cleaning materials, and shampoo. But because of innovative approaches and technological advancement coupled with research and development (R&D), palm oil can now be used as raw material for biofuel.

The key players in the global palm oil industry are still Indonesia and Malaysia. Both countries are leaders in the production and exportation of palm oil. Malaysia and Indonesia accounted for 83 percent of palm oil production and 89 percent of global palm oil exports in 2001. Until now, these two countries continue to dominate palm oil production and exports, gaining more than 80 percent, especially from trade (see figure 3). From 2004 to 2008, Indonesia recorded a 56.1 percent increase in palm oil production, from 12.38 million tons in 2004 to 19.33 million tons in 2008. Its exports of palm oil increased 60.8 percent from 8.99 million tons in 2004 to 14.47 million tons in 2008.

Figure 3. Indonesia and Malaysia's palm oil market share value in the world, 2000—2009 (in %)



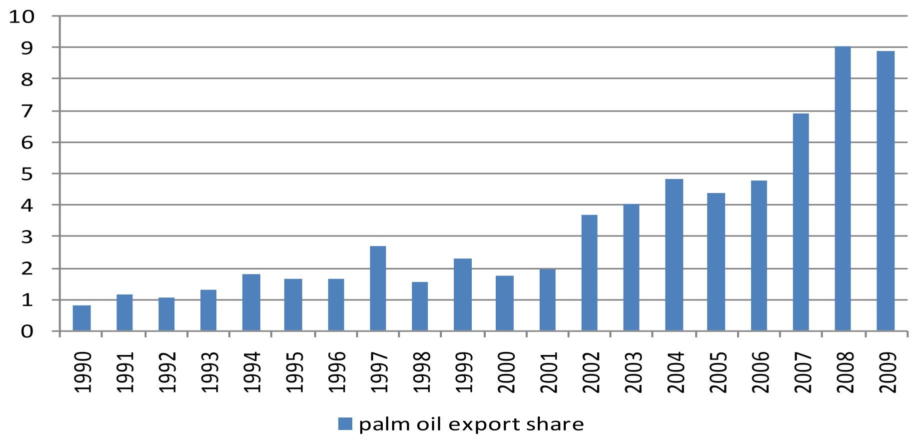
***Source*:** UN Comtrade

Figure 3 shows Indonesia and Malaysia leading palm oil exports globally (in trade value) since 2000, with a total market share of around 80 percent. This trend was further boosted when the Indonesian government focused on the expansion of palm oil plantations in 2005. Indonesia's market share continued to make significant growth, breaking Malaysia's dominance in palm oil exports in 2009. The government's consistent intervention remains a major factor in maintaining this positive trend in palm oil production and export. The government's ten-year program to expand oil palm plantation areas to up to 20 million hectares in 2020 should also be backed by a strong legislative foundation.

Palm oil has become a major commodity and has contributed quite significantly to Indonesia's total exports since 2002 (see figure 4). The highest contribution of palm oil exports to total exports was 9 percent in 2008. The significant increase in palm oil export between 2007 and 2008 was due to the high global demand for palm oil. Indonesia, as one of the largest producers of palm oil, tries to meet the high demand by expanding oil palm plantations. The significant contribution of palm oil exports to total exports will benefit Indonesia's balance of payment (BOP), as current account is expected to become positive with trade surplus. Brisk export activities will consequentially boost economic growth.

However, there are major hurdles to contend with in the planned expansion program for palm oil export. These hurdles include the new rules related to renewable energy (e.g., the European Union's Renewable Energy Directive or EU RED), exchange rates, and the export tax policy implemented by the Indonesian government. In June 2007, export tax was 6.5 percent. In February 2008, the Indonesian government implemented a progressive schedule for export tax, which encouraged producers to increase exports because of the hike in prices for palm oil on the world market (World Bank 2009). If the Indonesian rupiah (IDR) depreciates against the US dollar, it can serve as a trigger for palm oil producers to increase their exports. A depreciated rupiah may also reduce the effectiveness of the export tax in achieving the stabilization of domestic prices of palm oil. However, the government should be more prudent in determining an export taxation scheme for palm oil (10 percent in November 2010, 20 percent in January 2011, and 25 percent in February 2011) in order to increase the volume of palm oil exports.

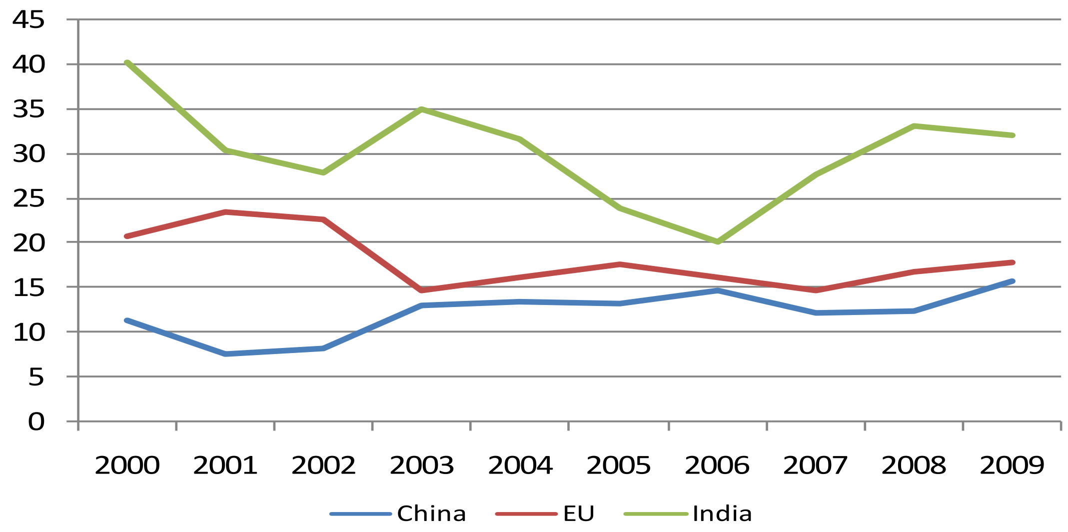
Figure 4. Proportion of Indonesia's palm oil exports to total exports, 1990—2009 (in %)



Source: UN Comtrade

Indonesia's palm oil production is mostly for the global market, and this can generate huge foreign assets for the country. Indonesia's trading partners in palm oil products, India and China, consume huge amounts of vegetable oil. In 2009, China and India imported more than 13 million tons of palm oil; the bulk of this came from Indonesia. Indonesia's other trading partners are some European countries, either members or nonmembers of the EU, that use palm oil as raw material for the production of biodiesel. A portion of Indonesia's palm oil output is intended for domestic consumption. Figure 5 shows the market shares of three of Indonesia's palm oil export destinations. India consistently led as the main importer for the period 2000—2009, followed by the EU and China.

Figure 5. Market share of Indonesia's major palm oil export destinations, 2000—2009 (in %)



Source: UN Comtrade

Government Policies

The palm oil industry is one of Indonesia's strategic industries because it can attract investors, all of whom are seeking high profits and a big return of investment. This makes the industry one of country's engines of economic growth. The prospects for palm oil production are very promising because the huge demand. Palm oil has a wide range of uses-- cooking oil and basic raw material for food products, cosmetics, and soap.

The palm oil industry thus helps boost the economy of Indonesia. It brings in revenues for the state coffers and offers job opportunities. It can also help improve the livelihood of people living around oil palm plantations. However, the development of oil palm plantations has been viewed as a threat to Indonesia's forests since these forests will have to be cleared to make way for said plantations.

Indonesia has rich biodiversity. It covers 1.3 percent of the globe's land surface. Its forests serve as homes for 10 percent of all species of flowering plants, 1.7 percent of bird species, 12 percent of mammalian species, 16 percent of species of reptiles, and 16 percent of amphibian species.

However, the development of the palm oil industry threatens to destroy such rich biodiversity. This calls for solid and effective measures from the government to ensure the protection of biodiversity even as the palm oil industry is further developed. This challenge falls on the eight government institutions that deal directly or indirectly with Indonesia's palm oil industry: the Ministry of Agriculture (MoA) through its Directorate General of Estate Crops (*Dirjen Perkebunan*), the Ministry of Industry (MoI), the Ministry of Trade (MoT), the Ministry of Forestry (MoF), the Ministry of Environment (MoE), the National Land Agency (BPN), the National Bureau of Statistics (BPS), and Indonesia's Investment Coordinating Board (BKPM).

The MoA's supporting agency, the Indonesia Oil Palm Research Institution (IOPRI), is a nonprofit research institution fully funded by the government with business-oriented research areas covering culture techniques, oil processing, engineering, and social economy (Rasiah and Shahrin 2006). IOPRI aims to increase value added and product development through R&D. IOPRI said that it has collaborated with numerous domestic and international institutions on projects related to oil palm research. The MoF, the MoE, and the BPN deal with forest conversion, land uses for oil palm plantations, the ecological impact of oil palm plantations, and other issues related to land property rights, the environment, and forests. BKPM deals mostly with investment facilitation for both local and foreign investors. The MoT and the MoI focus on marketing policies while the BPS provides the necessary data on palm oil (Rasiah and Shahrin 2006).

Besides government institutions, there are also associations that deal with the palm oil industry; namely, the Indonesian Oil Palm Producers Association (*Gabungan Pengusaha Kelapa Sawit Indonesia* or GAPKI) and the Indonesian Edible Oil Association (*Asosiasi Minyak Makan Indonesia* or AIMMI). GAPKI represents state-owned, private estates, cooperatives, and smallholders. AIMMI, on the other hand, represents palm and other edible-oil producers and exporters (Rasiah and Shahrin 2006).

Government policies on palm oil development in Indonesia can be divided into five phases of regulation: PIR-trans phase, deregulation phase, privatization phase, cooperatives phase, and decentralization phase.

PIR-trans Phase (Up to October 1993)

The PIR-trans phase took place during Soeharto's era (before October 1993) with the aim of establishing oil palm plantations in forested areas and allocating these areas to PTPN (*Perseroan Terbatas Perkebunan Nusantara* or state-owned plantation companies). As operators of the plantations, the PTPN controlled both *inti* (large-scale operations in extensive areas) and *plasma* (individual smallholdings) holdings (Colchester et al. 2006). This program was supported by smallholders and workers from the transmigration program. This policy aimed to increase the total land area for oil palm plantations. The total area for oil palm plantations increased from 65,573 hectares in 1967 to 176,406 hectares in 1975. At that time, oil palm plantations were located mostly in Sumatera. In 1985, there was a threefold increase in the total area for oil palm plantations (compared to 1975), or up to 600,000 hectares. Areas of expansion were concentrated in Kalimantan and Papua.

The expansion of land areas for oil palm plantations continued in the succeeding years, aided by the implementation of laws designed to (1) ensure better coordination among government agencies and (2) hasten the processing of permits to convert forest lands into oil palm plantations. The law that facilitated those two objectives was passed in 1986 and further amended in 1990. The supervision of forests in the PIR-trans phase was centralized, with regional forestry offices (*Kanwil Kehutanan*) authorized to release up to 100 hectares of land for plantation use. This condition is related to Presidential Instruction (Inpres) No. 1/1986 and a joint decree among the MoA, the MoF, and the *Badan Pertanahan Nasional* (BPN) No. 364/Kpts-II/1990.

During this period, the customary land rights of communities were mostly not recognized. Protection for the right to property was provided by a law on agrarian and natural resources management, as mentioned in articles 28H and 28I (*Undang-Undang Dasar (UUD)* 1945). Article 28H (which focuses specifically on human rights) of said law states that every person has the right to own property and that this property cannot be taken from any person by anybody. Article 28I, on the other hand, states that the cultural identity and the rights of traditional societies shall be respected in accordance with this age of progress and human civilization.

The interests of indigenous peoples (IPs) were also inserted into the transmigration schemes for economic purposes. The PIR-trans schemes allocated two hectares to each transmigrant family. One hectare should be planted to rice. The other should be developed as an oil palm plantation whose output would go to the mills that were established alongside the nucleus estate. The PIR-trans scheme promoted the growth of smallholdings and encouraged the growth of oil palm smallholdings in particular as a vehicle for rural development (Rasiah and Shahrin 2006).

Deregulation Phase (1993—1996)

During the deregulation phase, which was started in October 1993, the government passed two laws as part of a national deregulation policy package: (1) MoA decree number 753/Kpts/KB.550/12/1993 and (2) MoF decree number 418/Kpts-II/1993. The main objective of the deregulation policy was to empower local governors to promote regional development and to ensure that private companies had a long-term commitment in areas they were investing in.

Under those two laws, the local government (through its governor) could issue permits for the conversion of forest areas up to 200 hectares, a 100 percent increase (equivalent to 100 hectares) on what was allowed before the passage of said laws. Meanwhile, areas over 200 hectares were still under the jurisdiction of the Directorate General of Estate Crops in Jakarta. Private companies that applied for forest-conversion permits were not allowed to transfer ownership of leaseholds (Colchester et al. 2006).

Still in this phase, the implementation of private sector development and the joint government scheme was maintained in order to promote the growth of smallholdings, which was first introduced in the PIR-trans phase.

Privatization Phase (1996—1998)

The privatization phase took place between 1996 and 1999, the last years of Soeharto's dictatorial era. The government policy during this phase aimed to encourage private sector initiatives and to facilitate foreign direct investment (FDI). Several laws passed during this phase were designed to accelerate estate-crop development and ensure fair play among companies (Colchester et al. 2006).

MoA decree number 786/10.96 provided for a clear-cut permit procedure for developing estates. A temporary, one-year start-up permit (*ijin prinsip*) could be extended for an additional two years. *Ijin prinsip* could be converted to a permanent permit (*ijin tetap*) and added as an expansion permit (*ijin perluasan*). Requirements of permits were introduced to ensure that companies that wanted to convert forests into oil palm plantations would first secure the consent of any logging companies with logging permits (*Hak Pengelolaan Hutan* or HPH) that operated in the same areas (MoF decree number 250/Kpts-II/1996).

The new laws also clarified that forest lands cleared and planted to estate crops were classified in Provincial Spatial Plans as agricultural lands without attaching plantation permits (MoF decree number 376/Kpts-II/1998). This resulted to the expansion of oil palm plantations. A total of 9.13 million hectares of land were allocated for oil palm plantations in the eastern part of Indonesia, including 5.56 million hectares in Papua, 1.70 million hectares in East Kalimantan, and 1.8 million hectares in Maluku.

Cooperatives Phase (1998—2002)

The cooperatives phase was a result of the fall of Soeharto's regime, specifically during the *reformasi* era. During this phase, politicians were allowed to come up with new ideas to develop rural areas in order to gain temporary power. They used jargon like *wong cilik*, and *ekonomi kerakyatan* in order to earn support from society. This policy allowed local communities to benefit more directly from lands and natural resources.

In the last period of the cooperative phase, specifically in 2002, the government started to introduce the KKPA scheme, which was a form of investment in which the government supported private sector and cooperative investments. In this scheme, potential investors from the private sector were required to form a partnership with a cooperative. The cooperative itself consisted of a group of smallholders that had realized economies of scale. The KKPA was quite successful in expanding the oil palm plantations in Indonesia. The increase was more than tenfold, from about 210,000 hectares in 1980 to 2.42 million hectares in 2002 (Rasiah and Shahrin 2006).

Also during this phase, the government prohibited the conversion of forests in protected areas (*hutan lindung*) into oil palm plantations and harmonized local and regional spatial planning procedures, as mentioned in the MoF and Estate Crops (EC) decree number 728/Kpts-II/1998. One year later, with MoF and EC decree number 107/Kpts-II/1999, the government allowed the issuance of three-year plantation permits (*ijin usaha perkebunan*) by provincial governors to cooperatives for areas of up to 1,000 hectares, or up to 20,000 hectares by the MoF and EC (Colchester et al. 2006). From 1998 to 2002, the expansion of oil palm plantations was sluggish because of conflicts related to land conversion.

Decentralization Phase (2002—2006)

Finally, the decentralization phase was introduced after fundamental political changes were implemented in Indonesia. During this phase, local government was authorized to control lands and resources. It was also entrusted to administer regional budgets along with local legislature. The decentralization phase has had an impact on the development of oil palm plantations since 2002 because the power of the local government to encourage medium-scale plantations was limited.

During this phase, a new law allowed district-level regents (*bupati)* to issue permits for up to 1,000 hectares. Meanwhile, areas with overlapping district boundaries remained under the jurisdiction of provincial governors. Furthermore, the authority to issue permits for the development of more than 1,000 hectares was entrusted to the MoA. The consequence of this policy was that a lot of protected forests were cleared for oil palm plantations even though vast areas of degraded lands were available for planting.

In 2005, the government passed a law establishing a moratorium on forest conversion for estate crops as stated in MoF decree number 603/2000, MoA decree number 357/Kpts/HK.350/5/2002, and MoF circular letter number S.112/Menhut-VIII/2005. This moratorium resulted in a signed letter of intent (LOI) between the government of Indonesia and the International Monetary Fund (IMF) about forest conversion and changing the status of forest lands for planting. In February 2005, the MoF also released two conflicting policies to be implemented by the local governments. One policy stated that the moratorium was still in effect while the other stated that to optimize the use of forest land for estate crops, the MoF would evaluate proposals for conversion based on their merits (Colchester et al. 2006). Those policies resulted in the establishment of 1.8 million hectares of oil palm plantations in Kalimantan, as written in MoF circular letters S.51/2005 and S.52/2005.

Recent Government Policies

Under the government of President Susilo Bambang Yudhoyono (SBY) and especially in the second period (2009—2014) of his leadership, the expansion of oil palm plantation areas was based on the Medium-Term National Development Plan (RPJMN 2010—2014). The national government has already planned for the further expansion of oil palm estates as shown in table 4. Table 5 shows the extent of expansion in Sumatera, Kalimantan, Sulawesi, and Papua, which is expected to reach a total of 19,840,000 hectares by 2020. This expansion plan has become a signal for Indonesia to encourage export-oriented policies, which are expected to increase competitiveness and attain economies of scale as well as technical efficiencies.

Table 5. Provincial Government Plan on Expansion of Oil Palm Plantations

Province	Area in 2005 (ha)	Expansion Area Plan by 2020 (ha)
Sumatera		
Aceh	222,389	340,000
North Sumatera	1,093,033	1,000,000
West Sumatera	489,000	500,000
Riau	1,486,989	3,000,000
Jambi	350,000	1,000,000
South Sumatera	416,000	1,000,000
Bangka Belitung	112,762	-
Bengkulu	81,532	-
Lampung	145,619	500,000
Java		

West Java	3,747	-
Banten	17,375	-
Kalimantan		
West Kalimantan	349,101	5,000,000
Central Kalimantan	583,000	1,000,000
South Kalimantan	391,671	500,000
East Kalimantan	303,040	1,000,000
Sulawesi		
Central Sulawesi	43,032	500,000
South Sulawesi	72,133	500,000
Southeast Sulawesi	3,602	500,000
Papua		
Papua	40,889	3,000,000
TOTAL	**6,059,441**	**19,840,000**

Source**:** Marcus Colchester et al. *Promised Land* 2006.

The national government's ten-year plan only allocates land already used for agricultural purposes. It does not particularly allocate forests for future production. The expansion plan is also considered for several provinces in Indonesia like Jambi, West Sumatera, and West Kalimantan, which have the most suitable land for oil palm plantations. The plan is also aimed at promoting growth and establishing an industrial area cluster program for palm oil in order to achieve economies of scale.

Besides opening a new area for oil palm plantations, the plan allows the national government to provide monetary incentives to palm oil businesses, especially those situated in the economic zones in North Sumatera (Sei Mangke and Kuala Tanjung), Riau (Kuala Eno and Dumai), and East Kalimantan (Maloy). Furthermore, the ten-year plan also focuses on the development of biofuel based on crude palm oil (CPO), the revitalization of oil palm plantations, and refining and downstream processing.

To address the deforestation issue, the global palm oil industry started the promotion of green certification through the Roundtable for Sustainable Palm Oil (RSPO) in 2004. The RSPO was formed to develop ethical practices and elicit commitments from stakeholders in preserving rainforests and wildlife. There are currently seventy-five Indonesian companies involved in palm oil production that already signed up with the RSPO; a significant number of companies have yet to sign up. The RSPO comes in useful when applying for bank loans; banks use the RSPO in determining the approval of loan applications. Companies that are already signed up with the RSPO have easy access to banks. RSPO is also a good measure to create a cohesive network among private firms and the government in terms of policy formulation, R&D, and other things related to the development of the palm oil industry.

As another response to the issue of forest destruction, the national government also plans to introduce another certification scheme called the Indonesian Sustainable Palm Oil (ISPO) certification. This certification will be awarded to producers who can meet sustainability standards at all stages, starting from processing up to production. However, some areas in the ISPO need to be clarified, especially about the body that will be authorized to award the certification and the standards/requirements that should be achieved in order to earn the certification.

Table 6. Estate Production, 2005—2008 (in tons)

Crop	**2005**	**2006**	**2007**	**2008**
Dry rubber	432,221	554,634	578,486	613,487
Crude palm oil	10,119,061	10,961,756	11,437,986	11,623,822
Palm kernel	2,139,652	2,363,147	2,593,198	2,646,577
Cocoa	55,127	67,200	68,600	71,300
Coffee	24,809	28,900	24,100	25,600
Tea	128,154	115,436	116,501	114,861
Cinchona bark	825	800	500	500
Cane sugar	2,241,742	2,307,000	2,623,800	2,800,900
Tobacco	4,003	4,200	3,100	3,200

***Source*:** BPS

Under SBY’s government, palm oil has become a more promising industry as global demand for it increases, brought about largely by the increasing applications for it. As shown in table 6, crude palm oil led other commodities in terms of output from 2005 to 2008.

3. Economic, Social, and Ecological Impacts of Indonesia’s Palm Oil

Palm oil is a component of many things used or consumed on a daily basis, from food to cleaning materials. The burgeoning world population and the various activities of that population have triggered the soaring demand for palm oil. To some extent, the increasing demand for palm oil has social implications. It has, for example, caused a shift in human activities and land uses. Oil palm plantations are concentrated in tropical areas, specifically, in rainforests. This has created problems because forests are a vital organ of the earth. They do not only produce oxygen for all living things but are also an integral part of a healthy ecosystem. This reality gives palm oil economic, social and ecological importance. The impacts resulting from the conversion of forests into oil palm plantations are keenly felt in Indonesia. As a tropical country, Indonesia has a large share in global palm oil production. This section will give a brief inquiry into the economic, social, and ecological impacts of oil palm plantations in Indonesia.

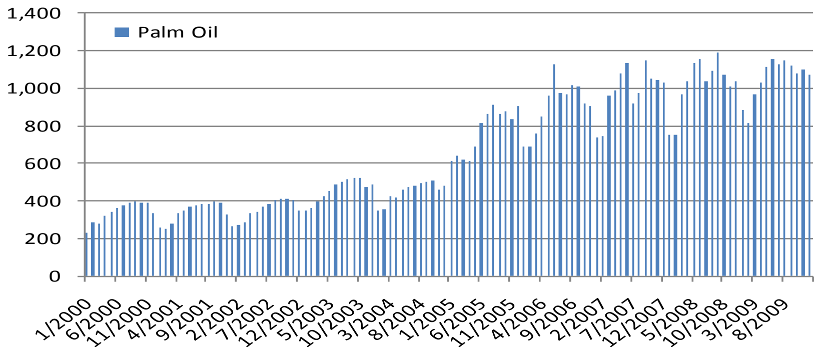
Economic Impact

Palm tree is a tropical tree. Naturally, palm plantations can only be established in tropical countries. This is an opportunity for Indonesia. As one of the largest tropical countries in the world, Indonesia can reap great benefits from oil palm plantations. There has been a massive expansion of oil palm plantations from 1967 up to the present time. Although oil palm estates suffered some setbacks because of the global economic crisis, the overall progress still showed a positive trend. Toward the end of 1970, the total area devoted to oil palm plantations was 260,000 hectares. This increased to 7,020,000 hectares in 2008. But the most notable development was that oil palm plantations are now spread out over 22 provinces across Indonesia.

Indonesia has become the largest player in the world in terms of palm tree cultivation, maintaining brisk production palm oil since 2000 (see figure 6). Palm oil is used to produce many consumer products and intermediary goods and is present in many commodities, including food, shampoo, soap, cleanser, and now biofuels; hence, the increasing demand.

In a 2006 report, the Food and Agriculture Organization (FAO) predicted that by 2030, the demand for palm oil will double. It is imperative then that supply keep up with demand. Under the market mechanism, large demand combined with low production cost has fueled the growth of the palm oil industry.

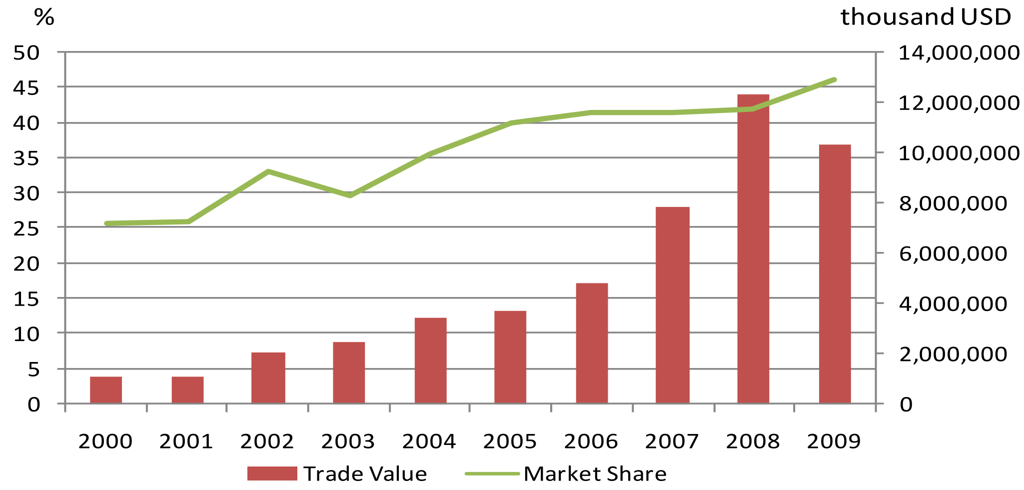
Figure 6. Monthly production of palm oil in Indonesia, 2000—2009 (in thousand tons)



Source**:** BPS

The growing palm oil industry has benefited palm oil-producing countries, many of which, including Indonesia, are developing countries. The benefits for palm oil-producing countries were interrelated. First, the robust industry boosted revenues from raw-material exports. Palm oil was exported as raw material to giant manufacturers, usually American or European companies such as Nestlé, Unilever, and Burger King. From 2000 to 2009, the market share of Indonesia’s palm oil exports continued to increase. Its trade value also steadily increased until 2008 but declined in 2009 due to the global economic crisis that started in 2008 (see figure 7).

Figure 7. Market share and trade value of Indonesia’s palm oil exports, 2000—2009

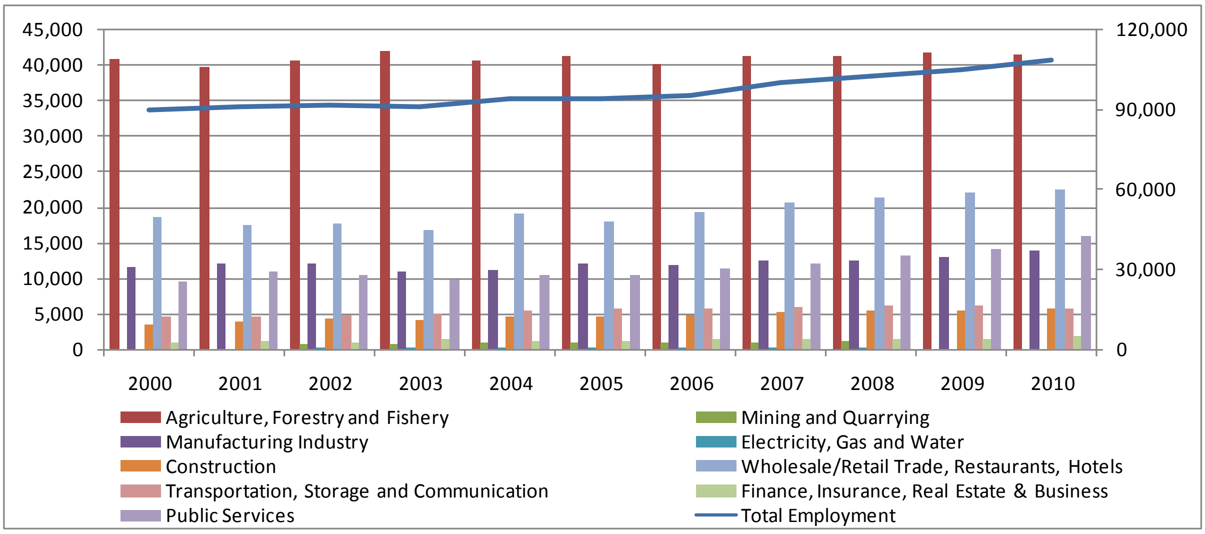


Source: UN Comtrade

Second, the palm oil industry created more job opportunities. As one of the most densely populated countries in the world, Indonesia has an advantage in terms of land and labor. The government can use these advantages to reduce poverty by employing more workers. The palm oil industry is a labor-intensive sector. More oil palm plantations will mean more job opportunities, especially for people in the rural areas or those who live near plantations.

For an agricultural country like Indonesia, the palm oil industry offers opportunities to not only enhance the agricultural sector but also to develop the rural areas. It is a fact that most of Indonesia’s poor live in the rural areas and are working in the agricultural sector. Developing the agricultural sector will thus mean developing the rural areas. Moreover, developing the rural areas can be a strategy for poverty reduction. In brief, the growing palm oil industry has helped palm oil-producing countries, including Indonesia, address the issue of poverty by generating job opportunities. Figure 8 shows the growing trend of employment in Indonesia, especially from 2006 to 2010. Employment in ALFF sector has significantly contributed to total employment since 2000.

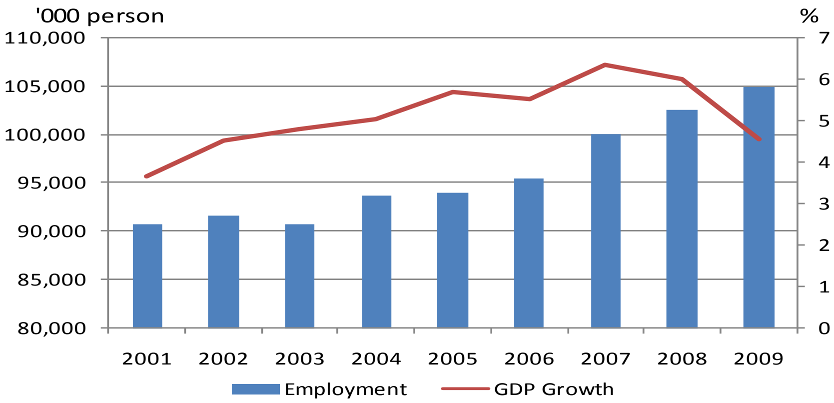
Figure 8. Indonesia's employment by sector and total employment, 2000—2010 (in '000)



Source: BPS

Unfortunately, the consistent increase in the number of jobs in Indonesia did not translate to a steady growth in GDP. Indonesia's employment increased from 93.7 million in 2004 to 108.2 million in 2009. GDP growth, however, fluctuated. In 2009, GDP dropped by 4.55 percent, from 6.01 percent in 2008 (see figure 9). This was due to the global economic crisis in 2008, which decelerated GDP growth by slowing down exports in almost all countries, including Indonesia.

Figure 9. Indonesia's total employment and GDP growth (2001—2009)



Source: BPS

Social Impact

The palm oil industry also exerts a social impact, not just an economic one. The social impact can be seen in society's willingness to change a certain way of life. People are naturally eager to take on opportunities that will help them attain a better life. There is no doubt that oil palm plantations create job opportunities because it is a labor-intensive industry.

The social change caused by oil palm plantations can be related to how society gains knowledge about concepts like debt. Putting up a new oil palm plantation requires high start-up costs, making smallholders indebted to existing palm oil companies. Through oil palm plantations, society is also introduced to the concepts of corruption and gratification. In order to get the approval of community leaders or individual households for the establishment of a new plantation, palm oil companies have to give presents or gifts (compensation), such as electronics, motorcycles, etc. Sometimes, the palm oil companies would promise to extend assistance to communities by building new schools, clinics, and other necessary infrastructure. However, such promises usually never get fulfilled at all.

With the growing number of oil palm plantations all over Indonesia, the locals have started to worry about the destruction of natural resources and their culture. People in older communities in some regions in Indonesia believe that they have a spiritual relationship with the environment. That is why they often oppose proposals for the establishment of oil palm plantations. They dislike the idea of having children and women work in the plantations. These plantations will bring about a shift in society's perception about their culture.

Oil palm plantations have also changed land use. There used to be an aggressive conversion of rainforests into farming and housing areas in Sumatera and Kalimantan. The shift in economic activities from farming to oil palm cultivation has made the locals stop growing their own food because they have become more dependent on palm oil companies.

Social groups, particularly the ethnic/indigenous tribes or groups, are also affected by the conversion of rainforests to oil palm plantations. Many of these groups still live in the rainforests. They are part of the rainforest ecosystem. The conversion of rainforests into oil palm plantations has pushed them out of their natural habitat.

Ecological Impact

Oil palm plantations have caused the degradation of rainforests, especially in Sumatera and Kalimantan. Rainforests produce oxygen; they are the lungs of the planet. Second, rainforests serve as habitat for thousands of species of plants and animals like the endangered *orangutan* and the Sumatera tiger. Third, trees support water reservoirs and help prevent floods. Deforestation results in floods, droughts, and forest fires. Smoke and haze from the annual forest fires that occur in Sumatera and Kalimantan disrupt human and economic activities, even reaching neighboring countries like Malaysia and Singapore. Deforestation and haze contribute to carbon emissions and global warming. During a meeting with business and political leaders in Singapore in April 2008, Nicholas Stern, former chief economist of the World Bank and a climate expert, said that "deforestation and burning for land clearance are huge problems for the world in terms of carbon emissions." Indonesia is one of the biggest carbon emitters in the world.

A study by the World Agroforestry Center (ICRAF) published in 2007 reveals that a hectare of forest would potentially absorb 50 tons to 200 tons of carbon. According to this study, forests in Sumatera in the 1950s could absorb 2.35 tons to 9.38 tons of carbon. However, 55 years later, the same forests can absorb only 1.1 tons to 4.5 tons of carbon. The ability of Sumatera's forests to absorb carbon has declined sharply over the years and has no doubt played a significant role in increasing greenhouse gas (GHG) emissions. This is a warning about environmental damage. The national government should exercise prudence when it comes to expansion plans for oil palm plantations.

In response to environmental concerns, the Indonesian government pledged during the Copenhagen meeting in December 2009 to reduce Indonesia's contribution to GHG emissions by 26 percent by 2020 (Warr and Yusuf 2011). Indonesia has prepared seven programs/actions to achieve GHG reduction; namely (1) sustainable peatland management; (2) decrease in the rate of deforestation and land degradation; (3) development of carbon sequestration projects in forestry and agriculture; (4) promotion of energy efficiency; (5) development of alternative and renewable energy sources; (6) reduction of solid and liquid waste; and (7) shift to low-emission transportation facilities. These programs pose a tough challenge for palm oil producers.

Another challenge for them to contend with is the EU RED, which has set certain criteria on the use of palm oil as raw material for biofuel production. One criterion states that plantations established after 2008 should not come from lands that are rich in biodiversity or that contain high carbon stock. The palm oil industry views such criteria as a burden, especially for producers who set up their plantations in forests and peatland areas.

In May 2010, Indonesia signed an LoI with Norway to reduce GHG emissions from deforestation and forest degradation and to stop new land clearing between 2011 and 2013. This action goes against the government's goal to expand oil palm plantations to around 20 million hectares in 2020 and to achieve food self-sufficiency by establishing new plantation/agricultural areas in several provinces in Indonesia. In this case, the national government should be consistent in implementing any agreement with other countries or international institutions related to environmental issues.

Another environmental provision applied in Indonesia is the ISPO, which supports the government's commitment to: (1) reduce GHG emissions: (2) raise awareness on the importance of sustainable palm oil production; (3) accelerate the implementation of a sustainable production system and certification; (4) enhance the competitiveness of Indonesia's palm oil on the global market; and (5) reduce GHG emissions caused by the establishment and operation of palm oil plantations. The Indonesia-based ISPO has a clear legal framework. It involves four implementing agencies: MoA, MoF, MoE, and the National Land Agency. ISPO implementation started in 2011. It helps to realize the objective of directing oil palm plantations to contribute to economic growth and boost the livelihood of people living around oil palm plantations.

4. The Effect of Oil Palm Plantations as a Concrete Realization of Rural Development

Gains from Oil Palm Plantations

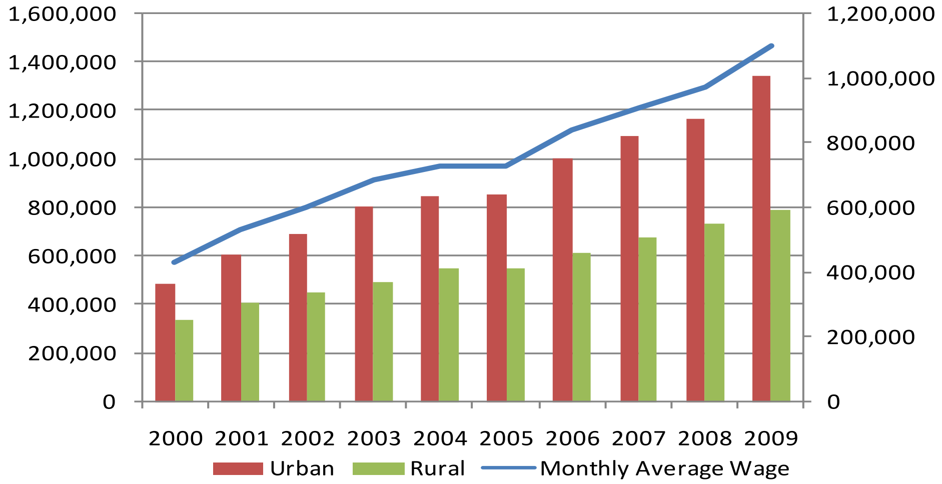
Large-scale expansion of oil palm plantations benefits the areas or provinces where the plantations are located. Oil palm plantations are located mostly in the rural areas. The development of a rural area and the improvement of the quality of life of the locals living around or near plantation areas are the important gains in the expansion of oil palm plantations.

Rural development requires infrastructure development and an improvement in the standard of living of the people. Rural development resulting from the expansion of oil palm plantations can be realized if there are effective and sustainable government regulations related to this industry. It should also consider the locals as important stakeholders who should receive as much gains as the palm oil company gets.

Gains from the expansion of oil palm plantations can be classified into three, all of which support the development of the area where the plantation is located: (1) it can generate additional income for local government; (2) it can improve the income and standard of living of the locals living around the plantation; and (3) it can develop the infrastructure in the area.

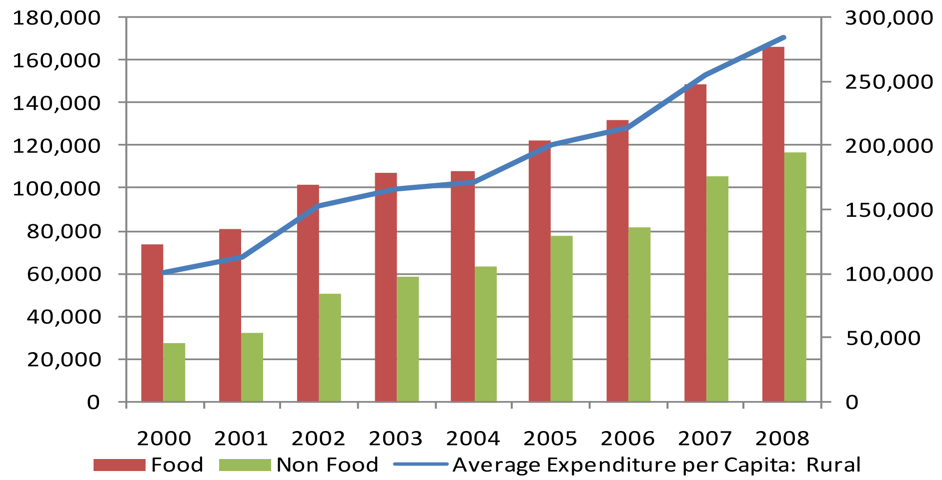
Rapid growth in investments generates additional income for the local government through foreign investment and taxes. Companies that set up their businesses pay taxes as do their employees (on income). An increase in the average monthly wage of workers in the rural areas (see figure 10) would mean an increase in the consumption of consumer items like food and nonfood stuff (see figure 11). Nonfood stuff includes taxes, which are regarded as mandatory expenditures. The additional income that the local government would earn, especially from taxes, can be used for infrastructure and other projects.

Figure 10. Average monthly wage in rural and urban areas, 2000—2009 (in IDR)



Source: Ministry of Manpower and Transmigration, BPS.

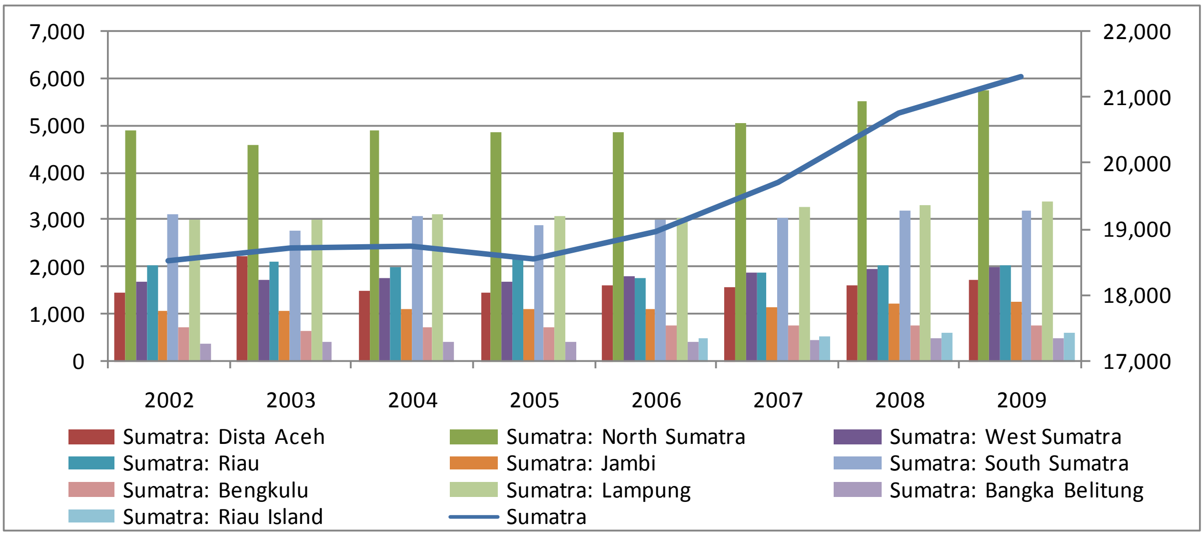
Figure 11. Average expenditure per capita in rural areas, 2000—2008 (in IDR)



Source: BPS

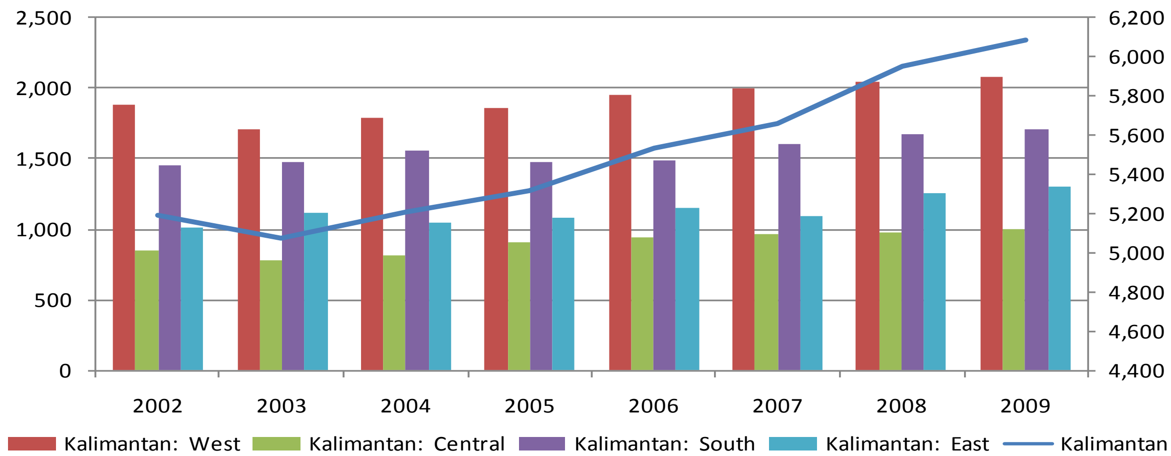
The expansion of oil palm plantations may improve the standard of living in local communities as shown by the consistent increase in the average monthly wage and average expenditure per capita since 2000. Expansion has a multiplier effect, that is, it creates job opportunities for the locals and triggers the establishment of other industries that use palm trees or palm oil as raw material. Locals can work as farm laborers or in administrative positions. Those who own large tracts of land can enter into a partnership scheme with private companies where they plant the oil palm trees. Figures 12 and 13 show the significant increase in employment in the two big islands in Indonesia (Sumatera and Kalimantan), which are the biggest producers of palm oil in the country.

Figure 12. Total employment in Sumatera's provinces, 2002—2009 (in thousand people)



Source: BPS

Figure 13. Total employment in Kalimantan's provinces, 2002—2009 (in thousand people)

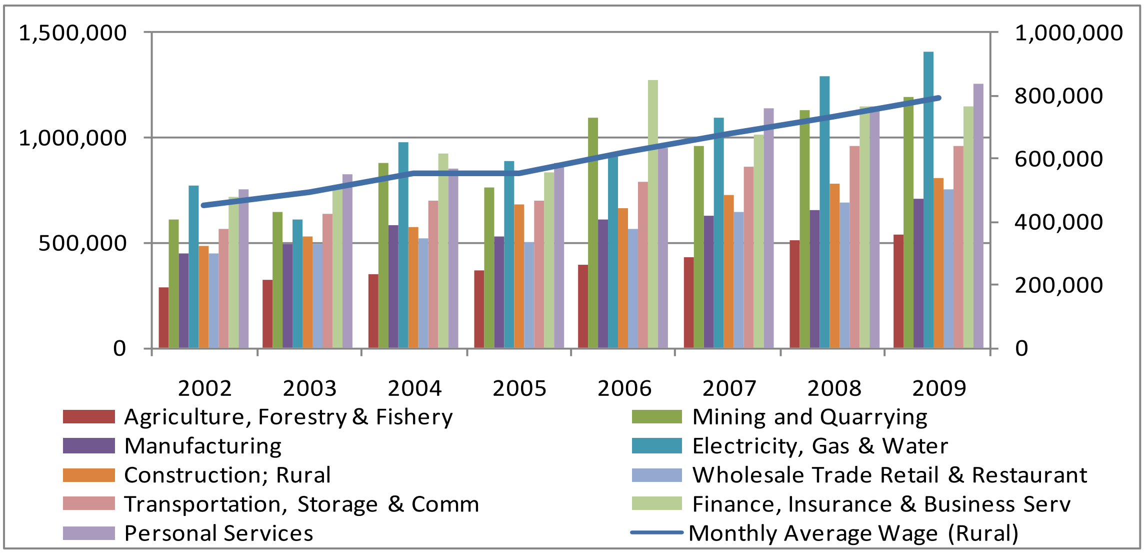


Source: BPS

A study done by Almasdi Syahza (2005) titled "Development Impact of Palm Oil Plantation Toward Rural Economic Multiplier Effect in Riau Province" shows that the expansion of oil palm plantations in Riau province had a multiplier effect for the people living there in terms of improvement in their standard of living. Having a steady job means having the purchasing power to buy goods to fulfill primary and secondary needs. The oil palm plantations also provided downstream income-generating opportunities for the locals in the form of small businesses like restaurants, inns, kiosks, grocery shops, and transportation services. An increase in income and purchasing power translates to an increase in consumption. When the market grows, it stimulates economic activities, many traditional markets will be built, and the trading of other goods and services will increase.

Figure 14 shows an increasing trend in the average monthly wage in the rural areas. The positive trend in the total average monthly wage is a result of the increase in the average monthly wage in several sectors, including agriculture, forestry, fishery, manufacturing, construction, wholesale trade, retail, restaurant, transportation, storage, communication, and personal services. Meanwhile, the average monthly wage in finance, insurance, and business services as well as in mining and quarrying has been fluctuating since 2002.

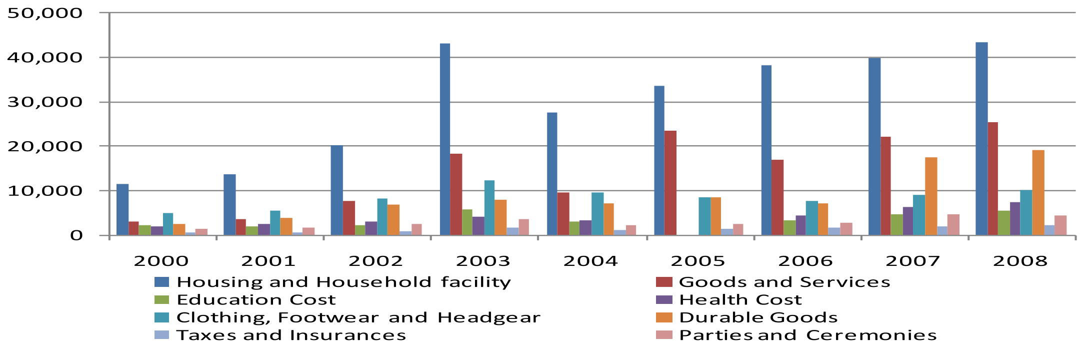
Figure 14. Average monthly wage in rural areas by sector, 2002—2009 (in IDR)



Source: BPS

Improving the income and standard of living of people in the rural areas creates a better socioeconomic life for them. With improved income, they will be able to afford better education for their children and have access to more nutritious food, medicine, and appropriate health services. Figure 15 shows the average expenditure per capita in the rural areas for nonfood consumer goods. Housing and household facilities take a bigger slice of the average expenditure per capita followed by goods and services, clothing, footwear and headgear, and durable goods.

Figure 15. Average expenditure per capita in rural areas for nonfood stuff, 2000—2008 (in IDR)



***Source*:** BPS

Oil palm plantations spur the development and expansion of infrastructure in the rural areas, such as roads, bridges, and power supply facilities, all of which are necessary to ensure efficient production and delivery of produce. These also benefit the local community because they can trigger the construction of local government offices, school buildings, markets, and health service centers (*Puskesmas*). Thus, infrastructure development can help improve the quality of life (in terms of access to education, health care services, and better social involvement) for residents near an oil palm plantation area.

Cost of Oil Palm Plantations

The expansion of oil palm plantations in a rural area can also generate some problems, specifically, environmental problems. Expansion entails clearing of large forest areas but many of these cleared areas are left unused for some time. Indonesia's vast tropical forests are home to a wide variety of flora and fauna; deforestation disturbs these flora and fauna and threatens their existence. Deforestation is too high of an ecological price to pay because its effects last through generations.

This problem requires from the government and the palm oil companies a commitment to protect the forests and to stop large-scale deforestation even as plantation areas are expanded. The cleared areas must be utilized as soon as possible and must not be left barren.

The expansion of oil palm plantations can generate conflicts between the locals and the plantation companies. These conflicts usually arise during the land acquisition process and may be due to the minimal participation in the plantation offered to the locals or because of the unpleasant relationship between the locals and the company's employees who come from other communities.

Such conflicts can be avoided if the local government has strong, clear, and fair regulations. The regulations must favor the palm oil company but must also protect the interests of the locals. Conflicts can also be avoided if the palm oil company recognizes the community as an important stakeholder and gives the locals the chance to benefit from the plantation by allowing them to become part of its operations.

Oil palm plantations in Indonesia's rural areas have been expanding at a substantial scale since the early 20th century, attracting both local and foreign investors. For Indonesia, the palm oil industry can create employment opportunities, foreign investments as well as huge revenues for the government through international trade.

To summarize, the large-scale expansion of oil palm plantations in the rural areas provide economic benefits to local communities through the development of infrastructure and the creation of employment and income-generating opportunities. The locals are important stakeholders in the plantations, and they have to get the most economic and social benefits from this exercise.

As expansion may also bring ecological and social problems, the local government and the palm oil companies must work toward creating a harmonious relationship with the community. The local government must put in place regulations that are fair and beneficial to both parties.

Palm Oil-Producing Provinces versus Non-Palm Oil-Producing Provinces

To compare developments in palm oil-producing provinces and provinces not involved in palm oil production, this section will present a brief overview on the employment and growth performance, basic infrastructure, and poverty incidence in such provinces. Palm oil-producing provinces are located mostly in Sumatera and Kalimantan. Based on data on palm oil plantation areas in 2005, the palm oil-producing provinces are Riau, North Sumatera, Central Kalimantan, West Sumatera, South Kalimantan, Jambi, West Kalimantan, East Kalimantan, Aceh, Lampung, Bangka Belitung, Bengkulu, South Sulawesi, Central Sulawesi, Papua, Banten, West Java, and Southeast Sulawesi. Among these nineteen provinces, Riau and North Sumatera have become the largest producers of palm oil, with 1.5 million and 1.1 million hectares of oil palm plantations in 2005, respectively. The provinces not mentioned in the first group are provinces are those that do not produce palm oil; namely, DKI Jakarta, Central Java, Yogyakarta, East Java, Bali, West Nusa Tenggara, East Nusa Tenggara, North Sulawesi, West Sulawesi, Gorontalo, Maluku, and North Maluku. For the complete summary of these two groups of provinces, see table 7.

Table 7. Palm Oil-Producing Provinces versus Non-Palm Oil-Producing Provinces

Palm Oil-Producing Provinces	**Non-Palm Oil-Producing Provinces**
Sumatera	***Java***
Aceh	DKI Jakarta
North Sumatera	Central Java
West Sumatera	Yogyakarta
Riau	East Java
Jambi	***Bali***
South Sumatera	Bali
Bangka Belitung	***Nusa Tenggara***
Bengkulu	West Nusa Tenggara
Lampung	East Nusa Tenggara
Java	***Sulawesi***
West Java	North Sulawesi

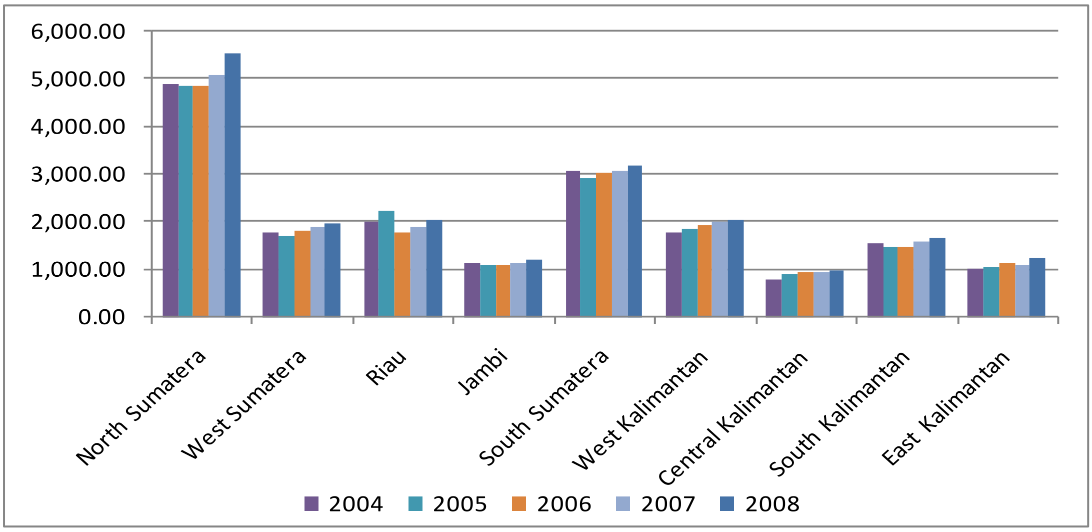
Banten	West Sulawesi
Kalimantan	Gorontalo
West Kalimantan	***Maluku***
Central Kalimantan	Maluku
South Kalimantan	***North Maluku***
East Kalimantan	North Maluku
Sulawesi	
Central Sulawesi	
South Sulawesi	
Southeast Sulawesi	
Papua	
Papua	

Employment and Growth Performance

The labor-intensive palm oil industry offers economic benefits for Indonesia because it creates jobs and promotes economic growth. Indonesia's palm oil exports have been increasing since 2004. Its market share of palm oil exports has reached the highest mark since 2009, making Indonesia the biggest palm oil exporter in the world.

Provinces producing palm oil have enjoyed an increasing trend in employment since 2006, especially when palm oil became a major industry in Indonesia (figure 16). Riau and North Sumatera, as the biggest producers in Indonesia, showed the most positive trend in employment for the period 2006—2008. Employment in North Sumatera increased from 1.57 million in 2007 to 1.62 million in 2008. Figure 16 shows the rate of employment for the top nine palm oil-producing provinces, based on the plantation area that they had in 2005, which totaled more than 300,000 hectares.

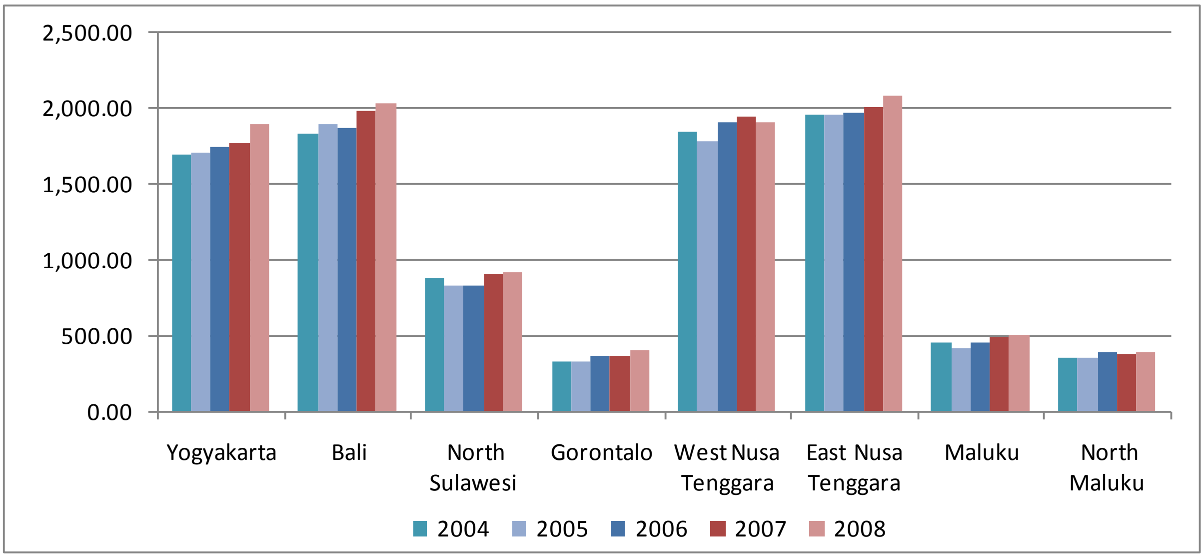
Figure 16. Employment performance of palm oil producers in Indonesia, 2004—2008 (in '000 person)



Source: BPS

Meanwhile, the employment trend in several provinces that do not produce palm oil or do not have oil palm plantations was identical with palm oil-producing provinces. Excluding the three biggest industrial zones in Indonesia; namely, Jakarta, Central Java, and East Java, most provinces showed a positive trend in employment between 2007 and 2008. Among the non-palm oil-producing provinces, only West Nusa Tenggara had a negative trend in employment between 2007 and 2008 (see figure 17).

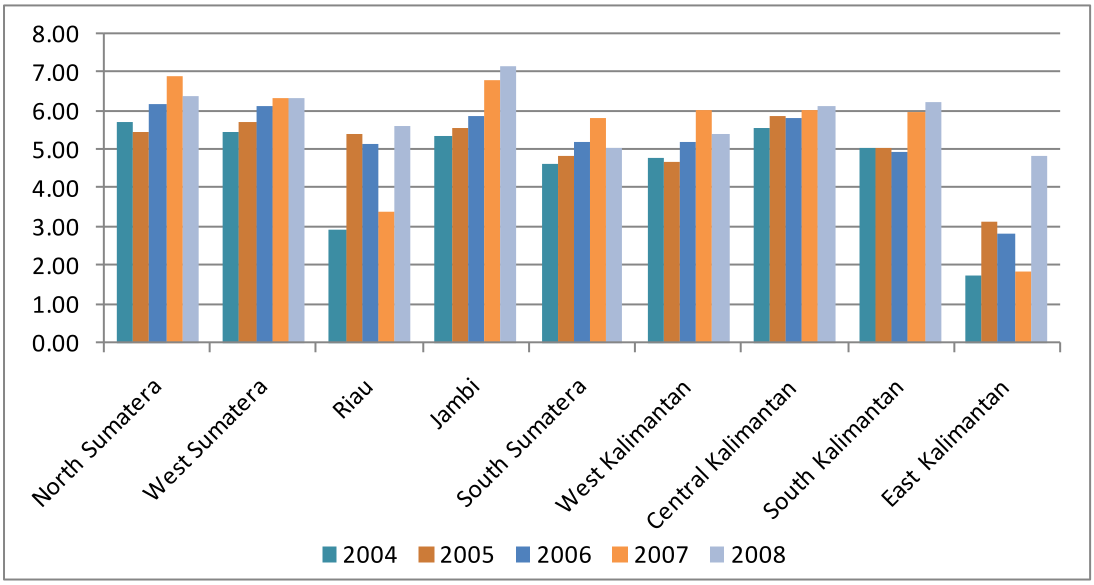
Figure 17. Employment performance of non-palm oil producers in Indonesia, 2004—2008 (in '000 person)



Source: BPS

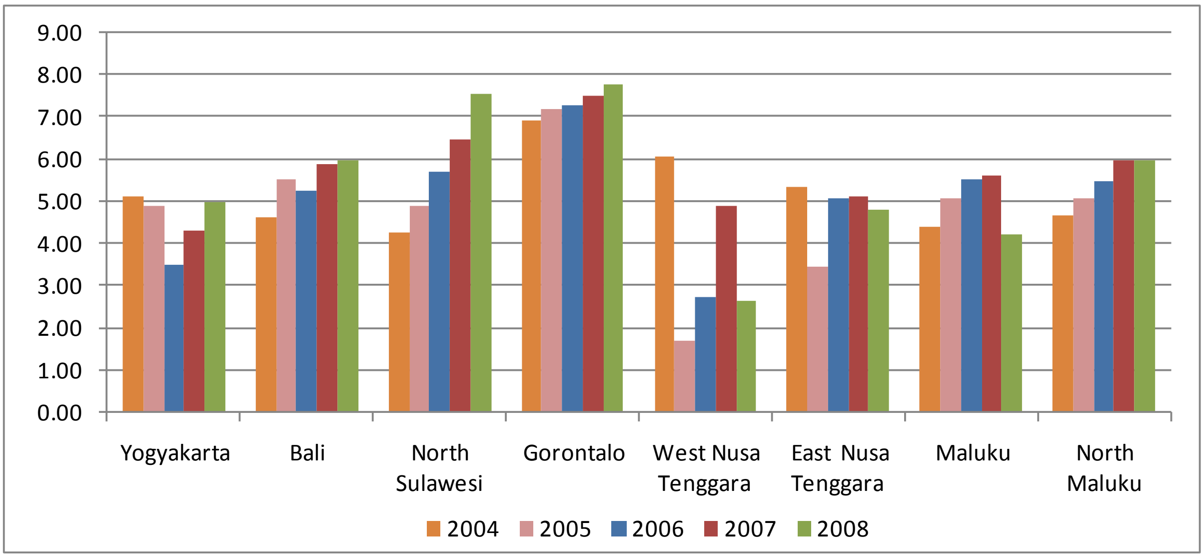
The palm oil industry started becoming a major industry in Indonesia around 2005—2006. A comparison of GDP growth between two groups of provinces shows that the palm oil industry effected positive trends in GDP growth in 2008, notably in the biggest palm oil-producing provinces (e.g., Riau, Jambi, and East Kalimantan). The situation did not hold true for North Sumatera, South Sumatera, and West Kalimantan. There was no extraordinary GDP growth from 2004 to 2008 for provinces that do not produce palm oil; GDP growth for these provinces showed a fluctuating trend. Only three provinces showed a positive trend since 2004: North Sulawesi, Gorontalo, and North Maluku (see figure 19).

Figure 18. GDP growth of palm oil-producing provinces in Indonesia, 2004—2008 (in %)



Source: BPS

Figure 19. GDP growth of non-palm oil-producing provinces in Indonesia, 2004—2008 (in %)



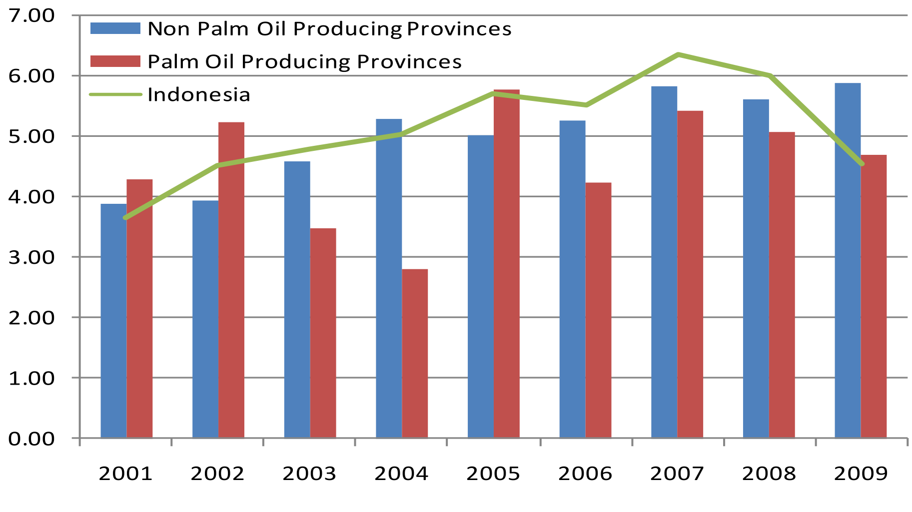
Source: BPS

The figures indicate that the palm oil industry has not yet made a significant impact on the employment and growth performance of the provinces and the nation in general. This is due to the fact that the palm oil industry in Indonesia started to develop only in the early 2000s.

The employment performance reflects the positive progress as the palm oil industry became a labor-intensive industry and served as trigger for creating employment in other sectors. Although the contribution of palm oil exports to GDP growth ranged between 7 percent and 9 percent during the period 2007—2009, palm oil exports did not actually boost GDP growth significantly in the provinces in particular and Indonesia in general.

Figure 20 shows the fluctuation of Indonesia's GDP growth and average GDP growth in the two groups of provinces. National GDP growth was influenced by economic activities in non-palm oil-producing provinces before 2005. Palm oil-producing provinces started to influence national GDP growth only in 2005 as the palm oil industry began to post increasing export value. Overall, GDP growth in palm oil-producing provinces is smaller than GDP growth in non-palm oil-producing provinces because most economic activities and industrial areas are located in Java, which neither produces palm oil nor depends on the palm oil industry.

Figure 20. National GDP growth and average GDP growth in two groups of provinces, 2001— 2009



***Source*:** BPS

Basic Infrastructure

This section analyzes the basic infrastructure necessary for delivering clean water, proper sanitation, and electricity in the two groups of provinces. Table 8 shows the percentage of households in the two groups of provinces that have access to clean water. It also shows the improvement in the percentage of households with access to clean water in the palm oil-producing provinces from 1993—1999. Meanwhile, non-palm oil-producing provinces also experienced a significant increase in the number of households with access to clean water in the same period. However, the percentage increase was higher in the palm oil-producing provinces (7 percent) than in the non-palm oil-producing provinces (5 percent). Between 2003 and 2009, the gap between the two groups of provinces narrowed, with more than 40 percent of households having access to clean water (table 8). Overall, this gap has been shrinking since 1993. For the years 1993, 1999, 2003, and 2009, the gap progressively narrowed—9.23 percent in 1993, 7.02 percent in 1999, 5.2 percent in 2003, and 4.42 percent in 2009.

Table 8. Households with Access to Clean Water in Indonesia (average in %)

Province	1993	1999	2003	2009
Palm Oil Producing Provinces	33.22	40.30	44.25	43.93
Non Palm Oil Producing Provinces	42.45	47.32	49.45	48.35

***Source*:** BPS

Another basic infrastructure is proper sanitation facilities. The two groups of provinces showed positive improvement from 1993 to 2009 (table 9). Between 1993 and 1999, palm oil-producing provinces lagged in access to proper sanitation facilities, with only between 20 percent and 27 percent having access to proper sanitation. Meanwhile, in the same period, between 31 percent and 39 percent) of people living in non-palm oil-producing provinces had access to proper sanitation facilities. Between 2003 and 2009, there was a significant increase in the percentage of households with proper sanitation. Note in table 9 that the gap between the two groups of provinces narrowed. In 1993 and 1999, for example, the gaps between the two groups of provinces were 10.95 percent and 11.89 percent, respectively. Then in 2003 and 2009, the gaps further narrowed, from 7.91 percent in 2003 to 5.82 percent in 2009. This significant improvement was likely caused by increasing economic activities in both groups of provinces, especially in the palm oil-producing provinces.

Table 9. Households with Access to Good Sanitation in Indonesia (average in %)

Province	1993	1999	2003	2009
Palm Oil Producing Provinces	20.25	27.88	30.42	44.51
Non Palm Oil Producing Provinces	31.20	39.77	38.33	50.33

Source**:** BPS

Electricity can be viewed as the engine that facilitates economic activities. That is why many provinces with no sufficient supply of electricity find alternative sources. To meet this need, the government commissioned PT Perusahaan Listrik Negara (PLN), a state-owned enterprise, to provide electricity to households and businesses all over Indonesia. There are also private companies that provide electricity through generators and power plants.

In table 10, we can see the significant improvement posted by palm oil-producing provinces in terms of access to electricity. In the 1990s, PLN focused only on non-palm oil-producing provinces because the main engine of economic growth at that time were mostly the Java-based provinces. In the late 1990s, PLN boosted its electricity supply for both groups of provinces, posting an increase of 23.58 percent for non-palm oil-producing provinces and 26.93 percent in palm oil-producing provinces. Between 2003 and 2009, the gap between the two groups of provinces narrowed. In 2009, people from both groups of provinces enjoyed the same access to electricity, with more than 70 percent of households having access to electricity from PLN. However, in 2009, palm oil-producing provinces overtook the non-palm oil-producing provinces in access to electricity because there were many private companies that provided electricity in the former.

Table 10. Access to Electricity of Households in Indonesia (average in %)

Province	1993		1999		2003		2009	
	PLN	TOTAL	PLN	TOTAL	PLN	TOTAL	PLN	TOTAL
Palm Oil Producing Provinces	36.33	44.61	63.26	69.11	68.04	74.29	77.04	86.10
Non Palm Oil Producing Provinces	57.42	-	81.00	-	76.71	80.29	77.20	85.41

Source**:** BPS

There is sustainable progress for households with access to the three basic types of infrastructure, both in the palm oil-producing provinces and in the non-palm oil-producing provinces. Most palm oil-producing provinces did not have access to good basic infrastructure in the early 1990s compared to the non-palm oil-producing provinces that were already enjoying good infrastructure (especially electricity) then. The growing palm oil industry effectively narrowed the gap between the provinces that produce palm oil and those that do not. This shows that the palm oil industry, whose players are mostly based in the provinces, can help people in the rural areas gain access to, and enjoy, basic infrastructure.

Poverty Incidence

The word “rural” tends to connote poverty. Rural areas are commonly identified as a “source” of poverty in Indonesia. The general view is that poor people usually come from the rural areas. In this section, we will investigate the progress of the poor in the palm oil-producing provinces and in the non-palm oil-producing provinces.

Table 11 illustrates the number and percentage of poor people in palm oil-producing provinces from 2007—2010. Between 2007 and 2008, there was an increasing number and percentage of poor people, especially in 2008, because Indonesia was hit by the global economic crisis, particularly the food crisis. However, the number of poor people gradually started to decrease between 2008 and 2010. In 2010, South Kalimantan, Bangka Belitung, and Central Kalimantan provinces had the lowest percentage of poor people, at 5.21 percent, 6.51 percent, and 6.77 percent, respectively. Meanwhile, Papua (36.8 percent) and Aceh (20.98 percent) had the highest percentage of poor people in the same year.

Table 11. Number and Percentage of Poor People in Palm Oil-Producing Provinces, 2007--2010

Provinces	Poor People ('000 person)				Percentage of Poor People (%)			
	2007	2008	2009	2010	2007	2008	2009	2010
Aceh	892.9	959.7	892.9	861.9	21.8	23.53	21.8	20.98
North Sumatera	1 499.7	1 613.8	1 499.7	1490.9	11.51	12.55	11.51	11.31
West Sumatera	429.3	477.2	429.3	430	9.54	10.67	9.54	9.5
Riau	527.5	566.7	527.5	500.3	9.48	10.63	9.48	8.65
Jambi	249.7	260.3	249.7	241.6	8.77	9.32	8.77	8.34
South Sumatera	1 167.9	1 249.6	1 167.9	1125.7	16.28	17.73	16.28	15.47
Bengkulu	324.1	352	324.1	324.9	18.59	20.64	18.59	18.3
Lampung	1 558.3	1 591.6	1 558.3	1479.9	20.22	20.98	20.22	18.94
Bangka Belitung	76.6	86.7	76.6	67.8	7.46	8.58	7.46	6.51
West Java	4 983.6	5 322.4	4 983.6	4773.7	11.96	13.01	11.96	11.27
Banten	788.1	816.7	788.1	758.2	7.64	8.15	7.64	7.16
West Kalimantan	434.8	508.8	434.8	428.8	9.3	11.07	9.3	9.02
Central Kalimantan	165.9	200	165.9	164.2	7.02	8.71	7.02	6.77
South Kalimantan	176	218.9	176	182	5.12	6.48	5.12	5.21
East Kalimantan	239.2	286.4	239.2	243	7.73	9.51	7.73	7.66
Central Sulawesi	489.8	524.7	489.8	475	18.98	20.75	18.98	18.07
South Sulawesi	963.6	1 031.7	963.6	913.4	12.31	13.34	12.31	11.6
Southeast Sulawesi	434.3	435.9	434.3	400.7	18.93	19.53	18.93	17.05
Papua	760.3	733.1	760.3	761.6	37.53	37.08	37.53	36.8

***Source*: BPS**

This section also describes the poverty line in palm oil-producing provinces. Poverty line is an addition to food and nonfood poverty lines. The food poverty line is standardized with minimum food needs (i.e., 2,100 kcal per capita per day) and is represented by 52 commodities. The nonfood poverty line covers the minimum needs on housing, clothing, education, and health.

People with per capita income below the poverty line can be categorized as poor. In table 12, we can see that the highest poverty line in 2010 occurred in Bangka Belitung, followed by East Kalimantan, Aceh, and Papua. From this data, we also can see the cost of living in each province. A higher poverty line means a higher cost of living. Meanwhile, the provinces with lowest poverty line in 2010 were South Sulawesi, Southeast Sulawesi, and West Kalimantan.

Table 12. Poverty Line in Palm Oil-Producing Provinces, 2007—2010

Provinces	Poverty Line (Rupiah)			
	2007	2008	2009	2010
Aceh	261 898	239 873	261 898	278 389
North Sumatera	210 241	193 321	210 241	222 898
West Sumatera	217 469	195 733	217 469	230 823
Riau	246 481	229 371	246 481	256 112
Jambi	199 623	182 229	199 623	216 187
South Sumatera	212 381	196 452	212 381	221 687
Bengkulu	210 084	189 607	210 084	225 857
Lampung	188 812	172 332	188 812	202 414
Bangka Belitung	266 843	246 169	266 843	286 334
West Java	191 985	176 216	191 985	201 138
Banten	198 750	181 076	198 750	208 023
West Kalimantan	174 617	158 834	174 617	189 407
Central Kalimantan	202 612	186 003	202 612	215 466
South Kalimantan	195 787	180 263	195 787	210 850
East Kalimantan	261 185	237 979	261 185	285 218
Central Sulawesi	189 653	168 025	189 653	203 237
South Sulawesi	153 715	138 334	153 715	163 089
Southeast Sulawesi	161 583	141 919	161 583	165 208
Papua	246 225	225 195	246 225	259 128

***Source*:** BPS

For deeper analysis, the poverty gap index and the poverty severity index were used to help us understand the impacts of oil palm plantations in the provinces that produce palm oil. Table 13 shows that Papua, Aceh, Southeast Sulawesi, and Central Sulawesi were the palm oil-producing provinces with the highest poverty gap index. A high poverty gap index means that the average expenditure per capita are far from the poverty line. Thus, Papua and Aceh were not only the provinces with highest poverty gap index but also the highest poverty severity index. This suggests that Papua and Aceh should get more attention from the national government in terms of antipoverty interventions (e.g., credit for small and medium enterprises or SMEs, cash transfer programs).

Table 13. Poverty Gap and Severity Index in Palm Oil-Producing Provinces, 2007--2010

Provinces	Poverty Gap Index				Poverty Severity Index			
	2007	2008	2009	2010	2007	2008	2009	2010
Aceh	4.46	4.92	4.46	4.11	1.34	1.5	1.34	1.26
North Sumatera	1.92	2.17	1.92	2.04	0.5	0.58	0.5	0.57
West Sumatera	1.41	1.6	1.41	1.49	0.32	0.39	0.32	0.35
Riau	1.25	1.63	1.25	1.38	0.25	0.4	0.25	0.37
Jambi	1.38	1.56	1.38	1.05	0.36	0.41	0.36	0.23
South Sumatera	3.06	3.15	3.06	2.63	0.86	0.85	0.86	0.71
Bengkulu	2.98	3.74	2.98	2.75	0.77	1.07	0.77	0.69
Lampung	3.94	3.83	3.94	2.98	1.12	1.03	1.12	0.72
Bangka Belitung	1.2	1.28	1.2	0.93	0.31	0.31	0.31	0.23
West Java	1.95	2.17	1.95	1.93	0.5	0.58	0.5	0.52
Banten	1.32	1.12	1.32	1	0.33	0.28	0.33	0.24
West Kalimantan	1.55	1.66	1.55	1.18	0.4	0.42	0.4	0.24
Central Kalimantan	1.03	1.47	1.03	1.02	0.22	0.37	0.22	0.24
South Kalimantan	0.73	1.03	0.73	0.69	0.17	0.27	0.17	0.18
East Kalimantan	1.51	1.61	1.51	1.27	0.43	0.39	0.43	0.34
Central Sulawesi	4.09	4.33	4.09	3.09	1.37	1.41	1.37	0.8
South Sulawesi	2.08	2.44	2.08	1.91	0.55	0.67	0.55	0.49
Southeast Sulawesi	3.44	3.74	3.44	3.18	0.98	1.08	0.98	0.89
Papua	9.07	10.89	9.07	9.36	2.98	4.01	2.98	3.37

***Source*:** BPS

It can be noted that there is also poverty incidence in several provinces without oil palm plantations. Table 14 shows that in 2010, there were many provinces with more than 20 percent of their population classified as poor. These provinces were West Papua (34.88 percent), Maluku (27.74 percent), Gorontalo (23.19 percent), East Nusa Tenggara (23.03 percent cent), and West Nusa Tenggara (21.55 percent). The provinces with the lowest percentage of poor people were DKI Jakarta and Bali.

Taable 14. Number and Percentage of Poor People in Non-Palm Oil-Producing Provinces, 2007—2010

Provinces	Poor People ('000 person)				Percentage of Poor People (%)			
	2007	2008	2009	2010	2007	2008	2009	2010
Riau Island	128.2	136.4	128.2	129.7	8.27	9.18	8.27	8.05
DKI Jakarta	323.2	379.6	323.2	312.2	3.62	4.29	3.62	3.48
Central Java	5 725.7	6 189.6	5 725.7	5369.2	17.72	19.23	17.72	16.56
DI Yogyakarta	585.8	616.3	585.8	577.3	17.23	18.32	17.23	16.83
East Java	6 022.6	6 651.3	6 022.6	5529.3	16.68	18.51	16.68	15.26
Bali	181.7	215.7	181.7	174.9	5.13	6.17	5.13	4.88
West Nusa Tenggara	1 050.9	1 080.6	1 050.9	1009.4	22.78	23.81	22.78	21.55
East Nusa Tenggara	1 013.1	1 098.3	1 013.1	1014.1	23.31	25.65	23.31	23.03
North Sulawesi	219.6	223.5	219.6	206.7	9.79	10.1	9.79	9.1
Gorontalo	224.6	221.6	224.6	209.9	25.01	24.88	25.01	23.19
West Sulawesi	158.2	171.1	158.2	141.3	15.29	16.73	15.29	13.58
Maluku	380	391.3	380	378.6	28.23	29.66	28.23	27.74
North Maluku	98	105.1	98	91.1	10.36	11.28	10.36	9.42
West Papua	256.8	246.5	256.8	256.3	35.71	35.12	35.71	34.88

***Source*:** BPS

Table 15 shows that DKI Jakarta, as Indonesia's capital, remains the most expensive province in Indonesia. Its poverty line is the highest among the non-palm oil-producing provinces. West Sulawesi has the lowest poverty line.

Table 15. Poverty Line in Non-Palm Oil-Producing Provinces, 2007--2010

Provinces	Poverty Line (Rupiah)			
	2007	2008	2009	2010
Riau Island	283 965	262 232	283 965	295 095
DKI Jakarta	316 936	290 268	316 936	331 169
Central Java	182 515	168 168	182 515	192 435
DI Yogyakarta	211 978	194 830	211 978	224 258
East Java	188 317	169 112	188 317	199 327
Bali	196 466	176 569	196 466	208 152
West Nusa Tenggara	185 025	167 536	185 025	196 185
East Nusa Tenggara	156 191	139 731	156 191	175 308
North Sulawesi	184 772	168 160	184 772	194 334
Gorontalo	162 189	147 154	162 189	171 371
West Sulawesi	163 224	146 492	163 224	171 356
Maluku	207 771	188 931	207 771	226 030
North Maluku	201 500	187 671	201 500	212 982
West Papua	277 416	233 570	277 416	294 727

***Source*:** BPS

Table 16 further shows the provinces with highest poverty gap index. These were West Papua (10.47 percent), Maluku (5.23 percent), East Nusa Tenggara (4.74 percent), Gorontalo (4.14

percent), and West Nusa Tenggara (3.77 percent). The provinces with high poverty severity indexes in 2010 were West Papua (4.3 percent), Maluku (1.47 percent), and East Nusa Tenggara (1.43 percent).

Table 16. Poverty Gap and Severity Index in Non-Palm Oil-Producing Provinces, 2007--2010

Provinces	Poverty Gap Index				Poverty Severity Index			
	2007	2008	2009	2010	2007	2008	2009	2010
Riau Island	2.02	2.07	2.02	1.05	0.77	0.72	0.77	0.25
DKI Jakarta	0.57	0.72	0.57	0.45	0.14	0.19	0.14	0.11
Central Java	2.96	3.39	2.96	2.49	0.74	0.9	0.74	0.6
DI Yogyakarta	3.52	3.35	3.52	2.85	1.04	0.92	1.04	0.73
East Java	2.88	3.38	2.88	2.38	0.76	0.93	0.76	0.59
Bali	0.74	0.84	0.74	0.71	0.17	0.18	0.17	0.14
West Nusa Tenggara	5.15	4.49	5.15	3.77	1.68	1.28	1.68	1.01
East Nusa Tenggara	4.14	4.87	4.14	4.74	1.14	1.35	1.14	1.43
North Sulawesi	1.55	1.53	1.55	1.14	0.36	0.38	0.36	0.24
Gorontalo	4.59	4.59	4.59	4.14	1.27	1.27	1.27	1
West Sulawesi	2.47	2.63	2.47	1.55	0.6	0.66	0.6	0.35
Maluku	5.59	5.89	5.59	5.23	1.67	1.75	1.67	1.47
North Maluku	1.44	1.65	1.44	1.47	0.36	0.39	0.36	0.33
West Papua	9.75	9.18	9.75	10.47	3.57	3.5	3.57	4.3

Source: BPS

Table 17 sums up several important indicators in the two groups of provinces. Table 17 shows that palm oil-producing provinces performed better, with a lower average percentage of poor people and higher poverty line than non-palm oil-producing provinces. From 2007 until 2010, the percentage of poor people in palm oil-producing provinces, on average, was around 13 percent to 14 percent. Meanwhile, the same indicator in non-palm oil-producing provinces was between 16 percent and 18 percent. If we compare those two groups of provinces in terms of the average number of poor people, table 17 shows that both groups had quite a similar number of poor people, on average, because the population in palm oil-producing provinces was higher than that in the non-palm oil-producing provinces. On average, the number of poor people in both groups totaled around 15 million to 17 million. In addition, the average poverty line in palm oil-producing provinces was also higher than in the non-palm oil-producing provinces. This can be an indication that the standard of living in the palm oil-producing provinces is better than in the non-palm oil-producing provinces. .

Table 17. Performance of Indicators between Palm Oil-Producing and Non-Palm Oil-Producing Provinces, 2007—2010

Indicators	Year	Palm Oil Producing Provinces	Non Palm Oil Producing Provinces
Population ('000 person)	2007	118,026.83	114,235.40
	2008	116,697.51	114,430.50
	2009	118,026.83	114,235.40
	2010	118,206.93	114,243.25
Average Number of Poor People ('000 person)	2007	16,161.60	16,368.40
	2008	16,204.50	17,726.90
	2009	16,161.60	16,368.40
	2010	15,623.60	15,400.00
Average Percentage of Poor People (%)	2007	13.69	17.08
	2008	14.86	18.07
	2009	13.69	17.08
	2010	13.08	16.25
Average Poverty Line (Rupiah)	2007	209,997	208,448
	2008	191,523	188,602
	2009	209,997	208,448
	2010	223,235	220,909

***Source*:** BPS

The section on poverty incidence wraps up the comparative values between the palm oil-producing provinces and the non-palm oil-producing provinces. With data on the number and percentage of poor people, poverty line, poverty gap index, and poverty severity index, it can be concluded that palm oil-producing provinces were substantially successful in reducing poverty when the palm oil industry took off in the 2000s. The image of rural areas, which used to be connected with poverty, has now shifted.

The expansion of oil palm plantations and the various government initiatives to promote the palm oil industry has created job opportunities and helped increase average monthly income as well as the average per capita expenditure.

Migration

Another indicator of how the palm oil industry affects the performance of palm oil-producing provinces is migration. Table 18 shows the magnitude of recent migration to palm oil-producing provinces based on population censuses conducted in 1980, 1985, 1990, 1995, 2000, and 2005. The term "recent migration" refers to migration where people were counted in the provinces they migrated to compared to where they lived five years before the census took place. In palm oil-producing provinces (see table 18), net migration showed a positive trend, which means that people migrated from outside palm oil-producing provinces. The highest migration in the palm oil-producing provinces was recorded in 1990 (1.28 million) and 2000 (1.22 million).

Table18. Recent Migration in Palm Oil-Producing Provinces

Provinces	1980	1985	1990	1995	2000	2005
Aceh	22,960	16,423	6,937	-19,980	-146,212	na
North Sumatera	-81,703	-104,258	-169,765	-95,615	-218,634	-94,568
West Sumatera	-60,122	-57,528	-44,171	-6,076	-124,929	-20,506
Riau	44,895	46,225	152,562	21,146	435,431	115,073
Jambi	71,095	20,487	72,364	4,362	26,188	14,980
South Sumatera	89,154	-6,581	13,355	-59,202	11,294	-40,778
Bengkulu	51,003	19,304	54,236	30,194	33,001	2,686
Lampung	462,209	41,541	76,391	-51,715	-245	-19,011
Bangka Belitung	na	na	na	na	2,763	2,115
West Java	83,519	210,386	854,869	668,836	465,268	287,839
Banten	na	na	na	na	412,941	158,009
West Kalimantan	10,949	797	-877	10,722	3,520	-16,506
Central Kalimantan	33,710	15,022	41,776	-6,594	99,484	-15,760
South Kalimantan	15,643	4,970	21,883	12,884	26,708	20,750
East Kalimantan	92,286	53,520	126,339	62,618	112,681	101,911
Central Sulawesi	66,313	16,059	41,996	42,816	44,773	24,833
South Sulawesi	-82,647	-41,366	-41,595	-11,807	-89,906	-36,127
Southeast Sulawesi	21,439	56,776	34,462	18,131	88,038	10,031
Papua	17,229	34,011	42,145	26,802	33,674	17,761
Net Migration	**857,932**	**325,788**	**1,282,907**	**647,522**	**1,215,838**	**512,732**

***Source*:** BPS (Population Censuses of 1980, 1985, 1990, 1995, 2000, and 2005)

Meanwhile, non-palm oil-producing provinces posted negative net migration, which means that people in these provinces moved out to other provinces. Table 19 shows that the highest migration (out of non-palm oil-producing provinces) was posted in 1990 and 2000, which totaled 1.21 million and 1.12 million people, respectively. Tables 18 and 19 show that a significant number of people transferred to palm oil-producing provinces because these provinces offered promising job prospects and a better standard of living. The growing number of oil palm plantations in palm oil-producing provinces attracted many people to settle in these provinces. In 2000, there were about 400,000 people who migrated to Riau, the largest palm oil producer in Indonesia.

Migration statistics indicate that many people from non-palm oil-producing provinces moved to palm oil-producing provinces because of the promise of a better standard of living. The transmigration program supported by the national government through the Ministry of Manpower and Transmigration (MoMT) also played a significant role in helping people move to palm oil-producing provinces, which have more rural areas than urban areas, more lands, and are less populated. Rural progress becomes possible when people can live comfortably in a rural area with better jobs and income. Such progress is also sustainable when people in rural areas who dream of better lives do not have to move to urban areas anymore because they can already achieve their dreams in the rural areas.

Table 19. Recent Migration in Non-Palm Oil-Producing Provinces

Provinces	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**
Riau Island	na	na	na	na	na	145,686
DKI Jakarta	384,037	285,264	-160,348	-228,503	-148,141	-159,411
Central Java	-724,541	-436,059	-774,941	-380,473	-663,290	-334,589
DI Yogyakarta	25,923	9,878	40,963	54,305	67,056	102,149
East Java	-367,380	-170,446	-318,741	27,837	-343,071	-94,111
B a l i	-15,150	-3,123	9,840	12,879	39,872	37,630
West Nusa Tenggara	-12,766	11,040	548	10,998	9,250	-5,393
East Nusa Tenggara	-8,737	-4,548	-18,513	-10,507	14,921	3,148
North Sulawesi	7,239	-15,447	-16,536	-26,290	15,674	-2,950
Gorontalo	na	na	na	na	-24,191	-4,534
West Sulawesi	na	na	na	na	na	na
Maluku	19,909	-687	29,802	-22,968	-74,124	-20,802
North Maluku	na	na	na	na	-13,716	-6,164
West Papua	na	na	na	na	na	na
Net Migration	**-691,466**	**-324,128**	**-1,207,926**	**-562,722**	**-1,119,760**	**-339,341**

***Source*:** BPS (Population Censuses of 1980, 1985, 1990, 1995, 2000, and 2005)

5. Summary and Conclusion

Large-scale oil palm plantations have attracted many investors hoping to gain profits from the trading of palm oil as a raw material for biodiesel and to fulfill global market demands. As palm oil production continues to rise, the national government plans to expand plantation areas to up to 19 million hectares in 2020. In terms of market share, Indonesia has been leading other palm oil-exporting countries since 2009.

The current government under SBY is focusing on the expansion of palm oil plantations in order to create more job opportunities. This is expected to boost economic growth and reduce poverty. The government's ten-year plan, which includes increasing oil palm plantations to about 19 million hectares in 2020, aims to: (1) revitalize palm oil plantations; (2) focus on CPO-based biofuel development; and (3) establish a palm oil industrial area cluster program to achieve economies of scale. The national government also provides financial incentives such as people-based small-business loans (*Kredit Usaha Rakyat/KUR*) to palm oil producers, especially smallholders, to help them operate their palm oil businesses in economic zones in Sumatera and Kalimantan,

The global palm oil industry has been promoting green certification through RSPO since 2004 as a response to the deforestation issue. The RSPO is meant to encourage ethical practices and commitment from stakeholders to preserve rainforests and wildlife. It also serves as a network linkage among firms in the palm oil industry and between these firms and the government. The Indonesian government also plans to issue ISPO certification in 2011 to producers who can meet the sustainability standards from the processing to the production stages. However, certain questions about the ISPO implementation process itself still need to be clarified, such as the body authorized to award the certification and the standards or requirements that firms should achieve in order to get certified. At this point, the government should craft proactive and clear regulations or policy instruments, including effective coordination, R&D, and funding/financial assistance to create a certain business climate in Indonesia.

The impacts of oil palm plantations range from economic to ecological. In terms of economic impact, the palm-oil industry can improve Indonesia's export revenues. However, there is the issue of export taxes being levied on palm oil The export tax on palm oil is meant to stabilize domestic palm oil prices, but the national government should be more prudent in determining and implementing it to avoid snags in Indonesia's palm oil exports. Palm oil producers are concerned about the 25 percent export tax because they think it will make palm oil trading more complicated and may turn off local and foreign investors.

In addition, the palm oil industry creates jobs, especially for people who live in the rural areas. The industry helps bring about progress by improving the standard of living and the infrastructure in rural areas. Comparing the performance indicators between palm oil-producing provinces and the non-palm oil-producing provinces would show that palm oil-producing provinces had a significantly narrowed the gap in performance and access to basic infrastructure like clean water, proper sanitation, and electricity.

Moreover, since 2004—2005, the growth in Indonesia's GDP has followed the trend in the GDP growth of palm oil-producing provinces. There is a strong relationship between these two indicators. There has been a consistently positive net migration (migration in) in palm oil-producing provinces since 1980 while non-palm oil-producing provinces have had a negative net migration (migration out). This phenomenon was due to the implementation of the transmigration program and the increasing economic activities in the palm oil industry, which enticed people to come to, and operate businesses in, palm oil-producing provinces, which are mostly in Sumatera and Kalimantan.

On the social aspect, it is evident that the palm oil industry can cause a shift in human activities and perception as well as land usage. In the gradual transition from old to new communities, there has also been a shift in society's perception about culture (e.g., on women and child workers, corruption/gratification, debt, and horizontal conflict). The palm oil industry has also made the locals more dependent on food companies as a result of which they have stopped growing their own food. This brings about the shift in land usage.

Finally, on the ecological aspect, oil palm plantations affect the environment negatively because it causes forest degradation. In this case, the government should be more cautious in implementing several agreements it has made with other countries and international institutions regarding the reduction of GHG emissions, deforestation, and forest degradation in order to minimize inconsistencies. A case in point is the government's plan to further expand oil palm plantations by 2020 even as it forged an LoI with Norway about stopping land expansion in 2011—2013.

In conclusion, the expansion of oil palm plantations in Indonesia's rural areas can economically benefit local communities via infrastructure development and job creation. It can stimulate the establishment of small businesses in rural areas. The government should factor in the role of the local communities in oil palm plantations because they are important stakeholders in the palm oil industry. The expansion of oil palm plantations can damage nature and create conflict between the locals and palm oil companies. These problems, however, can be minimized, if not avoided, if a good relationship can be established among the local community, the local government, and the palm oil companies. Through right, strong, clear, and fair policies, the government will be able to promote rural development and poverty alleviation in Indonesia.

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Chapter 6

Agricultural Development, Trade, and Regional Cooperation in an Integrating and Industrializing East Asia
The Case of Lao PDR

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CHAPTER 6

Agricultural Development, Trade, and Regional Cooperation in an Integrating and Industrializing East Asia
The Case of Lao PDR

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1. Introduction

1.1. Background and rational of the project

Lao PDR is located in the center of Southeast Asia and shares borders with China in the north, Cambodia in the south, Viet Nam in the east, and Thailand and Myanmar in the west. The country has a total land area of 236,800 square km, on which about 5.6 million people are living.[1] Socioeconomically, Lao PDR is classified as a least developed country (LDC) with Gross Domestic Product (GDP) per capita of US$924 in 2009.[2] Agriculture is an important economic sector, contributing approximately 29.9 percent of GDP in 2009.[3] The sector employs over 70 percent of the country's total labor force.

[1] Population census, 2005
[2] The Ministry of Planning and Investment: Socioeconomic Development Plan 2009--2010.
[3] Ibid.

In 1986, Lao PDR adopted a comprehensive reform program called the New Economic Mechanism (NEM) to shift its central economic planning model to a market-oriented one. The program brought about open-door and integration policies in the following years. The open-door and integration policies had significant effects on the livelihood of the Lao people, including their production capacity.

There are a number of research studies and publications related to regional economic integration and agricultural production in Lao PDR. However, these materials provide only limited information and statistical data on integration and agricultural production in the country. They are not comprehensive and do not give a clear picture of the linkages between regional economic integration and the changes in Lao PDR's agricultural production. They also do not offer clear information on the impacts of improved agricultural production on economic growth and poverty reduction and on the risks and threats to agricultural development under the open-door and integration policies. A review done by the National Economic Research Institute (NERI) revealed that a number of questions related to regional economic integration and agricultural production remained unanswered.

In response to this need, NERI decided to conduct a study titled "Agriculture Development, Trade and Regional Cooperation" in cooperation with the Economic Research Institute for ASEAN and East Asia (ERIA). The goal of the study was to provide clearer and more comprehensive information on the issue. Additional details have been provided by the research team in the following subsection on research objectives and questions.

1.2. Objectives and Questions

The overall objective of this research is to provide the public with clearer and more comprehensive information on the linkages between regional integration policies and changes in agricultural production as well as the impacts of improved agricultural production on economic growth and poverty reduction in Lao PDR. Specifically, this research focuses on:

(1) reviewing regional economic integration policies and measures that affect agricultural production in Lao PDR
(2) reviewing agricultural development policies in Lao PDR in the context of regional economic integration
(3) providing some statistical data on agricultural production, investment, and trade
(4) evaluating the impacts of agricultural production and exports on economic growth and poverty reduction at the community level
(5) discussing how to maximize the benefits and minimize the cost of agricultural production under regional economic integration

1.3. Research Methodologies and Activities

To attain the research objectives and answer the questions, the research team conducted the following activities:

- *Literature Review.* The research team collected various documents, including previous research publications related to regional economic integration, agricultural production, investment in the agriculture sector, socioeconomic development, poverty reduction plans and strategies. All publications used in this report have been properly cited.
- *Interviews with Key Informants.* To get more detailed information, the research team conducted individual interviews with key informants, especially representatives from concerned agencies, including the Ministry of Planning and Investment (MPI), Ministry of Agriculture and Forestry (MAF), Ministry of Industry and Commerce (MOIC), Land Management Authority (LMA), and the Water Resource and Environmental Authority (WREA). Interviews were also conducted with representatives from nongovernment organizations (NGOs) operating in Lao PDR, including the International Union for Conservation of Nature (IUCN) and World Vision.
- *In-depth Study:* To get in-depth information and statistical data on the impacts of agricultural production and trade on poverty, the research team conducted an in-depth study in the Sing district in Luang Namtha province located in the northern part of Lao PDR where sugarcane plantations are abundant. Sugarcane produced in this area is exported to China. We interviewed representatives from the provincial departments of agriculture and forestry,

planning and investment, industry and commerce and the Sing district offices for agriculture and forestry and for planning and investment. We likewise organized focused group discussions in two villages involved in sugarcane production and export in the Sing district.

2. Regional Economic Integration and Trade Facilitation Policies in Lao PDR

2.1. Regional Economic Integration

The regional economic integration policy of Lao PDR started in 1986 with the introduction of a comprehensive reform program called the NEM, which was intended to facilitate the shift from the central planned economic model to a market-oriented one and which would consequently lead to the open-door policy in the 1990s.

Since the introduction of the NEM, Lao PDR has been gradually promoting regional integration and cooperation and became a full member of the Association of Southeast Asian Nations (ASEAN) in 1997 together with Cambodia, Viet Nam, and Myanmar. Consequently, Lao PDR joined the ASEAN Free Trade Area (AFTA). It thus took on an obligation to facilitate trade with other ASEAN member countries.

The ASEAN expanded its cooperation and free trade area (FTA) by introducing several programs. The ASEAN+3 (ASEAN + Japan, South Korea, and China) program expands cooperation and free trade with China. In November 2001, the ASEAN and China agreed in Phnom Penh to launch negotiations for the ASEAN-China Free Trade Area (ACFTA). In 2002, the parties signed the Framework Agreement on Comprehensive Economic Cooperation, which aims to: (1) strengthen and enhance economic trade and investment cooperation between the ASEAN and China; (2) progressively liberalize and promote trade in goods and services as well as create a transparent, liberal, and facilitative investment regime; (3) explore new areas and develop appropriate measures for closer economic cooperation between both parties; and (4) facilitate a more effective economic integration of newer ASEAN members and bridge the development gap among the parties.[4]

In 2004, the ASEAN and China signed the Agreement on Trade in Goods. According to this agreement, the six original ASEAN members (Thailand, Malaysia, Indonesia, the Philippines, Singapore, and Brunei) and China should reduce tariff on 90 percent of their products by 2010 while the new ASEAN members (Cambodia, Laos, Myanmar, and Viet Nam) will have to implement the agreement in 2015.[5]

The ACFTA will be fully implemented by 2015. However, Article 6 of the Framework Agreement requires the implementation of tariff reduction and tariff elimination on certain agricultural products ahead of schedule, supposedly to enable the parties to enjoy the early benefits of the FTA. The Early Harvest Program (EHP), for example, includes a total of 562 products. However, it allows for an exclusion list whereby a party can have certain products exempted from the program's coverage and a request list for the inclusion of certain products not covered by the program but mutually agreed upon by China and the concerned ASEAN member. Brunei and Singapore, whose economies are nonagricultural, fully subscribed to the provisions of EHP with no exemption. Viet Nam and Cambodia submitted their exclusion lists in 2002 prior to the signing of the framework agreement. Malaysia followed suit before the March 2003 deadline. Indonesia and Thailand had no exclusion list but had request lists. Indonesia's request list (as agreed upon with China) included coffee, palm oil, coconut oil, vegetable oil and fats, cocoa powder, soap, vulcanized rubber, glass for cathode-ray tubes (CRTs), and wooden furniture. Aside from including anthracite and coke of coal on its request list, Thailand earlier agreed with China in June 2003 to implement zero tariffs on fruits and vegetables. Lao PDR did not submit an exclusion list or request list. Consequently, the Lao-China EHP automatically includes all 562 agriculture product items. This means that reduced import tariffs will be imposed on Lao PDR's agricultural exports to China. Until recently, however, there has been no study on the effects of the EHP on the Lao-China trade flow.

[4] Framework Agreement on Comprehensive Economic Cooperation between ASEAN and People's Republic of China, Phnom Penh, 5 November 2002.
[5] Bernardino, "ASEAN-China Free Trade Agreement."

In addition, Lao PDR is working toward its acceptance to the World Trade Organization (WTO). When it becomes a member of the WTO, it will gain access to foreign markets and opportunities to get more investments and technological advancements, which are important factors in stimulating economic growth and reducing poverty in the long term. However, to get the real benefits of WTO accession, the country has to stimulate its production capacities, enhance productivity, and improve the quality of its products in order to increase its competitiveness in the international market.

Moreover, Lao PDR signed a bilateral and multilateral trade and transportation agreement with Thailand, Viet Nam, and China. This includes the following:

(1) Agreement to Exchange Traffic Rights and Implementation of the Customs Transit System in Lao PDR, Thailand, and Viet Nam on June 11, 2009. This agreement facilitates cross-border transportation along the East-West Corridor (EWC). To ensure the continuity of the integration policy and facilitate cross-border transportation, the governments of Lao PDR, Thailand, and Viet Nam agreed on June 11, 2009 to: (a) facilitate a vehicle's passage across national borders through the exchange of traffic rights; (b) permit vehicles to forgo the need to unload and reload goods at each border crossing through the customs transit guarantee system; and (c) allow minimum inspection of goods at border checkpoints within a reasonable amount of time via a single-stop and single-window inspection facility.

(2) Bilateral Transportation Agreement with Thailand, Viet Nam, China, Cambodia, and Myanmar. Lao PDR signed a bilateral transportation agreement with its neighboring countries to facilitate the movement of people and goods. The bilateral transportation agreement allows trucks from Lao PDR entry to and exit from neighboring countries with reloading rights. The agreement allows trucks from neighboring countries the same privileges. The bilateral transportation agreement facilitates trade and cooperation between Lao PDR and its neighbors.

However, it should be noted that Lao PDR does not have any specific bilateral agreement on agricultural trade with foreign countries. Instead, its exports of agricultural products are facilitated by regional and multilateral trade agreements. The lack of bilateral agreements on agricultural trade (which would facilitate the export of specific agricultural products to specific markets) seems to indicate that the country has no specific policy and strategy on agricultural trade. A specific policy and strategy would help agricultural development because the country has many constraints in agricultural production (e.g., land constraints, limited financial and human resources). It would also help Lao PDR enhance its productivity and competitiveness.

2.2. Trade Promotion Policies in Lao PDR

Recognizing the role of external trade in the country's economic growth and poverty reduction efforts, the government facilitates exports and imports through several policies, such as the:

(1) *One-Stop Service Policy*. On October 13, 2004, the MOIC enacted Order Number 962 (Implementing Decree Number 205/PM on the Establishment of One-Stop Service) in an effort to facilitate exports and imports.[6] This policy directs all export- and import-related agencies in all provinces and the nation's capital, Vientiane, to establish offices at all border checkpoints and to abolish export-import licenses (except for gold, copper, vehicles, vehicle spare parts, petroleum, gas, diamonds, and other prohibited goods requiring import licenses from the MOIC). A study conducted by NERI in 2008 showed that the implementation of the One-Stop Service policy facilitates cross-border trade by reducing time and costs.

(2) *Border Trade Facilitation Policy*. In 2001, the MOIC issued Instruction Number 948 on the Management of Border Trade. This policy aims to promote small-scale commercial production and exports as well as create jobs and income-generating activities for people living on the country's borders. It also classifies border areas into two types: remote areas and nonremote areas. Remote areas have no access to, or have difficulty in accessing, domestic markets while nonremote areas have good access to domestic markets. People in remote areas can export and import all kinds of products necessary for production and consumption while those in nonremote areas can export all their products but import only the necessary production inputs. People living in nonremote areas have to buy consumer products from the domestic market.

[6] Cross-Border Economy 2008.

(3) *Special Economic Zone and Border Trade Area Establishment Policy.* To facilitate trade and promote investment, the government implements policies governing special economic zones (SEZs) and establishing border trade. To date, one SEZ and three border trade areas have already been established. Additional incentives and facilitating measures are necessary to attract more investment and trade in the border areas and SEZs. For example, investors at the SAVAN-SENO SEZ enjoy privileges such as exemption from turnover and utilization and minimum tax and other incentives. These incentives include: (a) tax exemption during the early stages of investment and tax reduction based on sector and condition; (b) dividend tax of only 5 percent, which is lower than the normal rate; (c) profit tax of 5 percent, which is also lower than the normal rate; (d) transferable deficit within five years; (e) exemption from import taxes on raw materials, construction materials, equipment, machinery, transport vehicles, spare parts, and semifinished products and end products for use in or assembly at the SEZ; and (f) reduced minimum registration capital based on investment sector. Investors at the Lao-China border trade area also enjoy various incentives, including (a) exemption from taxes on profit and income for the first four years of operation and a 50 percent reduction in said taxes for an agreed period when the four years are up; (b) seven-year exemption from land taxes; and (c) 10 percent reduction in import tax. If investors use domestic raw materials in their production processes, the import tax levied on the final products coming from the border trade area into the Lao domestic market is reduced based on the percentage cost of the domestic raw materials used vis-a-vis the total production cost. For example, the import tax for an investor who uses domestic raw materials costing 30 percent of the total production cost will be reduced by 30 percent when the final products are imported into the domestic market.[7]

2.3. Development of Infrastructure Links with the External World

The preceding subsection clearly shows that Lao PDR recognizes the important role of external trade and regional integration in its economic growth and poverty reduction efforts. The country has implemented many policies and measures to facilitate trade and investment. In addition, it is

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[7]The National Economic Research Institute (NERI), "*The Effect of Border Trade on Human Resource Development.*"

also working towards developing infrastructure and communication systems that will link it to neighboring countries. This includes upgrading the following public infrastructure: (1) EWC, which crosses Lao PDR from east to west and links the country with Viet Nam to the east and with Thailand to the west; (2) the North-South Corridor, which crosses Lao PDR from northeast to northwest and links the country with China to the north and with Thailand to the northwest; and (3) the First and Second Friendship Bridges in Vientiane and Savannakhet province, respectively. In addition, a number of international and local border gates have been opened to facilitate the movement of commodities and people. There are currently about fourteen international border gates in Lao PDR and a big number of local and informal border gates. The pictures below show infrastructure linking Lao PDR with neighboring countries.

Picture 1: Savannakhet-Mudahan international border gate	**Picture 2: Second Friendship Bridge**	**Picture 3: Road 9 (East-West Corridor)**
		

Photo Credit: NERI 2008.

Communication and information systems are also being developed. Mobile phone networks are present in all the cities and economic centers of the country. SIM cards from neighboring countries can be used at the border areas. Broadcasts from radio stations and television channels from Thailand, Viet Nam, and China are available everywhere in the country. The development of information and communication infrastructure facilitates the cross-border movement of trade and people.

Regional economic integration significantly affects agricultural production in the country. Details of this are discussed in the succeeding sections.

The government is also implementing various programs to develop road networks that will link the country to main roads in the regions and to the border areas in order to boost cross-border trade and facilitate the movement of people. The transportation sector received the biggest budget allocation from the government in the last decade. From fiscal years 2005—06 to 2009—10, the government allotted a total of US$846 million to develop the domestic transportation system. This amount represented 39.1 percent of the total government budget during that period. Table 1 shows total expenditures for the development of the domestic transportation system for fiscal years 2005—06 to 2009—10.

Table 1. Budget Allocation for the Transportation Sector, 2005/06 and 2009/10 (in US$ million)

Sectors	**2005/06**	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2005/06-2009/10**
Transportation sector	235.9	198.8	159.2	119.5	128.2	841.6
Non-transportation sector	220.2	220.3	258.5	296.7	316.2	1,312.0
Total	456.1	419.1	417.7	416.2	444.4	2,153.6

***Source*:** Ministry of Planning and Investment (MPI), Socioeconomic Development Plan 2009—10.

The budget allocation helped improve the quality and quantity of road infrastructure, increasing the total distance of road networks by 16.9 percent from 2005 to 2009, or a total of 33,861 km in 2005 to 36,831 km in 2007 and finally to 39,569 km in 2009 (see table 2).

Table 2. Statistical Data on Road Distance in Lao PDR, 2005/09 (km)

Sectors	**2005**	**2006**	**2007**	**2008**	**2009**
Concrete road	0	0	0	0	34
Asphalt concrete road	0	0	0	0	496
Tarred road	4,586	4,548	4,811	4,739	4,882
Graveled road	11,608	11,981	12,572	10,928	13,864
Earthen road	17,667	18,731	19,448	19,327	20,293
Total	33,861	35,260	36,831	34,994	39,569

***Source*:** Statistical Year Book 2009.

The improvement of road infrastructure has lowered transportation costs and shortened travel time. For example, the transportation cost per truck on Road Number 9 (part of the EWC) from the Lao-Viet Nam border to the Lao-Thai border (which has total distance of 280 km) has gradually gone down from US$1,012 in 2004 to US$837 in 2006 and further to US$526. Travel time has also decreased from 7.5 hours in 2004 to 4.6 hours in 2008 due to road upgrades and the completion of the Second Friendship Bridge. The transportation cost includes the border crossing fee and fees on the Lao border but excludes the fees collected at the Viet Nam and Thai borders.[8] The travel time involved includes time spent in crossing the borders.

The development of roads and lower transportation costs facilitate trade and investment, including trade and investment in the agriculture sector. However, due to geographical constraints, the roads are still relatively underdeveloped and transportation costs remain relatively high in Lao PDR compared to neighboring countries like Thailand, Viet Nam, and Cambodia. Road infrastructure and transportation costs remain a drawback to agricultural production and trade, especially in the remote areas in the northern and eastern parts of the country.

3. Agriculture Development in Lao PDR in the Context of Regional Economic Integration

3.1. Agriculture Promotion Policy and Measures in Lao PDR

Developing the agriculture sector is crucial to stimulating economic growth and reducing poverty in Lao PDR. The government has been implementing policies and measures to spur development in this sector. These policies and measures include the following:

[8] The National Economic Research Institute (NERI), "*Sharing the Benefits from Transportation Linkages and Logistics Improvement in the GMS: A Case Study of the East-West and North-South Corridor*," Lao Country Report (Bangkok: Thailand Development Research Institute Foundation, 2009).

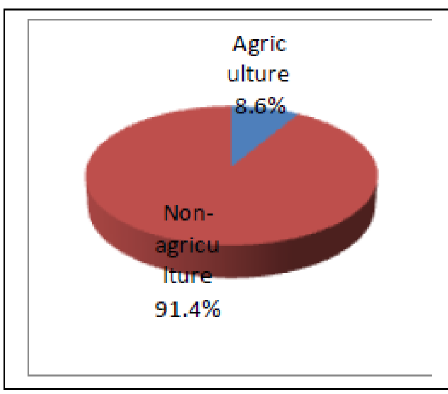
- ***Fiscal Policy***. The government has been allocating a substantial budget for agricultural development for decades. From the fiscal years 2005—06 to 2009—10, the total budget allocated for the agriculture sector was approximately US$184.8 million, corresponding to about 8.6 percent of the total national budget during the same period (see table 3).

Table 3. Budget Allocation for the Agriculture Sector, 2005/06 to 2009/10 (in US$ million)

Sectors	2005/06	2006/07	2007/08	2008/09	2009/10	2005/06-2009/10
Agriculture	54.6	39.6	34.2	28.9	27.5	184.8
Non-agriculture	401.5	379.6	383.5	387.4	416.9	1968.8
Total	456.1	419.1	417.7	416.2	444.4	2153.6

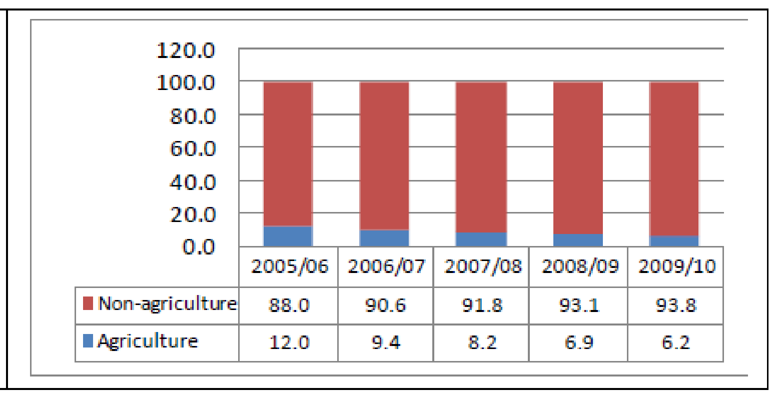
Source: Ministry of Planning and Investment (MPI), Socioeconomic Development Plan 2009—10.

Figure 1. Share of budget allocated to the agriculture sector, 2005/06 to 2009/10 (%)



Source: Estimated by NERI by using data provided by the MPI

Figure 2. Share of budget allocated to the agriculture sector, by year, 2005/06 to 2009/10



Source: Estimated by NERI by using data provided by the MPI

Thus, the agriculture sector is the third sector to receive the biggest budget allocation after the transportation and education sectors. About 80 percent of its budget is used for the development of agricultural infrastructure, including irrigation systems. Only about 20 percent is used for technical undertakings, such as training and research and development (R&D).

Despite being the third-biggest allocation in the national budget, the agriculture budget is very limited relative to actual need, according to the MAF. Underdeveloped agricultural infrastructure, relatively low productivity, relatively low quality of agricultural products, lack of effective land-use planning, among others, indicate that agricultural development needs more capital and human resource input from the government.

Figure 2 shows the share of the budget allocated to the agriculture sector, which has been gradually declining from 12 percent in fiscal year 2005—06 to 8.2 percent in fiscal year 2007—08, and further to 6.2 percent in fiscal year 2009—10. On average, allocation for the agriculture sector has been reduced by about 1.6 percent per year because of the government's industrialization/modernization policies and strategies. The government is committed to transforming the economy from being agriculture based to being industry- and service based. Thus, it is constrained to allocate bigger budgets for the industry and service sectors, causing a decline in the budget for agriculture.

- ***Monetary Policy.*** To facilitate monetary requirements in agricultural production, the government established the Agriculture Promotion Bank (APB), a state-owned enterprise (SOE) specifically mandated to promote agricultural production in the country. The APB's headquarters is in Vientiane Capital. It has a branch in each province and a representative office in many districts in Lao PDR.

  The APB, which receives funding and subsidy from the government, offers zero-interest or low-interest credit (i.e., between 7 percent and 10 percent per year) to support agricultural production. From 2006 to 2009, it provided credit amounting to US$263.9 million to support activities related to agricultural production (see table 4).

  The Policy Bank (PB), established in 2008, also provides financial support for agricultural production. The bank is not mandated to directly promote agricultural production but to support the poverty reduction policy of the government. However, due to the high concentration of the poor in the agriculture sector and the fact that agricultural development is crucial to fighting poverty, the PB has indirectly become an agriculture promotion bank. The bank's headquarters is situated in Vientiane Capital, with branches in each province and a representative office in many poor districts in Lao PDR.

The PB obtains capital from government allocations, the poverty reduction fund, and financial assistance from local organizations, among other sources. It is mandated to offer low-interest or zero-interest credit to support poverty reduction activities, including agricultural production. Since its establishment in 2008, the bank has issued credit amounting to US$95.8 million to support activities related to agricultural production (see table 4).

Table 4. Credit to Support Agricultural Production, 2006/09 (in US$ million)

Banks	**2006**	**2007**	**2008**	**2009**	**2006/09**
Agriculture Promotion Bank	27.6	38.7	92.5	105.1	263.9
Policy Bank			32.2	63.5	95.8
Total	27.6	38.7	124.7	168.7	359.7

Source**:** Estimated by NERI using data provided by the APB and the PB.

However, a manager at the APB claimed that the amount of credit the bank has provided was very small compared to actual need, meeting only about 10 percent of the demand for credit. The bank manager further said that most of the credits availed of were short-term credits and were provided to domestic agricultural production companies, including companies collecting and exporting agricultural products. Only a small share of the credit was provided directly to independent farmers due to several constraints, particularly reservations about the determination and capability of the farmers to develop a business plan required by the bank and their ability to pay. This indicates the need for appropriate training in this aspect for farmers.

There are also commercial banks that provide credit, including the Development Bank, the Banque Pour Le Commerce Exterier Lao (BCEL), and the Phongsavane Bank. However, these banks are purely commercial and charge relatively high interest rates (about 17 percent to 20 percent). Local farmers do not have easy access to credit because of their small income.

In conclusion, the agriculture sector (and small-scale farmers, in particular) in Lao PDR has to hurdle problems and difficulties related to access to credit.

- ***Agriculture Investment Promotion Policy.*** As previously mentioned, agricultural development is one of the key approaches to economic growth and poverty reduction in Lao PDR. The agriculture sector has been made accessible to all investors, including foreign investors. Investors in the sector enjoy a number of incentives, including:

(1) Land Leasing. Investors can avail themselves of large areas of land via concession agreement, at a reduced cost and for a long period of time. The provincial government is responsible for considering and leasing out lands of less than 100 ha to investors. The national government processes and leases out lands of less than 10,000 ha while lease applications for lands exceeding 10,000 ha are handled by the National Assembly. The concession fee depends on location and negotiation. The lowest yearly concession fee is US$6 per ha. The longest concession period is 60 years.

(2) Export and Import Facilitation. Lower taxes levied on imported machinery, equipment, raw materials, and other commodities necessary for agricultural production facilitates importation. Import taxes are currently pegged at only 1 percent of the total value of the imported goods. Meanwhile, small-scale exports of agricultural products are tax-free (by virtue of border trade agreements). Large-scale exports of agricultural products, however, are levied an export tax of less than 1 percent of the total value of exported goods.

(3) *Business / Income / Profits Tax Exemption*. Investors in the agriculture sector get longer tax holidays and pay lower taxes compared to investors in other sectors. Investors who

choose to set up businesses in remote areas where road infrastructure is underdeveloped and access to market is difficult get a tax holiday of up to seven years after initial harvest. For example, investors in rubber plantations (where it takes typically seven to eight years before the first harvest) get 14 to 15 years' tax exemption.

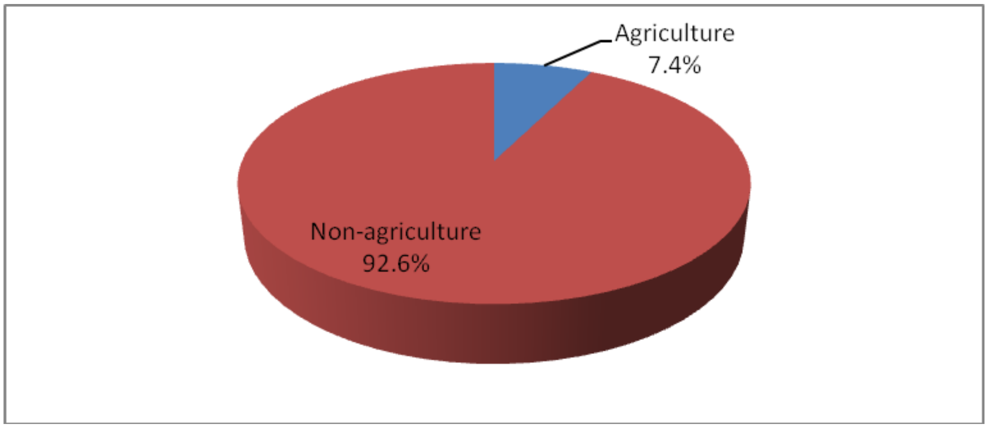
As a result of the vast incentives made available to investors, a significant number of foreign direct investments (FDI) flowed into the agriculture sector. Data from the MPI show that for the period 2005—09, the total amount of FDI in the agriculture sector was about US$917.9 million, which represents approximately 7.4 percent of total FDI in the Lao PDR during the same period (see table 5).

Table 5. Foreign Direct Investment (FDI) in the Lao PDR, 2005/09 (in US$ million)

Sectors	**2005**	**2006**	**2007**	**2008**	**2009**	**2005/09**
Electricity	1,065.3	1,776.7	360.5	640.0	218.2	4,060.7
Agriculture	17.4	458.5	183.8	78.5	179.7	917.9
Mining	93.5	73.8	115.3	102.1	2,142.4	2,527.1
Industry and handicrafts	14.6	123.0	134.2	156.9	192.1	620.8
Trade	7.8	86.0	13.9	12.9	10.0	130.6
Construction	1.6	1.8	0.0	66.6	22.2	92.2
Service	20.9	181.2	181.2	23.4	1,047.6	1,454.3
Hotel and restaurant	13.1	32.2	58.2	29.4	40.2	173.1
Telecommunications	0.0	0.0	0.0	32.5	80.0	112.5
Wood processing	5.7	1.0	57.0	21.0	0.0	84.7
Banking	5.0	0.0	25.0	43.0	50.0	123.0
Garments	0.3	3.9	5.5	5.1	1.2	16.0
Consultancy services	0.2	1.8	2.3	4.0	5.4	13.7
Total	**3,250.4**	**2,739.9**	**1,136.9**	**1,215.4**	**3,989.0**	**12,331.6**

***Source*:** MPI

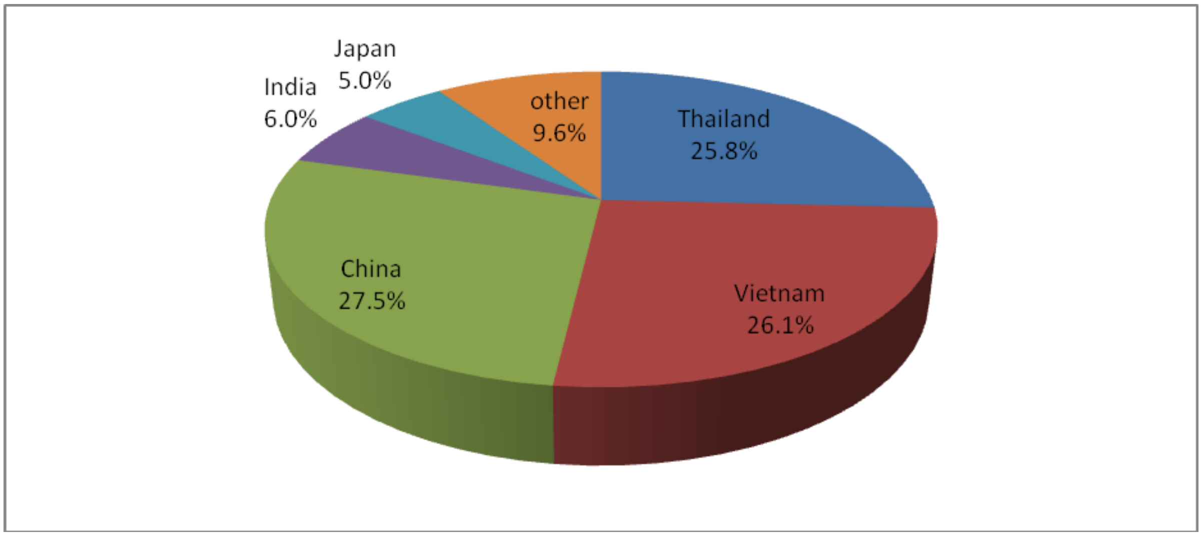
Figure 3: Share of the agriculture sector in FDI, 2005/09



Source**:** Estimated by research team by using data provided by the MPI.

The agriculture sector is the fourth-largest sector in terms of FDI, after electricity, mining, and the services sectors. The biggest share (27.5 percent) of FDI comes from China. A total of 26.1 percent comes from Viet Nam, while 25.8 percent is from Thailand (see figure 4).

Figure 4. Source of FDI in the agriculture sector, by investing country, 2005/09



***Source*:** Estimated by research team by using data provided by the MPI.

Due to the lack of an efficient monitoring system, exact statistics on private domestic investments in the agriculture sector is not available. However, a case study done in the Savannakhet and Saravane provinces by the NERI in 2010 shows that the number of private domestic investments in the agriculture sector is also significant, accounting for over 35 percent of total private investments (private domestic and foreign investment). Total private investments were estimated to have reached over US$1,230 million. Thus, the country's agriculture sector is one of the sectors with the most number of investors.

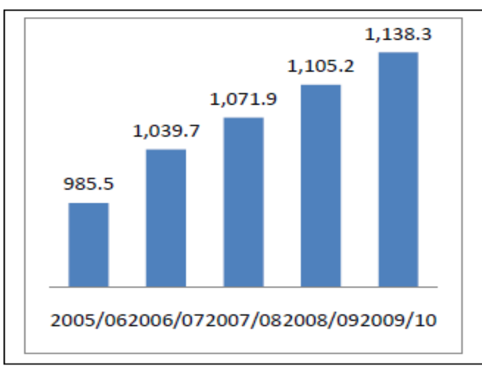
However, existing agricultural promotion policies and strategies focus mainly on promoting agricultural production to meet domestic demand, especially in terms of food security and poverty reduction. Until recently, the government had no clear policy and strategy to promote large-scale and export-oriented agricultural production. There are, as yet, no comprehensive plans on land use, no system for determining key products and standards, and no concrete marketing strategies. The larger and decidedly more export-oriented agricultural enterprises, such as rubber plantations, sugarcane plantations, and eucalyptus plantations, are driven more by global market demand than by government policies and strategies. The expansion of agribusiness in the country is thus associated with risks and threats, especially of the social and environmental kind. For example, land concessions lacking detailed studies, land allocation, and land-use planning can affect forestry, biodiversity, and watershed areas. It can also produce serious land conflicts and a negative impact on the livelihood of the locals. Therefore, the effects of recent agribusiness expansion in the country bear watching.

3.3. Agricultural Production Value in Lao PDR

As a result of massive promotion policies and measures, agricultural production in the country has experienced a rapid increase. The total production value of agricultural production (at 2005 prices held constant) increased from US$985.5 million for the fiscal year 2005—06 to US$1,071.9 million for the fiscal year 2007—08 and then to US$1,138.3 million for the fiscal year 2009—10. This represents an average increase of 3.1 percent per year. This rate of increase is small compared to the average increases posted by the industry and services sectors of 12.3 percent and 8.8 percent, respectively, during the same periods (see figures 5 and 6).

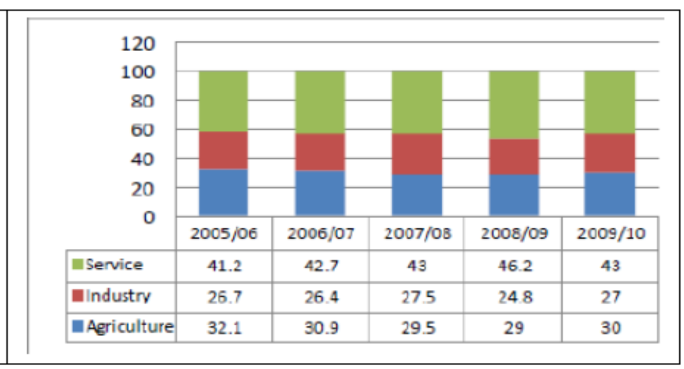
Despite only a slight increase, however, agricultural production remains an important economic sector. It contributed around 30 percent to the total production value (TPV) during the fiscal year 2009—10 (figures 5 and 6).

Figure 5. Total agriculture production value, 2005/06--2009/10 (in US$ million)



***Source*:** MPI

Figure 6. Share of agriculture production value in GDP in Lao PDR, 2005/06--2009/10 (%)



***Source*:** Estimated by research team by using data provided by the MPI.

It should be noted that the share of agricultural production in TPV gradually declined from 32.1 percent in the fiscal year 2005—06 to 30 percent in the fiscal year 2009—10 because the industry and service sectors experienced higher growth rate during the last decade. Also, some crops like rubber had not yet produced yields during that period. The total land area devoted to rubber plantations in Lao PDR has reached more than 115,213.9 ha, of which only a small portion (300 ha) has started to produce rubber. A bigger harvest of rubber is expected within the next three years.

3.4. Key Agricultural Products of Lao PDR

The agriculture sector includes crop farming, livestock production, and fishery.

3.4.1. Key crops

Crop farming is the biggest and most important subsector in the country's agriculture sector. Generally, there are two kinds of crop farming: food and industrial crop production. Food production in the Lao PDR remains basic, utilizing traditional production practices. Thus, food production is relatively low compared to food production in neighboring countries like Viet Nam and Thailand (see table 6).

Table 6. Production Area and Productivity of Key Food Items Produced in the Lao PDR, 2008/09

Items	2008			2009		
	Harvest (ha)	Production (ton)	Productivity (tons/ha)	Harvest (ha)	Production (ton)	Productivity (tons/ha)
Rice	825,545	2,969,910	3.6	872,869	3,144,800	3.6
Sweet maize	14,500	51,800	3.6	17,500	60,500	3.5
Starchy roots	24,295	396,259	16.3	28,506	323,737	11.4
Vegetables and beans	81,305	521,495	6.4	115,769	722,166	6.2
Peanuts	19,376	32,690	1.7	19,577	35,163	1.8

Soybeans	9,690	13,515	1.s4	10,278	15,989	1.6
Mungbeans	2,920	3,890	1.3	2,430	3,686	1.5

***Source*: MPI**

Table 6 shows that the major food item produced in the country is rice. In 2009, approximately 3.1 million tons of rice was produced from a total of 872,869 ha. This covers areas with seasonal, irrigated, and upland rice production. Rice productivity, especially upland rice production (with productivity of about 1.5 tons per ha), is quite small at 3.6 tons per ha compared to that of neighboring countries like Thailand, Viet Nam, and Cambodia. In Thailand and Viet Nam, the average rice productivity is 5 tons per ha.

The low rice yields indicate that the country's rice production needs to be given more support and development effort by concerned agencies, especially in the areas of high-quality seeds, irrigation systems, and training on rice production.

Vegetables and beans come in second on the list of key food items. In 2009, the country's output of vegetables and beans, produced from a total of 115,796 ha, reached 722,166 tons. Productivity is estimated to be 6.2 tons per ha. Starchy roots, peanuts, and sweet maize followed vegetables and beans in terms of output and productivity.

Rice production per capita in 2009 was estimated to be 561.6 kg per person. Vegetable and bean production per capita was about 129 kg per person per year in the same year (see table 7).

Table 7. Per Capita Food Production in Lao PDR, 2008/09

	2008		2009	
Food Items	**Production (ton)**	**Production/person (kg/person)**	**Production(ton)**	**Production/person (kg/person)**
Rice	2,969,910	530.3	3,144,800	561.6
Sweet maize	51,800	9.3	60,500	10.8
Starchy roots	396,259	70.8	323,737	57.8

Vegetables and beans	521,495	93.1	722,166	129.0
Peanuts	32,690	5.8	35,163	6.3
Soybeans	13,515	2.4	15,989	2.9
Mungbeans	3,890	0.7	3,686	0.7

Source**:** Estimated by the research team by using data provided by the MPI.

Figures presented in table 7 suggest that Lao PDR has produces sufficient rice and other food items for domestic consumption. However, over 1.5 million people, accounting for about 28 percent of the total population, still live below the poverty line. This means that these people have a monthly rice consumption of less than 16 kg per person. Most of these people live in the remote areas in the northern and eastern parts of the country where infrastructure is underdeveloped and access to market and food production are difficult. In these areas, food production is insufficient.

Lao PDR exports some food items including rice, vegetables, fruits, and livestock to neighboring countries like China and Viet Nam. It also imports from Thailand and China several food items, such as rice, vegetables, fruits that are not produced in the country, meats, and fish through border trade.

Industrial crop plantations experienced a significant change, gradually industrializing and using modern production systems, during the last decade due to the massive inflow of investments (see table 8).

Key industrial crops in Lao PDR are rubber, sugarcane, coffee, and maize (table 8).

Table 8. Key Industrial Crops in Lao PDR, 2008/09

Item	2008			2009		
	Production Area (ha)	**Production (ton)**	**Productivity (ton/ha)**	**Production Area (ha)**	**Production (ton)**	**Productivity (ton/ha)**
Tobacco	5,923.0	13,103.0	2.2	5,513.0	15,966.0	2.9
Cotton	1,796.0	1,196.0	0.7	2,522.0	2,036.0	0.8
Sugar cane	17,055.0	749,295.0	43.9	19,147.0	856,915.0	44.8
Coffee	57,875.0	31,125.0	0.5	46,758.0	37,252.0	0.8
Tea	1,930.0	2,500.0	1.3	1,000.0	890.0	0.9
Rubber	115,213.9	N/A	1.36	115,213.9	N/A	1.36
Maize	229,220	1,107,775	4.8	207,600	1,134,386	5.5

***Source*:** Estimated by research team by using data provided by the MPI.

Note: N/A = not applicable

Maize is the most important industrial crop in Lao PDR in terms of production area (table 8). In 2009, the country's total maize production area was 207,600 ha, producing over 1.1 million tons. Estimated productivity was about 5.5 tons of maize per ha.

Rubber, the second-most important industrial crop in the country, owes its growth to FDIs, particularly from China and Viet Nam. The total area devoted to rubber plantations in 2009 was about 115,000 ha. A large number of rubber trees planted in 2006 and 2007 have not yet produced any yield, but a big harvest is expected within the next three years. Rubber is exported to neighboring countries, particularly China.

The total output for coffee, another important industrial crop, was over 37,252 tons in 2009, generated from over 46,758 ha. Coffee plantations are located mostly in the southern part of the country. Coffee productivity is estimated to be about 0.8 ton per ha. A large portion of output is exported.

Sugarcane, the next important industrial crop, had over 19,000 ha planted to it in 2009. There are two sugar factories in Savannakhet province established by Thai investors, which support sugarcane contract farming. The factories have over 15,000 ha of sugarcane plantations in the same province, accounting for the biggest share (over 15,000 ha) of the total number of sugarcane plantations in the country. There are also sugarcane plantations in the northern provinces, especially in Luang Numtha, Phongsaly, and Oudomxay provinces. The sugarcane produced in these areas is exported to China.

3.4.2. Livestock and Fishery Production

Livestock production in Lao PDR is generally a small-scale affair that follows traditional production systems and is devoted mainly to meeting domestic demands. Only a small portion of output is exported to neighboring countries, especially Viet Nam. Key animals produced are buffaloes, cattle, pigs, goats, sheep, and fowl. Livestock production in Lao PDR has generally followed an increasing trend. In 2009, there were about 1.17 million heads of buffaloes and 1.51 million heads of cattle (see table 9).

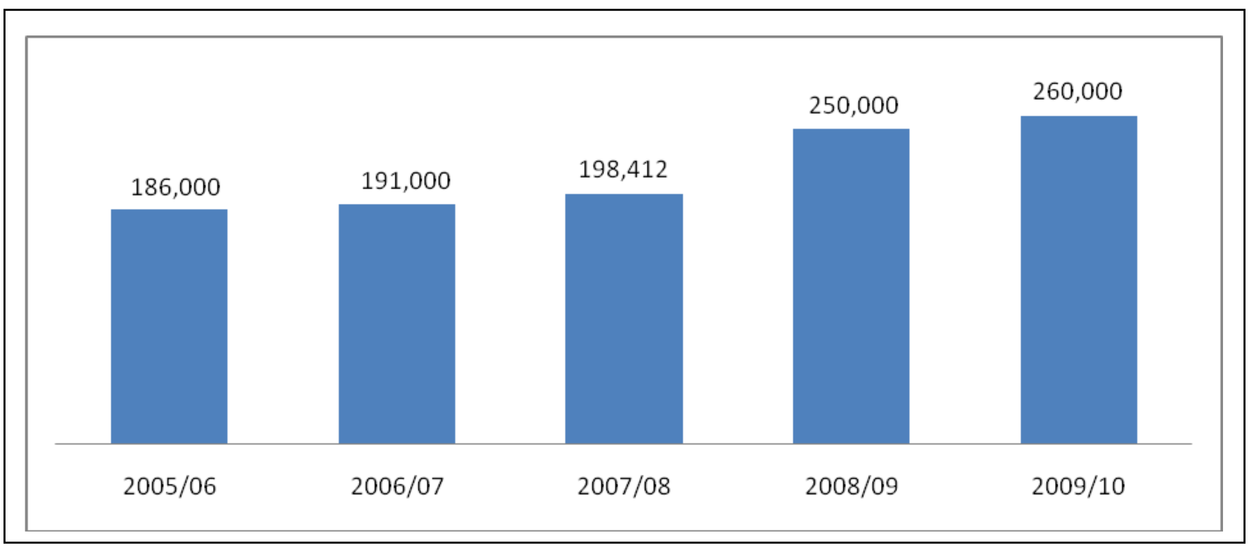
Table 9. Number of Livestock in Lao PDR, 2008/09 (heads, in millions)

Items	2008	2009
Buffalo	1.15	1.17
Cattle	1.50	1.51
Pig	2.60	2.92
Goats and sheep	0.30	0.40
Fowl	22.00	22.50

Source**:** MPI Socioeconomic Development Plan 2009/10.

Meanwhile, brisk production in the fisheries subsector has resulted in an average growth rate of about 8 a year. The output of 186,000 tons in fiscal year 2005—06 increased to 198,412 tons in fiscal year 2007—08 and then to 260,000 tons in fiscal year 2009—10 (see figure 7). The fisheries subsector serves mainly the domestic market. Per capita production in fiscal year 2009—10 was estimated to be 46.2 kg per person, sufficient to meet domestic demand.

Figure 6. Fish Production in Lao PDR, 2008/09—2009/10 (ton)



Source**:** MPI Socioeconomic Development Plan 2009/10.

3.4. Agricultural Products Exported by Lao PDR

As previously mentioned, most of Lao PDR's industrial crops are exported to neighboring countries, particularly China, Thailand, and Viet Nam. In addition, the country also exports some livestock to neighboring countries, especially Viet Nam (table 10).

Table 10. Agricultural Products Exported by Lao PDR, 2005/09

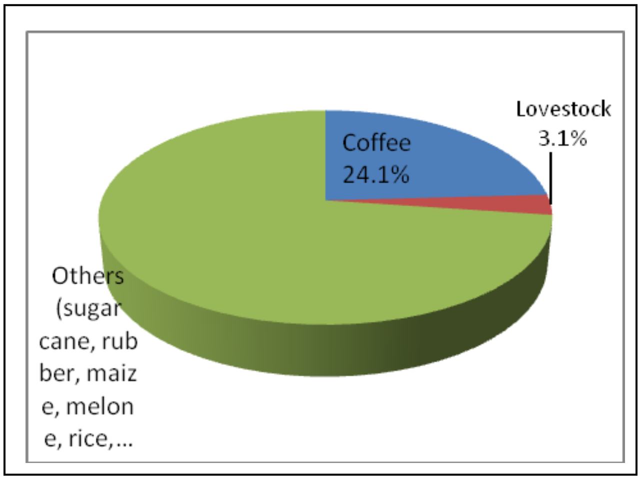
Items	2005	2006	2007	2008	2009	2005/09
Agriculture products	**32.3**	**38.2**	**61.2**	**56.0**	**57.7**	**245.4**
Coffee	*9.6*	*3.0*	*15.6*	*16.0*	*15.0*	*59.2*
Livestock	*3.1*	*1.4*	*1.0*	*1.0*	*1.0*	*7.5*
Others (sugarcane, rubber, maize, melon, etc.)	*19.6*	*33.8*	*44.6*	*39.0*	*41.7*	*178.7*
Non-agriculture products	**420.8**	**582.8**	**967.1**	**969.0**	**988.4**	**3,928.1**
Total	**453.1**	**621.0**	**1,028.3**	**1,025.0**	**1,046.1**	**4,173.5**

***Source*:** MPI Socioeconomic Development Plan 2009/10.

Table 10 shows the export performance of agricultural products from 2005—09 (valued at more than US$245.4 million) and accounting for about 5.9 percent of the country's total export value during the same period. This excludes the export of processed agricultural products like sugar. Lao PDR exported to the European Union (EU) via Thailand more than 37,000 tons of sugar in 2009. Exports of processed agricultural products is recorded under industrial product exports.

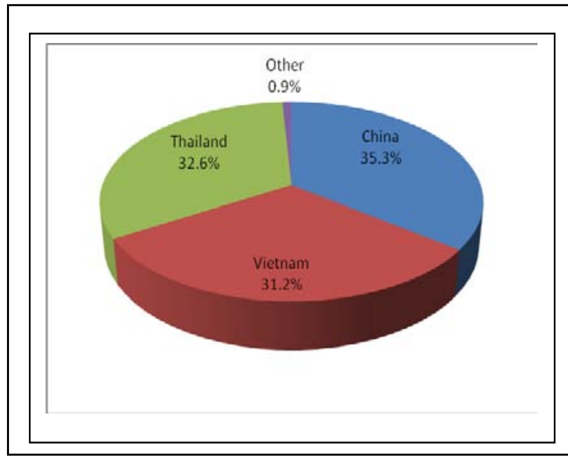
The most important agricultural export products are coffee, livestock, sugarcane, maize, watermelon, and rice (see figure 8).

Figure 7. Share of agriculture exports, by product, 2005/09



***Source*:** Estimated by research team by using data provided by the MPI

Figure 9. Share of agriculture exports, by country, 2005/09



***Source*:** Estimated by research team by using data provided by the MPI

From 2005—09, exports of agricultural products to China (the country's biggest export market for agricultural products) reached a total of US$86.6 million, accounting for about 35.3 percent of the total value of agricultural exports during the same period. Exports to Thailand, the second-biggest export market for the period 2005—09 reached more than US$80 million, accounting for about 32.6 percent of total agricultural exports. Viet Nam is the third-most important export market for the country's agricultural products (see picture 9).

4. Impacts of Agricultural Production and Trade on Economic Growth and Poverty Reduction in Lao PDR: A Case Study on Sugarcane Plantation and Exports in the Sing District, Luang Numtha Province

This subsection evaluates the impacts of agricultural production and exports on economic growth and poverty reduction at the community level. However, the researchers were not able to explore the impacts of all agricultural products and exports throughout the country because of constraints in budget, time, and human resources. The researchers instead conducted an in-depth study on sugarcane plantation and exports in the Sing district to see how agricultural production and exports contribute to economic growth and poverty reduction in the area. There were many reasons for selecting this product and area for this study, one of which is the significant role of agricultural production and exports and the relatively high poverty level in the area. For these reasons, the researchers anticipated significant impacts of agricultural production and exports on poverty reduction in the Sing district.

In order to present in detail the effects of agricultural production and exports on poverty, an overview of the area's geographical location, road infrastructure, and information links with the external world (i.e., China) would also need to be presented. The macroeconomic situation in the area, including poverty incidence and poverty reduction over time, is also discussed, followed by an analysis of the effects of sugarcane plantations and exports on poverty in the Sing district.

4.1. Geographical Location, Infrastructure, and Communication Development in the Case Study Area

Map 2. Geographical location of case study area, Sing District, Luang Numtha province

Source: NERI

Map 1. Sing District, Luang Numtha province

Source: the National University of Laos

The Sing district is located in Luang Numtha province, about 60 km north of the provincial capital. The district covers an area of 1,430 square km (142,957 ha) and is bordered by the La district of China in the north, Long district in the south, Numtha district in the east, and Myanmar in the west (see maps 1 and 2). The most important specific characteristics of the district are its landscape, temperature, and soil fertility. Over 60 percent of the district's land area is endowed with pastures. The average temperature is estimated to be 25 degrees Celsius. The topographical and climatic conditions are excellent for agricultural production, including rubber and sugarcane plantations.

In addition, the district has good road and information links with China, especially with the La district, which further facilitates trade. A paved road crosses the district and connects the area with China while an international border gate serves as the main gate for trade with China. China SIM cards can also be used in the district. Total population is 30,548, over 60 percent of which is of working age (i.e., between 15 and 60 years old).[9]

4.2. Macroeconomic Situation in the Case Study Area

Socioeconomically, the Sing district has middle-income status, compared with other cities in the country. The district has a relatively high socioeconomic status compared to other districts in northern Lao PDR. In 2008, the average per capita income was US$600, and poverty incidence was 11 percent.[10] During the last decade, the district experienced relatively high economic growth and a rapid decline in poverty level. According to the Sing district's Office for Planning and Investment, the district experienced yearly economic real growth of about 8 percent and poverty reduction of 1.6 percent per year during from 2004 to 2006. Based on per capita income and poverty incidence, the Sing district is considered a relatively more developed district in the Luang Numtha province.

[9] 2005 population census

[10] Sing District's Office for Planning and Investment

The main economic activity in the district is agriculture, which contributed about 70 percent of its total production value and employed over 80 percent of its labor force in 2008. The services sector, including trade and tourism, contributed about 20 percent of production value and employed about 15 percent of the labor force. The industry sector is undeveloped, contributing only about 5 percent of total production value in 2008. The district also has relatively good access to health and education services, compared to the entire Luang Numtha province. There are fifty-six primary schools in the entire district. The school attendance rate of children is about 85 percent, compared to 80.1 percent for the entire Luang Numtha province. Maternity mortality rate is 300 per 100,000 births. Mortality rate of children under five years old is 48 per 1,000 live births and that of infants, less than1 is 32 per 1,000 live births.The rate for the entire Luang Numtha province was 306, 51, and 34 in 2008.

4.3. Sugarcane Plantations and their Impacts on Economic Growth and Poverty Reduction in the Sing District, Luang Numtha Province

Favorable geographical and climatic conditions in the Sing district have enabled the locals to maintain their sugarcane plantations. However, before sugar became an export item to China, these plantations were mainly at subsistence levels and were using traditional production techniques. Only a small amount of produce was sold in the Lao-China border market.

Picture 3. A sugar cane plantation in the Sing district

Source: NERI field visit, 2010

In the mid-1990s, representatives from a Chinese sugar factory located in the Pong district, which borders the Sing district, approached local farmers to discuss the possibility of growing sugarcane commercially. The local government encouraged farmers to grow sugacane, while the factory provided technical assistance and financial support. The company also signed a purchase contract with villagers.

Initially, only a few villages and households joined the project. However, the factory’s good business practices have encouraged more villages and households to join the sugarcane contract-growing projects. Statistical data provided by the Office for Planning and Investment in the Sing district showed that, by 2008, sixty-five villages (covering 3,200 households) accounting for 67 percent of the total number of villages (or about 52.3 percent of total households in the Sing district), had joined the contract-growing project. In the same year, the project had a total production area of around 2,000 ha.

Techniques and technologies from China, including machinery, fertilizers, and seeds used by the sugarcane plantations as well as access to the Chinese market, have transformed the sugarcane industry from subsistence-level agricultural production to commercial production, which is characterized by the use of more sophisticated techniques and technologies, more intensive production, and higher productivity. According to the Sing district's Office for Agriculture and Forestry, the average productivity of sugarcane plantations in the area is about 45 tons per ha. It is a bit higher than the value of productivity in the entire country.

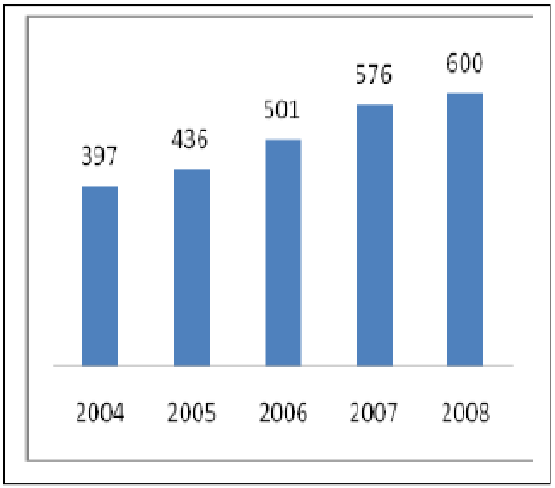
In 2008, the district exported 70,550 tons of sugarcane to China. With an average export price of US$18 per ton, the total export value of sugarcane was estimated to be around $1.6 million in 2008, corresponding to about 8.7 percent of the district's total export value.

Due to the active contribution of sugar production and exports, the Sing district has been enjoying high economic growth rate and reduced poverty levels during the last decade. Statistical data provided by the Office for Planning and Investment showed that the district's GDP per capita increased rapidly from US$379 per person per in 2004 to US$501 in 2006 and then to U$600 in 2008 (see figure 10). During the same years, the district's average economic growth rate was 15 percent per year (nominal or equal to about 8 percent real GDP growth). This growth rate is significantly high compared with the growth rate of other districts in Lao PDR and especially with the other districts in the north. Figure 10 shows the increase in GDP per capita between 2004 and 2008.

In line with rapid economic growth, poverty incidence in the district has also been sharply reduced from 28.2 percent in 2004 to 25.4 percent and then to 20.1 percent in 2008 (see figure

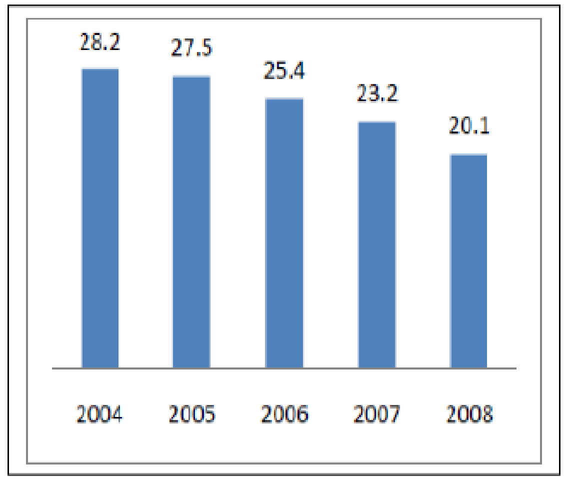
11). This corresponds to an average rate of decline of 1.6 percent a year, which is significantly high compared to that of other districts in Lao PDR.

Figure 9. GDP per capita in the Sing district, 2004/08 (in US$)



Source: Office for Planning and Investment of Sing District

Figure 11: Poverty incidence in the Sing district, 2004/08 (%)



Source: Office for Planning and Investment of Sing District

Sugarcane plantations and exports to China contributed significantly to economic growth and poverty reduction in the Sing District.[11] However, some stakeholders, including sugarcane-producing households in the district and the Water Resource and Environmental Office of the Luang Numtha province, believe that the sugarcane industry negatively affects the environment, especially forest cover, watershed areas, soil quality and fertility, and biodiversity. The areas now devoted to sugarcane plantations used to be forests where the villagers grew rice, harvested nontimber forestry products (NTFP), and hunted wild animals, which were their main source of livelihood before sugarcane production became commercialized. The once-forested areas used to serve as protective watersheds. Thus, the conversion of forests into sugarcane plantations, the intensive land use, and the use of chemical fertilizers and insecticides to enhance productivity

[11]Sugarcane production and exports are just two of the various economic and income-generating activities that contribute to economic growth and poverty reduction in Sing district in Luang Namtha province. The locals grow rice, vegetables, chili peppers, watermelons, etc. They are also into trade and tourism services. Such economic and income-generating activities also contribute to economic growth and poverty reduction in the district.

have adversely affected the watersheds as well as soil quality and fertility. According to the Water Resource and Environmental Agency in Luang Numtha and Oudomxay provinces, the water level in several rivers in northern Lao PDR has dropped significantly during the period 2004—08. However, the researchers are not suggesting that sugarcane plantations alone are responsible for the reduced water level. There are many other plantations in the area, including rubber and bananas, all of which endanger forest cover and thus contribute to the drop in the water level in several rivers in the northern provinces. It should be noted that these plantations are involved in agricultural production and export.

In addition, farmers and sugarcane producers in the Sing district say that sugarcane plantations require ever-increasing amounts of chemical fertilizers to maintain productivity. According to them, about 0.3 tons of chemical fertilizers per hectare are needed to cultivate sugarcane. The amount of chemical fertilizers required increases by around 15 percent a year, which leads to increasing production costs of about 7 percent a year. If such an increase in production costs is sustained over the long term, the cost of maintaining sugarcane plantations may exceed revenues. Thus, there is the possibility of sugarcane plantations becoming unprofitable in the long run. Consequently, poverty and lack of food security in the area may recur and at increased levels, exacerbated by the destruction of forests and degraded soil fertility. These factors may render the planting of any crops impossible in the future.

5. Conclusion and Discussion on the Way Ahead for Agricultural Development in Lao PDR

5.1. Conclusion

The agriculture sector is one of the most important economic sectors in Lao PDR. In 2009, the sector contributed around 29 percent of total production value and employed over 70 percent of the labor force. However, for a long period of time, agricultural production remained at subsistence levels using traditional production techniques and characterized by low productivity.

In 1986, Lao PDR adopted a comprehensive reform program called the NEM to transform the central planned economic model to a market-oriented one, which consequently led to the open-door and integration policy in the following years. In 1997, Lao PDR together with Viet Nam, Cambodia, and Myanmar, became a full member of the ASEAN and joined the AFTA, which directs member countries to liberalize trade (i.e., promote the free movement of people and commodities among member countries). These steps resulted in a number of multilateral and bilateral cooperation agreements with ASEAN member countries and the development of road and communication infrastructure that now link Lao PDR with neighboring countries.

The country has determined agriculture to be one of the key approaches to economic growth and poverty reduction. Thus, it has implemented a number of policies and measures to promote this sector, including fiscal, monetary, investment promotion, land leasing, and taxation policies.

The regional economic integration and massive promotion policies boosted the agriculture industry in the country. It gradually moved from subsistence production using traditional production techniques to a more industrialized and modernized commercial approach. Total agricultural production value enjoyed an average annual growth rate of 3.1 percent, or an increase from US$985.5 million in fiscal year 2005—06 to US$1,071.9 million in fiscal year 2007—08 and further to US$1,138.3 million in fiscal year 2009—10.

The case study on the Sing district in Luang Numtha province revealed that increasing agricultural production has contributed significantly to economic growth and poverty reduction at the community level. However, there are serious concerns that these recent developments (i.e., the development of agriculture in the context of regional economic integration and cooperation) have serious negative impacts on the environment and may have implications on the long-term sustainability of certain agricultural enterprises. Large forested areas have been converted to agricultural production areas. Also, the intensive use of chemical pesticides and fertilizers to enhance productivity damages soil quality, watersheds, and biodiversity.

5.2. Discussion on the Way Ahead for Agricultural Development in Lao PDR

Findings from a number of previous studies tell of an increasing demand for agricultural products in the world market due to several factors, particularly: (1) increasing population and stronger economies of some countries, which lead to higher demand for food, biofuels, and other raw materials for industrial production; and (2) declining access to arable land in developed countries and in some developing countries such as Thailand.

The increasing global demand for agricultural products presents an opportunity for countries like Lao PDR, which has abundant land resources. However, to gain from this trend, Lao PDR first has to improve its agriculture sector. This will necessitate enhancing agricultural productivity, improving the quality of agricultural products, and boosting accessibility to markets.

The researchers recommend that Lao PDR develop specific policies and strategies to promote agricultural production for export. The policies and strategies should prioritize export-oriented agricultural production, which means specific agricultural products and specific locations and target markets should be determined accordingly (e.g., the output of rubber plantations in the northern provinces are for export to China; coffee from the Boliven Pasture is for export to the EU markets). This approach should help the country maximize its limited financial and human capital. In addition, identifying specific target markets will make standard product development easier.

The researchers further recommend the export of final or semifinished agricultural products. That means that the country should establish factories that will process agricultural products into final or semifinished products before such products are exported to other countries.

The strategies recommended here are expected to enhance the productivity and competitiveness of the country’s agricultural products.

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Chapter 7

Agricultural Transformation, Institutional Changes, and Rural Development in Ayeyarwady Delta, Myanmar

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CHAPTER 7

Agricultural Transformation, Institutional Changes, and Rural Development in Ayeyarwady Delta, Myanmar

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1. Introduction

1.1 Rationale

Myanmar is an agricultural country. The agriculture sector accounts for 34 percent of its gross domestic product (GDP) and 15.4 percent of total export earnings. It also employs 61.2 percent of the total labor force. The importance of agriculture in Myanmar is underscored by the stated objective of having agriculture as the base of the country's economy and the engine for the overall development of other sectors. The agriculture sector suffered severe setbacks between 1962 and 1988, but the recovery phase, which was dubbed the "New Agricultural Transformation," began in 1989. The sector has been enjoying steady growth for the past twenty years, especially with the liberalization in cropping and marketing, which is supported by the Ministry of Agriculture and Irrigation (MOAI).

Rural development is the priority in Myanmar's development policy. The government has issued five rural development principles and formed a special department to implement these principles. The programs achieved positive development in the rural areas.

Ayeyarwady Delta is located in the southern part of the middle plains of Myanmar. Its total area is approximately 13,566.5 square miles. It consists of three regions: Yangon, Ayeyarwady, and part of the Bago region. Geographically, the delta is bordered by Rakhine state on the northwest, the Bay of Bengal in the west, and the Andaman Sea in the south. An estimated 40 percent of Myanmar's total population lives in the delta. Of that proportion, 85.1 percent live in the rural area of the delta, working mainly in agriculture for their income and livelihood and producing food for their community. The agricultural sector of the delta region thus provides food for the community, employs the majority of the regional populace, and contributes surplus for regional and national growth. The Ayeyarwady Delta is known as the "rice bowl" of the country because of the vast paddy farms occupying the whole region. Its rich alluvial soil is very suitable for agricultural production. As the production volume of its agricultural sector, including the fish and meat subsectors, is quite huge, the Ayeyarwady Delta has come to be regarded as the lifeline of Myanmar's economy. This study aims to analyze the development of the Ayeyarwady Delta area in terms of agricultural transformation, institutional changes, and rural development.

1.2 Objectives

The objectives of this study are to:

1. examine agricultural transformation and performance in connection with the economic and agricultural policy reforms passed since 1988;
2. examine sources of changes and transformation in agriculture, the pricing policy and open market for produce, internal market access, and export potential;
3. look into the current progress of rural development through the implementation of rural development principles; and
4. identify policy directions to ensure more sustainable agriculture and rural-regional development in Myanmar.

1.3 Organization of the Research Report

The paper is divided into four parts. The first part deals with the introduction and is followed by overview of Myanmar's agriculture sector, including an overview of agriculture in the socialist economist system and a chronology of agricultural reforms. Part three constitutes agricultural transformation towards growth. Rural development principles and their implementation will be covered in part four. The final part will be the findings, conclusion, and recommendations.

2. Overview on Agriculture in Myanmar

2.1. Overview of Agriculture during the Socialist Economic System

The objectives of the agricultural development program were as follows:[1]

1. to increase agricultural production by raising productivity;
2. to increase the use of scientific methods in agriculture;
3. to improve the structure of the agrarian system;
4. to improve the social conditions in rural areas; and
5. to organize the peasantry throughout the country.

By enforcing the Amendment to the Land Nationalization Act[2] in 1965, the landlord system, which had prevailed for over a century, was finally abolished during the Revolutionary Council period. Since agriculture is the mainstay of Myanmar economy, the Socialist government undertook support measures, such as cultivation of fallow lands, construction of irrigation facilities for dry zones, flood-control work, and expansion of areas devoted to multicropping. In addition, the necessary agricultural inputs and farm implements, such as quality seeds, fertilizers, insecticides, tractors, and water pumps, were distributed to farmers to encourage intensive cultivation. To boost output through higher productivity, the government also implemented a "Green Revolution" featuring the use of chemical fertilizers and high-yielding varieties (HYV) of seeds.

Table 2.1 shows the total output of paddy rice in Ayeyarwady Delta over a twenty-year period beginning 1963-64 to 1986-87. According to these figures, the sown acreage of

1 Myat Thein, *Economic Development of Myanmar* –p-88
2 The Land Nationalization Act was enforced in 1953.

paddy rice rapidly declined from 3.4 million acres in 1963-64 to 3.1 million acres in 1972-73. This happened because of two main factors: (1) the lack of security in the region and (2) the inability of the people to work in marginal areas because of the lack of security. The government carried out heavy operations in the Irrawaddy Delta during the 1960s and early 1970s. These operations continued until government forces quelled the rebellion in the region in 1972. Starting 1973, the sown acreage increased again. However, to reach an output exceeding the previous maximum acreage was still difficult because during the conflict, most of the marginal areas were destroyed by floods due to lack of maintenance.

Table 2.1. Rice Production in Ayeyarwady Delta from 1963/64-1986/87

Year	**Sown acreage (thousand acre)**	**Output (thousand metric ton)**	**Yield/acre (metric ton/acre)**
1963-64	3,413	2,445.35	0.72
1964-65	3,391	2,642.95	0.78
1965-66	3,358	2,492.38	0.74
1966-67	3,285	2,042.80	0.62
1967-68	3,229	2,513.11	0.78
1968-69	3,253	2,318.09	0.71
1969-70	3,227	2,442.98	0.76
1970-71	3,237	2,467.74	0.76
1971-72	3,220	2,441.52	0.76
1972-73	3,197	2,401.24	0.75
1973-74	3,220	2,484.02	0.77
1974-75	3,318	2,536.51	0.76
1975-76	3,304	2,655.47	0.80
1976-77	3,293	2,784.96	0.85
1977-78	3,298	2,816.99	0.85
1978-79	3,321	3,198.16	0.96
1979-80	3,329	3,457.93	1.04
1980-81	3,343	4,195.45	1.25
1981-82	3,339	4,288.96	1.28
1982-83	3,308	4,669.25	1.41
1983-84	3,190	4,542.06	1.42
1984-85	3,394	4,738.34	1.40
1985-86	3,243	4,466.89	1.38
1986-87	3,160	4,381.64	1.39

Source: Kan Zaw (1998); various issues of the Statistical Yearbook.

The output of paddy rice production fluctuated within the period under study until 1977-78 when the real potential growth rate of the agriculture sector emerged due to the intensive use of HYVs in the region. Starting 1977-78, not only has there been a yearly increase in the output of paddy rice but also in the yield per acre. This increase was the result of the vertical expansion (i.e., technological change) in paddy rice production. Technological change refers to the use of hybrid paddy rice seeds starting 1974.

Table 2.2. Rice Production in Myanmar from 1963/64-1986/87

Year	**Sown acreage (thousand acre)**	**Output (thousand metric ton)**	**Yield/acre (metric ton/acre)**
1963-64	12,256	7,782.77	0.64
1964-65	12,790	8,507.65	0.67
1965-66	12,948	8,055.10	0.62
1966-67	12,389	6,636.36	0.54
1967-68	12,328	7,769.41	0.63
1968-69	12,194	8,022.87	0.66
1969-70	12,402	7,984.68	0.64
1970-71	12,244	8,161.94	0.67
1971-72	12,293	8,175.06	0.67
1972-73	12,300	7,356.84	0.60
1973-74	12,014	8,601.89	0.72
1974-75	12,575	8,583.36	0.68
1975-76	12,792	9,207.61	0.72
1976-77	12,856	9,319.33	0.72
1977-78	14,104	9,461.89	0.67
1978-79	12,691	10,528.55	0.83
1979-80	12,955	10,447.89	0.81
1980-81	12,419	13,317.38	1.07
1981-82	12,987	14,146.55	1.09
1982-83	12,928	14,373.18	1.11
1983-84	12,370	14,350.09	1.16
1984-85	12,241	14,516.36	1.19
1985-86	12,459	14,484.03	1.16
1986-87	12,422	14,547.15	1.17

***Sources*:** Various issues of the Statistical Yearbook; Various issues of the *Report to the Pyithu Hlutaw* (People's Assembly).

Table 2.2 also illustrates the national output of paddy rice during the same study period. Data in tables 2.1 and 2.2 show that over 30 percent of the national paddy rice output was produced in the Ayeyarwady Delta, which also highlights the degree of specialization of that region in the national economy.

The second major crop in Ayeyarwady Delta was jute, one of the exports and industrial crops of the region. Table 2.3 shows the regional and national sown acreage of jute from 1963-64 to 1986-87. The sown area of jute in Ayeyarwady Delta was more than 50 percent than that in the whole country.

Table 2.3. Sown Acreage of Jute in Myanmar from 1963/64-1986/87

Year	Sown acreage (national)	Sown acreage (Ayeyarwady Delta)	% of total sown acreage
1963-64	54,380	34,360	63.18
1964-65	53,045	31,189	58.80
1965-66	72,226	41,711	57.75
1966-67	69,302	39,660	57.23
1967-68	86,770	48,817	56.26
1968-69	98,390	55,966	56.88
1969-70	103,295	54,741	52.99
1970-71	115,357	66,980	58.06
1971-72	224,226	133,797	59.67
1972-73	287,545	177,499	61.73
1973-74	290,898	198,664	68.29
1974-75	166,438	107,962	64.87
1975-76	148,104	104,082	70.28
1976-77	135,861	89,941	66.20
1977-78	175,901	119,711	68.06
1978-79	256,365	180,891	70.56
1979-80	260,420	173,259	66.53
1980-81	250,283	169,190	67.60
1981-82	122,343	67,839	55.45
1982-83	139,142	70,398	50.59
1983-84	166,321	85,755	51.56
1984-85	161,968	84,774	52.34
1985-86	151,436	83,350	55.04
1986-87	125,987	73,992	58.73

***Sources*:** Kan Zaw (1998); Various issues of the Statistical Yearbook.

In order of importance, the other crops grown in the region were groundnuts (peanuts), sesame, beans and other pulses, onions, chilies, and vegetables. Among these, peanuts, sesame, and beans were produced for consumption and commercialization but the others were produced for subsistence only.

Over a twenty-five-year period, the growth of agriculture in Ayeyarwady Delta was consistently above the national average. The government, therefore, exported the region's agricultural surplus.

2.2 Chronology of Reforms in Agriculture

The period under study was characterized by a shift towards a market economy. The analysis of the pattern of changes in the delta after 1983 was based on an impact analysis of the policy reforms made by the series of governments. The reform measure on agricultural policy started with the Socialist government that was in power in September 1987. Said policy was characterized by the lifting of the 21-year-old restriction on the procurement and domestic trade of rice and eight other crops, including wheat, maize, pulses, cotton, rubber, and sugarcane. This crucial policy reform was followed by several other reforms along with the ascension of the State Law and Order Restoration Council (SLORC) government to power in 1988. Myanmar's policy reform measures for the agriculture sector are shown in table 2.4.

Of these various policy reforms, the deregulation of the prices of major agricultural products, the removal of restrictions on private-sector participation in domestic and foreign trade, the introduction of summer paddy rice cultivation, and, more recently, the deregulation of paddy rice procurement by the State Economic Enterprise (SEE) Law changed the way the agricultural sector operates and functions. As a result, farmers were able to freely choose the crops they grew, stored, and sold at market prices. On the other hand, agricultural inputs, such as chemical fertilizers, pesticides, and hybrid seeds, were distributed either partially or wholly by the private sector. The marketing and export of agriculture products were also opened to private-sector participants. Thus, the policy reforms certainly changed the *modus operandi* in the agricultural sector.[3]

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3 Kan Zaw, "Agro-industrial Integration," p-9

Concomitantly, these policy reforms had a large influence on the delta region. The introduction of summer paddy rice cultivation opened up a new chapter in the delta's agriculture. Crop intensification and specialization occurred due to new technological changes and market response. In brief, the farm-structure situation became neither unimodal nor static. In fact, nonsubsistence farm families with ten or more acres of holdings found that the farm structure changed significantly.[4]

To support the growth of the agriculture sector, the MOAI set three objectives for the sector's development:

- to achieve surplus in rice production;
- to achieve sufficiency in edible oil; and
- to set up the production of exportable pulses and industrial crops.

[4] Ibid.

Table 2.4. Macro and Micro Policy Reforms in Agriculture Development in Myanmar

1987	Participation of private and cooperative sector in foreign trade
	Relaxation of the government's monopoly of the domestic marketing of rice and some important crops
1988	Removal of restrictions on private-sector participation in domestic and foreign trade
	Introduction of liberal Foreign Investment Law
	Restitution of small- and medium-size establishments
1989	Deregulation of prices
	Official revocation of the 1965 law establishing the Socialist Economic System
	Regularization of border trade
	Introduction of the State Economic Enterprise (SEE) Law allowing private-sector participation in economic activities
	Relaxation of restrictions on private investment
1990	Introduction of the law on 100 percent retention of export earnings
	Introduction of the Myanmar Agricultural and Rural Development Law
1991	Reestablishment of Myanmar Chamber of Commerce and Industry
1992	Announcement of lease-inefficient state-owned factories
	Announcement of government-owned palm-oil firms for sale
	Introduction of summer paddy rice cultivation in Ayeyarwady Delta
1993	Introduction of foreign exchange certificates (FECs)
1994	Introduction of Myanmar Citizens Investment Law
1995	Formation of Privatization Committee to facilitate the shift to a market-oriented economy and the smooth running of enterprises
1997	Introduction of new paddy-rice procurement systems—tender system, procurement by representative, preference sale and procurement system
	Procurement of paddy rice through the tender bid system in November 1997; however, the plan did not materialize and the requirement to sell paddy rice to the state remains as usual
1998	Leasing of fallow and virgin lands for cultivation or livestock breeding by private farmers, including foreign investors

Sources: Kan Zaw (1998); Thein and Than (1995); Various publications of the Myanmar government (1988—1996).

Table 2.5 shows the sown acreage of paddy rice from 1962 to 2008. It was clearly seen that in 2007—08, the total sown area devoted to rice was found almost double of 1962-63. Statistics in table 2.5 indicate that the total sown area of rice in the delta was more than 25 percent of the sown area for rice nationwide. Almost 80 percent of the total summer paddy rice in the country was also grown in the delta, underscoring the fact that the delta is the most significant and vital agricultural area in Myanmar.

Table 2.5. Sown Acreage of Paddy Rice (thousand acre)

Year	Sown acreage	Sown acreage	% of total sown
1962-63	11,953	3,173	26.55
1966-67	12,328	3,285	26.65
1976-77	12,547	3,293	26.25
1986-87	12,422	3,160	25.44
1987-88	11,531	3,133	27.17
1988-89	11,807	3,154	26.17
1989-90	12,057	3,203	26.57
1990-91	12,220	3,241	26.52
1991-92	11,935	3,245	27.19
1992-93	12,684	3,429	27.03
1993-94	14,021	4,352	31.04
1994-95	14,643	4,661	31.83
1995-96	15,166	4,892	32.23
1996-97	14,518	4,460	30.72
1997-98	14,294	4,506	31.52
1998-99	14,230	4,636	32.58
1990-00	15,528	4,920	31.68
2000-01	15,713	4,988	31.74
2001-02	15,940	4,997	31.35
2002-03	16,032	4,568	28.49
2003-04	16,168	4,724	29.22
2004-05	16,946	4,511	26.62
2005-06	18,259	4,801	26.29
2006-07	20,076	4,904	24.43
2007-08	19,990	4,956	24.79

***Sources*:** Kan Zaw (1998); Various issues of the Statistical Yearbook.

Rice yields in the delta are relatively better than rice yields in other parts of the country due to the increasing use of modern rice varieties along with intensive use of fertilizers. The utilization rate of chemical fertilizers in the delta happens to be the highest among the agricultural regions in Myanmar.

In terms of irrigated capacity, about 50 percent of total irrigated area is in the delta. The common type of irrigation usually seen here is the drainage-type irrigation system. If agricultural intensification is to be considered the major concern, the nature and production processes of both monsoon and summer paddy rice and other types of agricultural production (e.g.,fish farming) will have to be properly addressed. Before 1991-92, the traditional practice was monoculture rice cultivation. Some of the rice varieties grown in the delta region were local varieties which took about six to seven months from planting to maturation and harvest. Among these varieties was the late-maturing *nga kywe*, which was of such high quality and good repute that it occupied an important position in the export market before 1988. At present, farmers grow rice on a double-cropping basis, using different varieties with short maturation periods. Many of these are cross-breeds and varieties from the International Rice Research Institute (IRRI).

On the macroeconomic level, rice is critically important for economic and political reasons. As rice is the country's staple food, any agricultural policy aimed at economic development will have to focus on rice. It is, therefore, one of the major objectives of Myanmar's agriculture sector to produce surplus paddy rice for domestic consumption and for export. Table 2.6 shows the sown area of different crops in Ayeyarwady Delta. The size of the sown area devoted rice in the delta region hints at its importance among cereal crops and why policies on rice have been prioritized.

Total sown area of the different crops in Ayeyarwady Delta reached a record 6,986.98 thousand acres in 2007-08 due to a concerted effort and the policies aimed at improving the overall agricultural situation in the country. Government policies and agricultural strategies involved the exploitation and expansion of land resources. In other words, the government simultaneously implemented the twin policies of vertical expansion and horizontal expansion where many factors and forces were involved in the growth process.

Table 2.6. Sown Area of Different Crops in Ayeyarwady Delta (thousand acre)

Year	1. Cereal crop		2. Oilseed crop	3. Pulses and beans	4. Industrial crops	Total sown area
	Rice	Others				
1988-89	3,154	22.2	130.4	160.6	-	3,467.2
1989-90	3,203	24.1	110.2	225	-	3,562.3
1990-91	3,241	23.8	104.4	299.6	-	3,668.8
1991-92	3,245	22.9	95.8	532	-	3,895.7
1992-93	3,429	24.8	104.9	546	-	4,104.7
1993-94	4,352	17.3	84.4	574.4	54.4	5,082.5
1994-95	4,661	29.1	137.7	820.5	64.48	5,712.78
1995-96	4,892	22.2	96.5	948.6	85.27	6,044.57
1996-97	4,460	20.4	78.86	847.3	76.72	5,483.28
1997-98	4,506	22.4	93.55	914.3	63.32	5,599.57
1998-99	4,636	22.2	98.55	956.5	72.33	5,785.58
1999-00	4,920	25.7	107.3	960.6	69.13	6,082.73
2000-01	4,988	49.6	113.2	1,141.4	84.34	6,376.54
2001-02	4,997	65.7	116.8	1,266.2	96.75	6,542.45
2002-03	4,568	48.1	111.3	1,263.9	91.55	6,082.85
2003-04	4,724	50.3	127.7	1,294.6	66.58	6,263.18
2004-05	4,511	40.1	144.6	1,460.7	54.78	6,211.18
2005-06	4,801	33.3	148.2	1,550.3	49.38	6,582.18
2006-07	4,904	23.9	149.1	1,619.4	35.88	6,732.28
2007-08	4,956	17.9	159.8	1,828.6	24.68	6,986.98

***Sources*:** Various issues of the Statistical Yearbook.

The importance of cereal crops in agriculture development is illustrated in Table 2.7.

Table 2.7. Sown Areas of Major Crops in Ayeyarwady Delta, 2007/08

Crop group	Major crops	Percentage of total sown area
Cereal crops	Rice, wheat, maize, sorghum	70.9
Oilseed crops	Groundnut, sesame, sunflower, mustard, niger, oil palm	2.3
Pulses and beans	Black gram, green gram, pigeon, pea, chick pea, soybean	26.2
Industrial crops	Jute, rubber, coffee, mulberry	0.4

***Source*:** Statistical Yearbook (2008).

After the adoption of market-oriented policies in 1988, farmers in the delta region and elsewhere in the country got the chance to grow any crop they wanted following market conditions. This is one of the crucial reasons why many farmers started double-cropping rice and other exportable crops like pulses and beans.

3. Agricultural Transformation towards Growth

3.1. Policy and Direction towards Agricultural Transformation

To facilitate the development of agricultural sector, the MOAI laid down four policies as follows:[5]

- To allow farmers freedom of choice in agricultural production
- To expand agricultural land and to safeguard the rights of farmers
- To encourage the participation of the private sector in the commercial production of seasonal and perennial crops and in the distribution of farm machinery and other inputs
- To encourage research and development (R&D) in order to improve the quality and increase the production of agricultural crops.

[5] Ministry of Agriculture and Irrigation, “Myanmar Agriculture in Brief ” (2010), -- p 56

To implement these four main objectives, five strategic measures will be implemented:[6]

- Development of new agricultural land
- Provision of sufficient irrigation water
- Provision and support for agricultural mechanization
- Application of modern agro-technology
- Development and utilization of modern varieties

To support the development of new agricultural lands, the MOAI implemented the following measures:[7]

1. Reclaimed fallow and cultivable waste lands;
2. Developed farmers' embankment and integrated farming of paddy rice and fish in deep-water areas; and
3. Protected soil against erosion as well as developed terrace farming in the highlands and in sloping land areas.

In terms of water resources, Myanmar has access to a total of 870 million acre feet per annum but only about 6 percent of this volume is being utilized annually. Therefore, the MOAI implemented six measures to provide irrigation water:[8]

- Construction of new reservoirs and dams;
- Proper management of the storage and utilization of runoff water from watershed areas;
- Renovation of existing reservoirs to raise storage capacity and ensure efficient delivery of irrigation water;
- Diversion of water from streams and rivulets into adjacent ponds or depressions during high water levels for storage using sluice gates;
- Lifting of water from rivers and streams through pump irrigation; and
- Efficient utilization of groundwater.

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6 Ministry of Agriculture and Irrigation, "Myanmar Agriculture in Brief " (2001), -- p 5
7 Ministry of Agriculture and Irrigation, "Myanmar Agriculture in Brief " (2001), – p 6
8 Ibid.

Myanmar has been exploring the use of farm machinery for crop cultivation instead of the more traditional draught cattle and manpower since colonial times. However, the effort has not been entirely successful due to lack of skills and experience. After independence, the government implemented agricultural mechanization schemes involving the distribution of farm machinery to farmers, production of farm machinery suitable to Myanmar's agricultural land, land expansion and development, and tilling in planned cropped areas. Following the market-oriented economic system, both the public and private sectors have increasingly utilized farm machinery and equipment in every stage of the agricultural production process. Table 3.1 shows the types and number of farm machinery used in Myanmar.

Table 3.1. Utilization of Machinery and Farm Implements in Myanmar, 2008/09

Type of Machinery	Number
Tractor	11,759
Power tiller	137,202
Threshing machine	21,284
Thresher	7,899
Dryer	549
Intercultivator	225,012
Seeder	46,354
Harvester	3,220
Water pump	169,881

***Source*:** Myanmar Agriculture in Brief (2009,80).

3.2 Response to Transformation and Its Impact

One-fourth of Myanmar's total land area of 167.7 million acres is cultivable land. Before independence, the government implemented land expansion programs with the goal of boosting revenues from the export of agricultural products. Although the civil war that happened immediately after independence damaged some cultivated land, the Revolution Council regime made an effort to reclaim fallow and new agricultural lands.

After taking over the reins of the government in 1988, the SLORC passed measures that resulted in a smooth and secure transportation system, a market-oriented economy, and stable crop prices. Thus, crop-sown areas throughout the country significantly increased as data in table 3.2 show.

Table 3.2. Development of Agricultural Lands in Myanmar

Year	Net sown acre (million)	Increased acre (million)
1900	11.5	-
1948-49	14.5	3
1988-89	19.9	5.4
1999-2000	25	5.1
2007-08	32.7	7.7

***Sources*:** Myanmar Agriculture in Brief (2001 and 2009).

The MOAI also improved existing agricultural lands with proper drainage, irrigation, and farm roads. Traditionally, Myanmar's agricultural businesses have focused on small-scale crop cultivation. These days, however, the private sector is being encouraged to develop modernized, large-scale agricultural businesses. Private-sector companies operating on a national level and associations are encouraged and granted rights to develop new agricultural lands in flooded area and deep water area for the cultivation of paddy, pulses, oilseeds, industrial crops, rubber, oil palm, and other types of crops. They are also allowed to develop existing fallow, waste, and virgin lands characterized by low productivity and high land-reclamation cost. Table 3.3 shows the total area of lands granted to national entrepreneurs for large-scale commercial farming.

Table 3.3. Areas Granted to National Entrepreneurs for Large-Scale Commercial Farming (as of 31 Jan 2009)

State/Division	No. of companies	Granted areas (acres)
Kachin	9	331,134
Kayin	1	781
Sagaing	28	100,294
Taninthayi	36	672,550
Bago (East)	9	5,859
Bago (West)	7	13,913
Magwe	38	19,9013
Mandalay	18	10,446
Yangon	7	30,978
Shan (South)	9	70,772
Shan (North)	9	40,937
Ayeyarwady	28	193,353
Total	**199**	**1,670,030**

Source**:** Myanmar Agriculture in Brief (2009, 74).

Moreover, the MOAI has implemented an upland reclamation project to meet the following objectives:[9]

- Replace the slash-and-burn method of agriculture with terraced farming, ensuring surplus food for people living in the upland regions;
- Enable the people in hilly regions to live in permanent settlements;
- Eliminate the cultivation of poppy for opium by encouraging terraced farming to improve the living standard of people in hilly regions; and
- Preserve and protect the natural environment.

Table 3.4 shows the current situation in land reclamation for terraced farming in upland areas.

[9] Ministry of Agriculture and Irrigation, “Myanmar Agriculture in Brief” (2010), – p 82

Table 3.4. Reclaimed Land for Terraced Farming in Upland Areas, As of End of Jan 2009 (in acres)

Region	No. of Machinery	Government	Farmers	Total
Shan (North)	11	6,757	3,801	10,558
Shan (East)	10	2,034	3,805	5,119
Shan (South)	9	3,500	2,863	6,363
Chin	14	2,028	2,694	4,722
Kyaukhtu	-	202	-	202
Ann Township	-	100	-	100
Napyidaw	3	232	-	232
Total	47	14,853	12,443	27,296

***Source*:** Myanmar Agriculture in Brief (2009, 75).

Myanmar has been constructing irrigation systems for crop cultivation since the reign of kings in the country's history. After independence, the government implemented various irrigation projects to maximize the utilization of water resources. After 1988, the government poured large capital investment and harnessed manpower and machinery to build many dams and reservoirs nationwide. Through the use of domestic resources and expertise, water resources are now being utilized considerably throughout the country. Total irrigated area is shown in table 3.5.

Table 3.5. Total Irrigated Area in Myanmar

Year	Irrigated area (million acre)	Increased irrigated area (million acre)
1900	0.833	-
1948--49	1.348	0.515
1988--89	2.516	1.168
1999--2000	4.32	1.804
2007--08	5.56	1.24

***Source*:** Myanmar Agriculture in Brief (2001, 2009).

Before 1988, the number of irrigation projects was 138. Due to the efforts of the government, the number of irrigation projects completed between 1988—89 and 2009 rose to 219. The total number of irrigated areas increased from 1.3 million acres before 1988 to 2.8 million acres by 2009. The total number of irrigated areas was 12.5 percent of the total net sown area in 1987—88; by 2007—08, it had increased to 17 percent of net sown area. Apart from the construction of dams and weirs, 322 river-pump stations and 7,927 tube wells were also established. Out of 39.94 million people in the rural areas, 14.73 million gained access to water supply.

The MOAI introduced mechanical paddy rice threshers and dryers to completely eliminate the traditional way of processing paddy rice (i.e., by threshing it on the floor). Farm mechanization enabled farmers to save time, labor, and human energy. Cropping intensity also increased as data in table 3.6 show.

Table 3.6. Cropping Intensity in Myanmar, 1948/49-2007/08

Year	Cropping Intensity (%)	Increase (%)
1948-49	106	
1988-89	119.6	13.6
1999-2000	146.5	26.9
2007-08	168	21.5

***Source*:** Myanmar Agriculture in Brief (2001, 2009).

Increased cropping intensity further boosted mechanization of agriculture. Factories under the MOAI and the Ministry of Industry (MOI) together with small-scale, private factories assembled and produced farm machinery used in all stages of the cropping cycle—from land preparation to harvesting and drying. Some types of machinery were also imported for distribution to farmers.

To increase agricultural production, the MOAI implemented technology transfer on crop cultivation practices, appropriate cropping patterns, provision and proper utilization of agricultural inputs, and systematic plant protection practices to farmers. There are large-scale demonstration plots and blocks of crop production zones at the entrance of each township. Farmers are encouraged to use appropriate agro-techniques and apply organic and bio-fertilizers. In addition, the MOAI is undertaking farmers' education activities through the mass media (e.g., newspaper, radio, television, journals), distribution of educational pamphlets, individual and group training and visits by extension workers.

The MOAI has conducted important research studies on the breeding of high-yielding varieties (HYVs) and upgrading the quality of seeds. It has also embarked on the production of hybrid varieties under bilateral and commercial cooperation programs. In order to upgrade the quality and increase the yield of existing field crops, fruits, and vegetables, the MOAI has been importing new and improved varieties from abroad and distributing these to farmers. A seed law is now being prepared to provide a legal framework for seed importation, handling, production, and marketing.

Increased cropping intensity boosted the production of all major crops, including rice and pulses, to levels higher than that which prevailed prior to 1988. Total rice production steadily moved from 7,409.56 thousand metric tons in 2000-01 to 8,509.95 thousand metric tons in 2008-09. Crop production data are presented in table 3.7.

Table 3.7. Crop Production in Ayeyarwady Delta (thousand metric tons)

Year	**Paddy rice (rainy season)**	**Paddy rice (summer season)**	**Paddy rice (total)**	**Pulses and beans**
2000-01	4,684.33	2,725.23	7,409.56	429.92
2001-02	4,716.34	2,668.58	7,384.92	474.14
2002-03	4,538.94	2,111.35	6,650.30	466.89
2003-04	4,980.68	2,373.55	7,354.23	556.86
2004-05	5,252.85	1,899.16	7,152.00	704.64
2005-06	5,563.55	2,310.33	7,873.88	798.28
2006-07	5,669.46	2,448.20	8,117.67	900.79
2007-08	5,844.82	2,444.91	8,289.72	1,049.06
2008-09	5,948.89	2,561.06	8,509.95	1,083.29

***Source*:** Ministry of National Planning and Economic Development.

Since the delta is the major rice production area, it is obvious that the sharp increases in the total output of rice and pulses on the national level is due to the multiple-cropping system practiced intensively in the delta. The free market situation and the steep increase in the prices of rice and pulses have led farmers in the region towards more land intensification. The prices of rice and pulses are shown in table 3.8.

Farmers, especially those in the southern part of delta, found the prices of summer paddy rice most profitable, especially when cultivation of it began in 1992-93. The increasing use of machinery and farm implements in agriculture also increased the output of summer and monsoon paddy rice, pulses, and beans. In addition, the large difference between the domestic price and the international price of rice encouraged farmers to produce more. Table 3.9 illustrates the Yangon prices (domestic prices) and international prices of rice.

Table 3.8. Prices of Rice and Pulses, 1991/92-2007/08 (kyat per ton)

Years	Paddy rice	Black gram	Green gram	Soy bean	Chick pea	Pigeon pea
1991-92	9,642	13,569	13,592	11,564	10,429	21,572
1992-93	9,642	14,490	20,881	15,174	10,746	20,072
1993-94	15,583	21,574	28,453	29,620	33,107	29,480
1994-95	15,583	28,827	31,774	29,624	37,798	34,809
1995-96	17,530	43,556	35,778	26,289	41,832	37,402
1996-97	29,704	45,802	57,047	39,650	46,893	45,524
1997-98	71,137	61,227	86,333	59,422	75,803	80,111
1998-99	70,122	66,889	100,116	64,400	106,741	105,778
1999-2000	70,122	112,680	98,136	100,065	133,492	132,002
2000-01	70,122	166,112	110,384	111,548	127,549	114,212
2001-02	70,122	15,555	202,222	211,555	186,666	132,222
2002-03	78,643	248,888	287,777	233,333	194,782	222,444
2003-04	274,400	217,777	228,666	233,333	217,507	256,666
2004-05	297,043	269,111	295,400	233,333	245,913	245,155
2005-06	448,000	395,111	406,528	258,844	368,463	269,111
2006-07	597,500	774,667	625,333	261,333	423,652	295,555
2007-08	623,309	590,334	538,223	436,707	492,150	450,801

***Sources*:** Various issues of the Statistical Yearbook.

Table 3.9. Domestic Price and International Price of Rice (US$ per ton)

Year	Yangon Price	International Price	% of profit
2003	141	220	56.0
2004	99	230	132.3
2005	118	240	103.4
2006	128	242	89.1
2007	184	240	30.4

***Source*:** Union of Myanmar Federation of Chambers of Commerce and Industry.

3.3 Institutions and Infrastructure for Agricultural Development

3.3.1 Institutions for Agricultural Development

The government established the Land Record and Agricultural Department in 1888 when Myanmar was still a British colony. In 1906, the Department of Agriculture was established separately. To promote the agricultural sector, the government set up the Agricultural College in 1924. This college became the Agricultural University in 1964. In 1999, it was renamed Yezin Agricultural University.

Myanmar being a predominantly agricultural country, the government established the Peasant Council in 1968, aiming to put the activities of agricultural production into operation. The Peasant Council developed a scientific agricultural system, made welfare available to farmers, and gave advice regarding agriculture and livestock breeding, all under the guidance of the centrally planned economic system.

According to the Land and Rural Development Programme, the Land and Rural Development Cooperation (Myay-Kyay-Shin) was established in 1952. In 1972, the government organized three departments; namely, the Agricultural Department, Land Record, and Land and Rural Development Cooperation. Collectively, the three departments were known as Agricultural Cooperation (Le-Sight-shin). The Agricultural Mechanization Department was established separately even before the three aforementioned departments were organized. On April 1, 1989, Agricultural Cooperation was renamed Myanmar Agriculture Service and placed under the guidance of the government. The Department of Agricultural Research was founded on January 1, 2004 to conduct extensive agricultural research in all states and divisions nationwide.

Prior to producing output for local consumption, the objectives of the agricultural sector are to (1) export surplus agricultural products to increase foreign exchange earnings and (2) effect rural development through agricultural development.[10] In line with this, the MOAI's primary aim is to increase crop production. To meet this objective, the MOAI and the institutions under it carry out their respective functions. These institutions are the:

- Department of Agricultural Planning
- Myanmar Agricultural Service
- Irrigation Department
- Agricultural Mechanization Department
- Settlement and Land Records Department
- Water Resources Utilization Department
- Myanmar Agricultural Development Bank
- Department of Agricultural Research
- Survey Department
- Yezin Agricultural University
- Myanmar Industrial Crops Development Enterprise

To facilitate agricultural development, the government of Myanmar provided research and extension activities, agricultural credit, irrigation water, agricultural mechanization, and new agricultural land.

Research and extension activities for the crop sector were done through the Central Agriculture Research Institute (CARI) and the Extension Division of the Myanmar Agriculture Service (MAS), both of which are under the MOAI. The activities of CARI include conducting basic crop research; breeding HYVs and upgrading the quality of crops; producing hybrid varieties through bilateral and commercial cooperation; and introducing improved varieties of field crops, fruits, and vegetables from abroad to

[10] Ministry of Agriculture and Irrigation, "Myanmar Agriculture in Brief " (2010), -- p 57

upgrade crop quality and increase yield. CARI also works closely with international organizations like the United Nations Development Programme (UNDP) and the Food and Agriculture Organization (FAO). It also collaborates with international research institutes such as the International Rice Research Institute (IRRI) and the International Centre for Research in Semi-Arid Tropics (ICRISAT).

Myanmar implemented the Whole Township Production Program (WTPP) in the 1970s, earning international recognition for its efforts in extending broad support to agricultural production (e.g., distribution of HYVs and fertilizers and provision of advisory services).
To support the country's agricultural development efforts, the Myanmar Agricultural Development Bank (MADB) provides crop loans covering the different cultivation seasons (i.e., premonsoon, monsoon, and winter season) and medium- and long-term loans for agricultural development programs. International nongovernment organizations (NGOs) contracted with the UNDP and the United Nations Office for Project Services (UNOPS), such as PACT, GRET, and Grameen Trust, also started offering microcredit schemes starting 1997.

The Irrigation Department under the MOAI, which is responsible for providing irrigation water, has been improving irrigation facilities since the early 1990s.

The government formed the Myanmar Industrial Development Committee in 1995 to help transform traditional methods of agricultural production into mechanized farming and to promote the use of farm machinery and implements. The Agricultural Mechanization Department and Myanmar Heavy Industries are the primary local manufacturers of farm machinery and implements.

The government has also been developing new agricultural lands since the early 1990s by using cultivable, fallow, and waste lands for plantation, orchard, and seasonal crops.

Following the market-oriented economic system, the MOAI has implemented the following measures to promote private-sector participation, attract foreign investments, and accelerate growth and development: [11]

[11] Myat Thein, *Economic Development*, p-189

- Tractors under the Agriculture Mechanization Department (AMD) have gradually been sold to expand private-sector farm mechanization;
- Distribution of farm inputs like chemical fertilizers, pesticides, and seeds that were formerly handled solely by the MAS was gradually transferred to the private sector while subsidies on farm inputs are being removed;
- Plantation estates were leased out to private entrepreneurs for a term of 10 to 15 years;
- Contract farming agreements were forged with the private sector for the production of annual crops and plantation crops such as rubber, oil palm, cashew nuts, etc.

In 2008, the government allowed the establishment of "rice specialization companies" to develop the rice industry. The objectives of rice specialization companies are to (1) produce high-quality rice; (2) increase rice production to ensure sufficient domestic supply and produce exportable surplus; (3) enhance yield per acre; and (4) improve the living standard of farmers. In line with these objectives, rice specialization companies have undertaken the following functions:

- Extend seasonal loans with an interest rate of 2 percent to farmers and distribute the necessary inputs (e.g., fertilizers, quality seeds, and farm machinery)
- Support the construction of rice mills by cooperating with local communities
- Distribute appropriate farming technologies to farmers

There are currently thirty-seven rice specialization companies in Myanmar. The established rice specialization companies in Ayeyarwady delta region are shown in table 3.10.

Table 3.10. Established Rice Specialization Companies in Ayeyarwady Region

No.	Companies	State and region	Township
1	Gold Delta Co., Ltd	Ayeyarwady	Danubyu
2	Adipade Laeyar Co., Ltd	Ayeyarwady	Kyaiklat
3	Ayeyardepar Pathein Co., Ltd	Ayeyarwady	Pathein
4	Ayeyar Delta Co., Ltd	Ayeyarwady	Pathein
5	Ayeyar Pathein Co., Ltd	Ayeyarwady	Pathein
6	Hinthada Rice and Paddy Co., Ltd	Ayeyarwady	Hinthada
7	Ayeyarwaddy Green Land Co., Ltd	Ayeyarwady	Phyapon
8	Kyeiklat Rice Production Co., Ltd	Ayeyarwady	Kyeiklat
9	Myaungmya Dragon Co., Ltd	Ayeyarwady	Myaungmya
10	Ayeyar Myitwakyunpaw Co., Ltd	Ayeyarwady	Bogalay
11	Myitwakyunpaw Co., Ltd	Ayeyarwady	Kyonpyaw
12	Seinkyun Yadanar Co., Ltd	Ayeyarwady	Mawlamyinggyun
13	Shwekanthar Co., Ltd	Ayeyarwady	Kangyidawnt
14	Shwemyay Kyaunggone Co., Ltd	Ayeyarwady	Kyaunggone
15	Towayeyar Co., Ltd	Ayeyarwady	Dedaye
16	Wakema Rice and Paddy Co., Ltd	Ayeyarwady	Wakema
17	Yaywaddy Co., Ltd	Ayeyarwady	Maubin
18	Yegyi Rice and Paddy Co., Ltd	Ayeyarwady	Yegyi
19	Zalon Ayeyar Co., Ltd	Ayeyarwady	Zalon
20	Zalon Shaesaung Co., Ltd	Ayeyarwady	Zalon

***Source*:** Myanmar Rice Industry Association (MRIA).

3.3.2 Infrastructure for Agricultural Development

Since the SLORC government came to power in 1988, one of its main objectives has been to maintain the "secure and smooth running of transportation, communication, and commodity flows." Accordingly, it exerted efforts to improve existing infrastructure by prioritizing the building of roads, dams and reservoirs, railroads, ports, and airports. The following table shows the construction of infrastructure related to agricultural development in the Ayeyarwady delta region.

Table 3.11. Infrastructure for Agricultural Development in Ayeyarwady Delta

Subject	**Count**	**1988**	**2005**	**2006**	**2007**	**2008**	**2009**
Water supply task							
Dams, Lakes, Reservoirs, Drains							
- Tasks completed	num	4	n/a	12	13	13	13
- Ongoing tasks	num	-	n/a	2	1	1	1
- Benefited area	acre	2,910	n/a	290,331	300,331	300,331	300,331
River water-pumping project							
- Task completed	num	-	23	23	24	24	24
- Ongoing tasks	num	-	6	6	5	5	5
- Benefited area	acre	-	-	-	28,627	28,627	28,627
Damming Creek	num	-		11	14	14	24
- Benefited area	acre	-		11,210	12,195	12,195	22,984
Artesian wells	num	-	716	716	716	716	716
- Benefited area	acre	-	6,169	6,169	6,169	6,169	6,169
- Total benefited area	acre	2,910	347,322	347,322	347,322	347,322	358,111
Tractor station	station	14	n/a	n/a	n/a	18	14
Rural Water Supply Task							
Villages where tasks are to be carried out	village	-	2,361	2,615	3,214	3,646	4,249
Completed work	work	-	2,700	3,447	4,158	4,775	5,700

***Source*:** Various issues of the Chronology of National Development.

The government has paid special attention to the improvement of basic infrastructure in the remote rural regions of the delta and the frontier border areas. It has raised capital for the improvement of the road-transport and land-route road network in Ayeyarwady Delta. Almost all townships that were previously connected only by waterways are now connected by a road-transport network (even if some of the connections consist only of earth roads). The most obvious improvement was the Yangon-Pathein highway connecting the regional capital of Pathein with the city of Yangon. Special infrastructure projects implemented in delta region are shown in table 3.12.

Table 3.12. Special Infrastructure Projects for Ayeyarwady Delta Development

Types of Projects	Name of Project	Location/Region
Bridges		
1	Nawaday (Pyay Bridge) - A bridge across the Ayeyarwady River, near Pyay Township	Bago, Ayayarwady, Rakhine, Magway, and East-West Connection (inter-regional connection)
2	Myaungmya Bridge - A bridge across Myaungmya River, near Myaungmya	Ayeyarwady, Yangon, East-West Connection (inter-regional connection)
3	Ma-U-Bin Bridge - A bridge across the Ayeyarwady River, near Ma-U-Bin	Ayeyarwady, Yangon, East-West Connection
4	Nyaungdon-Setkawt Bridge - A bridge across the Ayeyarwady River, near Nyaungdon	Ayeyarwady, Yangon, East-West Connection
5	Pin-Lai-Lay Bridge - A bridge across Latputta-Ainmae	Ayeyarwady, Yangon, East-West Connection (inter-regional connection)
6	Bayin-Naung Bridge - A bridge across Pan-hlaing River, Yangon	Yangon-Ayeyarwady, Gateway to Yangon City (inter-regional connection)
7	Insein Bridge - A bridge across Hlaing River, Yangon	Yangon-Ayeyarwady, Gateway to Yangon City (inter-regional connection)
8	Khattiya Bridge	Maubin, Ayeyarwady Region
9	Daydalu Bridge	Pyapon, Ayeyarwady Region
10	Seikmachaung Bridge	Bogalay, Ayeyarwady Region
11	Natchaung Bridge	Bogalay, Ayeyarwady Region
12	Myaungmya Bridge	Myaungmya, Ayeyarwady Region
13	Bo Myat Tun Bridge	Nyaungdon, Ayeyarwady Region

***Sources*:** Kan Zaw (1998); New Light of Myanmar and other government publications related to the special project implementation committee (1997); Chronology of National Development (2009).

The East-West connection is strategically important to strengthen physical integration. Accordingly, the government extended road networks across the Ayeyarwady to strengthen rural-rural and rural-urban linkages. The presence of numerous rivers and creeks in the delta region and the shift to the market-oriented economic system prompted the government to construct bridges in order to facilitate inter-regional connection. Some of the finished bridges include the Pantanaw, Gonnhindan, Shwelaung, Wakema, Dedaye, Dahka, Pathein, Panmawady, Ngawun, and Kyungone bridges. Consequently, travel time by car within the region has been reduced to a few hours' time.

It is evident that tremendous development has occurred since 1989 in regional transportation networks, economic infrastructure, and road construction. Data on road improvements are presented in table 3.13.

Table 3.13 Road Improvement in Ayeyarwady Delta

Subject	**Count**	**1988**	**2005**	**2006**	**2007**	**2008**	**2009**
Urban Development							
Urban Roads	**Mile/Pharlon**	**490/4**	**617/6**	**667/6**	**698/6**	**731/1**	**770/0**
Bituminous road	Mile/pharlone	155/1	204/6	241/6	266/6	283/7	310/0
Metalled road	Mile/pharlone	89/4	101/4	109/4	115/1	127/4	138/4
Granite road	Mile/pharlone	24/3	35/7	35/7	36/0	36/0	36/0
Earth road	Mile/pharlone	221/4	275/5	280/7	280/7	283/6	285/4
Urban bridge	**bridge**	**783**	**n/a**	**n/a**	**n/a**	**1,166**	**1,243**
Concrete	bridge	503	n/a	n/a	n/a	680	726
Wood	bridge	104	n/a	n/a	n/a	152	154
Conduit	conduit	141	n/a	n/a	n/a	275	304
Other	bridge	35	n/a	n/a	n/a	59	59
Rural Development							
Rural roads	**Mile/Pharlon**	**837/1**	**2,998/**	**3,305/**	**3,517/**	**3,561/2**	**3,762/**
Bitumonous road	Mile/pharlone	20/3	49/5	54/3	56/0	58/0	58/4
Metalled road	Mile/pharlone	132/2	435/3	560/1	620/7	653/0	727/7
Granite road	Mile/pharlone	106/6	127/7	132/4	135/7	137/6	161/1
Earth road	Mile/pharlone	577/6	2,385/	2,558/	2,705/	2,712/4	2,815/
Rural bridge	**bridge**	**88**	**358**	**523**	**654**	**562**	**625**
Concrete	bridge	31	n/a	n/a	n/a	90	102
Wood	conduit	48	n/a	n/a	n/a	221	243

Conduit	bridge	9	n/a	n/a	n/a	226	255
Other	bridge		n/a	n/a	n/a	25	25

***Sources*:** Various issues of the Chronology of National Development.

Road improvements are evident from efficiency in travelling time, frequency and numbers of vehicles. A summary of developments in the different modes of transport is shown in table 3.14.

Table 3.14. Improvements in Transport Network in Major District Towns of Ayeyarwady

Move ment	**1990**		**1992**		**1997**		**2010**	
	Ship	**Motor Car**	**Ship**	**Motor Car**	**Ship**	**Motor Car**	**Ship**	**Motor Car**
Yangon-Pathein								
Types of vehicles	B-Class	No road transport	B & W	Cargo, BM	B & New Chinese B	BM, Tour Bus, Salon	B & New Chinese B	BM, Tour Bus, Salon
Capacity	150		150	40*5=200	400	40*12=480	700	40*20=800
Volume	100 tons		100 tons		250 tons		450 tons	
Travel time	16--20 hrs		16--18 hrs	6--9 hrs	14 hrs	6 hrs	14 hrs	5 hrs
Distance				136 miles		136 miles		136 miles
Yangon-MyaungMya								
Types of vehicles	T-Class	No road transport	T & S Class	Cargo	B & New Chinese B	BM, Tour Bus, Salon	B & New Chinese B	BM, Tour Bus, Salon
Capacity	280		400	20*2=40	400	20*6=120	600	20*10=200
Volume	50 tons		110 tons	6*2=12 tons	110 tons	20--30 tons	200 tons	30--40 tons
Travel time	24 hrs		24 hrs	6--10 hrs	24 hrs	6--8 hrs	24 hrs	5--7 hrs
Distance				109 miles gravel rd.		109 miles gravel rd.		109 miles gravel rd.
Yangon-Hinthada								
Types of vehicles	T-Class	No road transport	T-Class	BM & Hilux	T-Class	BM, Air-con Bus	T-Class	BM, Air-con Bus
Capacity	T*2=520		T*2=520	20*6=120	T*2=520	40*16=640	T*2=52	40*20=800
Volume	50 Tons		50 tons	20 tons	50 tons	45 tons	50 tons	50 tons

Travel	72 hrs		72 hrs	8--10 hrs	72 hrs	5--6 hrs	72 hrs	4-5 hrs
Distance				81 miles gravel rd.		81 miles		81 miles
Yangon-Nyaungdon								
Types of vehicles	T-Class	Dodge, Dyna	T-Class	BM & Hilux	Cargo Tug only	BM, Air-con Bus	Cargo Tug only	BM, Air-con Bus
Capacity	150	10*10=30	150	30*25=75		40*80=320		45*90=4050
Volume	120	20 tons	120 Tons	100 tons		120 tons		140 tons
Travel	12 hrs	3--4 hrs	12 hrs	2--2.5 hrs		1.5--2 hrs	12 Hrs	1--1.5 hrs
Distance		Gravel		34 miles tar road		34 miles Ac road		34 miles Ac road
Yangon-Kyaungon								
Types of vehicles	T-Class	No road transport	T-Class	Dyna	T-Class	BM, Air-con Bus	T-Class	BM, Air-con Bus
Capacity	120		150	40*4=160	150	40*9=360	200	40*15=600
Volume	100		120 Tons	20 Tons	120 tons	72 tons	140 tons	90 tons
Travel	24 hrs		24 hrs	5--6 hrs	20 hrs	4 hrs	20 hrs	4 hrs
Distance				79 miles gravel rd.		79 miles gravel rd.		79 miles gravel rd.
Pathein-Myaungmya								
Types of vehicles	B & W Class	No road transport	W & B Class	No road transport	B & New B Class	Dyna/Hilux	B & New B Class	Dyna/Hilux
Capacity	400		400		500	40*2=80	600	40*4=160
Volume	120		120 Tons		120/50	2 tons	130 tons	3 tons
Travel	4 hrs		4 hrs		4 hrs	3 hrs	4 hrs	2.5 hrs
Distance						32 miles gravel rd.		32 miles gravel rd.

***Sources*:** Kan Zaw (1998); author's survey on the transport network.

The road connection between the delta region and Yangon was established in the early 1990s. This physical land route connection between the delta and central regions ended the long-standing "dendritic market system," which was a legacy of the colonial period in the delta. It also facilitated interaction between the delta and central regions and improved center-periphery relation.

3.4 Agriculture Trade and Markets for Agriculture

3.4.1 Marketing Channels and Linkages

The market system in Ayeyarwady Delta was generally characterized as a “dendritic market system” that connected dependent villages to the port city. Apart from the dependent village, the market channel was composed of three other major elements: local town, strategic town, and port city. The basic marketing channels in delta were formed by the dependent, agriculture-based villages that are connected with the locality and the strategic district town. Each district consisted of five to six townships where each township served as a local market center. The commodities produced within the locality were sold at the local market or at the center adjacent to the village. Marketing channels were characterized by a mono or single tract system. The maximum distance in which producers did their marketing was up to the adjacent locality where they exchanged their farm produce with the necessary consumer goods and inputs for the next cropping. Thus, every producer passed along the main rivers and waterways on their way to the adjacent local centers. The transport cost involved in the single tract system resulted in a large deduction of producer surplus from the farm sector. In many years before1990, producers in the delta faced with the mono system of marketing for their products.

Agricultural products produced in the delta were transported to the port city of Yangon for export or to the Bayintnaung wholesale trading center in Yangon for redistribution to the local market. The government resolved to facilitate the stronger flow of goods and services into major trading areas like Yangon and, consequently, invested a considerable amount of capital in regional infrastructure. The waterways of the Ayeyarwady Delta, which consists of a huge network of small and big rivers, was previously regarded as the chief means of transport and travel before 1988. Soon after the SLORC government took power, waterways were soon replaced by other transport networks. Nowadays, bridges combined with a network of highway roads have made life much easier.

As a result of new infrastructure in the delta, the marketing of agricultural products was done on a wider and more efficient scale. All activities connected with agriculture became more concentrated, thereby achieving a higher rate of growth in production as well as yields. A good transportation system has an effect on a lot of people living in the delta. Marketing or transportation of agricultural goods from other parts of the delta to Yangon sometimes took two to three days in the past. With the new infrastructure, this was shortened to a couple of hours. As market development relies mostly on improved inter- and intraregional road connection, it is evident that the newly built infrastructure in the delta region significantly changed the existing dendritic market system to an "intermatch market system" that connected the region with international markets.

Good transportation systems, in fact, turned the whole delta into a more dynamic region. After 1991—92, when double-cropping of rice together with other new types of production like rice-fish farming was introduced into the area, the production of rice, peas, and beans significantly increased. When the bulk of the agricultural output was channeled to the export market, there was a need for greater mobilization of natural resources and capital. The government and the private sector took the initiative to mobilize all the necessary resources inside the region. The efficient use of new resources along with the use of existing resources resulted in an increase in both production and yield. Increased agricultural production in the region is assumed to have increased regional income as well.

3.4.2 Trade and Markets for Agriculture

As external demand increased, paddy rice producers in the region were ready to respond to the growing demand from the urban center through the improved road networks. To boost trade performance in line with the new, market-oriented economy, the following trade liberalization measures were introduced:[12]

1. Private individuals or enterprises were allowed to engage in the export/import business, which was previously handled only by the state.
2. Border trade was regularized to develop and strengthen bilateral trade relations with Myanmar's five neighboring countries. The Department of Border Trade was established, with its eleven branch offices providing one-stop service for border trade matters in collaboration with other concerned departments.
3. Export and import procedures were realigned.

[12] Ministry of Commerce, Directorate of Trade, Trade and Investment of the Union of Myanmar, 2006.

4. Technical barriers to trade were lowered and simplified export/import procedures geared towards trade facilitation and promotion were implemented.
5. As an incentive, exporters were allowed to retain all of their export earnings for them to use said earnings in the importation of goods.
6. Trade notifications were issued, specifying the rules to be followed in order to conform to the changing internal and external business environment.
7. Imported items like fertilizers, agricultural machinery and implements, insecticides and pesticides, medicines, and raw materials were exempted from commercial tax and customs duties.
8. The Chambers of Commerce and Industry was reactivated and reorganized as the Union of Myanmar Federation of Chambers of Commerce and Industry (UMFCCI) for the purpose of helping the private sector promote trade and industry.

Due to the complete privatization of the agriculture sector, the commodities that private individuals and enterprises can now freely trade in include rice, which was once controlled by the state as a strategic crop. Table 3.15 shows Myanmar's volume of exports of selected agricultural products.

Table 3.15. Export Volume of Agricultural Products in Myanmar (thousand metric ton)

Commodity	Rice and Rice Products	Pulses	Maize	Oilcakes	Raw rubber	Raw cotton	Raw jute
1988-89	48	17	1	16	2		
1989-90	169	56	14	29	2		5
1990-91	134	195	20	25	1	*	
1991-92	183	195	41	16	8		*
1992-93	199	449	44	25	18		
1993-94	261	514	40	35	23		
1994-95	1,041	425	70	14	24		
1995-96	354	610	62	31	25	*	5
1996-97	93	595	103	7	26	*	2
1997-98	28	769	50	*	22	4	5
1998-99	120	622	174	1	30	4	
1999-2000	55	561	89	11	30	2	
2000-01	251	831	148	*	20	3	4
2001-02	939	1,035	90	*	25	*	30
2002-03	793	1,038	219		22	*	8
2003-04	168	1,211	151		20		6
2004-05	182	873	255		14		
2005-06	180	865	90		29		
2006-07	15	1,156	183	*	9		
2007-08	358	1,141	156		19		

***Source*:** Various issues of the Statistical Yearbook.

Note: * less than one unit

As can be seen in the table 3.15, although rice was the main export in 1988-89 and 1989-90, pulses and beans became the main exports starting 1990-91. Generally, Southeast Asia was Myanmar's major market for rice up to 2003-04. The Middle East replaced Southeast Asia as a major export market for rice starting 2004-05. Other Asian countries also became important rice export markets in 2007-08. The situation in rice exports is shown table 3.16.

Table 3.16. Direction of Rice Export Trade (thousand metric ton)

Year	Southeast Asia	Rest of Asia	Middle East	America	Europe	Africa	Oceania	Total
1988-89	2	12			10	24		48
1989-90	29	78	5		5	52		169
1990-91	15	66	3	10		40		134
1991-92	47	57				79		183
1992-93	4	75	6			114		199
1993-94	16	57	3		11	174		261
1994-95	635	99		15	16	276		1041
1995-96	261	44		26		23		354
1996-97	47	20	*		1	25		93
1997-98	1	27			*	*		28
1998-99	66	20		*	3	31		120
1999-2000	20	23			12			55
2000-01	46	174	*		6	25		251
2001-02	367	55	367	8	57		85	939
2002-03	321	35	350	31	14		42	793
2003-04	78	53	33		4			168
2004-05	28	48	66		31			173
2005-06	49	31	90		1	9	9	189
2006-07	3		12					15
2007-08	55	194	44		7	58		358

***Sources*:** Various issues of the Statistical Yearbook.

***Note*:** * less than one unit

Table 3.17 presents the share of various agricultural products in total exports. The share of gas in total exports became bigger after 2000. Data, however, indicate that agricultural products are still important in Myanmar's total exports.

Table 3.17. Composition of Exports (%)

Year	Agricultural Products	Animal Products	Marine Products	Timber	Base Metal and Ores	Precious and Semiprecious Minerals	Gas	Garments	Other Commo-dities	Total Exports
1988-89	5.90	0.23	2.81	30.47	3.23	2.77	0	0.37	54.22	100
1989-90	15.18	0.11	4.73	31.46	2.40	3.07	0	0.49	42.55	100
1990-91	26.26	0.18	6.05	36.63	2.64	3.15	0	0.29	24.79	100
1991-92	28.20	0.15	5.85	34.91	1.80	2.02	0	2.21	24.86	100
1992-93	31.12	0.06	7.79	28.53	0.81	3.25	0	2.92	25.53	100
1993-94	28.38	0.12	9.18	30.97	0.72	4.12	0	5.49	21.01	100
1994-95	42.34	0.10	12.16	20.90	1.20	2.07	0	6.76	14.48	100
1995-96	46.12	0.14	12.22	20.82	1.39	2.72	0	5.96	10.63	100
1996-97	36.10	0.16	16.16	17.95	0.60	2.90	0	7.33	18.80	100
1997-98	30.28	0.12	14.66	13.23	0.47	3.21	0	6.76	31.27	100
1998-99	27.98	0.50	13.93	11.68	1.10	2.21	0.07	6.97	35.57	100
1999-00	17.91	0.31	9.02	10.34	3.23	2.45	0.35	30.42	25.98	100
2000-01	18.15	0.29	7.33	6.30	2.54	2.85	8.72	29.72	24.09	100
2001-02	17.63	0.25	5.03	10.97	1.68	0.74	24.79	17.42	21.48	100
2002-03	14.07	0.11	5.59	9.38	1.41	1.25	29.66	14.91	23.61	100
2003-04	16.59	0.09	6.84	14.51	2.41	2.53	24.63	13.92	18.47	100
2004-05	10.92	0.10	6.19	13.39	3.27	3.68	34.72	7.66	20.08	100
2005-06	12.28	0.10	5.56	13.32	3.13	6.58	30.20	7.68	21.15	100
2006-07	13.31	0.06	4.52	9.79	2.13	7.43	38.89	5.34	18.55	100
2007-08	13.26	0.06	4.68	8.40	1.35	10.08	39.49	4.41	18.28	100

***Source*:** Various issues of the Statistical Yearbook.

4. Rural Development Principles and its implementation

4.1. Government's Five Principles for Rural Development

In Myanmar, 70 percent of total population lives in the rural areas. The government's rural development program covers health, education, water and sanitation, transportation, and communication. The agricultural sector is a major source of income for the rural people, so the government provides guidance for rural development in the form of five principles. These five principles, which are aimed at promoting the living standards in the rural areas, are:

1. Providing better transportation
2. Providing water supply for agricultural purposes and ensuring potable water
3. Raising the education standard
4. Providing better health care services
5. Developing agriculture and livestock-breeding activities

To facilitate the development of rural areas, two principles were added:

1. Providing rural libraries for educational support
2. Providing rural electrification

4.2. Implementation of Rural Development Principles and Impact on Rural Communities

The tasks concomitant to the actualization of the five rural development principles are being implemented nationwide under the guidance of the government. The government has been building dams, reservoirs, and river water-pumping infrastructure nationwide to provide sufficient water for agricultural purposes and to ensure the availability of potable water in the rural areas.

It has been developing the agricultural sector in accordance with the new, market-oriented economic system. To raise education standards (one of the five principles for rural development), the Information and Public Relations Department under the Ministry of

Information opened self-reliant libraries in the rural areas. The government has also been establishing electricity-generating plants (in the rural areas) that use biogas, rice husks, and coconut-palm leaves for fuel.

To develop agriculture and the rural economy, the government introduced better and modern methods for maximizing crop yields and encouraged the breeding of livestock, fish, and prawn. This increased farm incomes and promoted the standard of living of the rural populace in general and farmers in particular. The MOAI has undertaken education activities on the progress of agricultural production. To give rural people better access to health care services, the government has established rural health centers. With 70 percent of the country's total population living in the rural areas, implementation of the five principles for rural development is expected to improve the income and standard of living in these areas. The progress of crop production in Ayeyarwady Delta is presented in table 4.1.

Table 4.1. Progress of Crop Cultivation in Ayeyarwady Delta

Subject	Count	1988	2005	2006	2007	2008	2009
Land resource							
- Sown acreage	acre	4,246,800	4,415,592	7,999,007	8,836,638	8,084,165	9,101,796
- Virgin and vacant land	acre	1,182,532	181,103	186,049	149,490	130,628	129,236
Crop cultivation							
Extended paddy cultivation							
- Monsoon paddy acreage	acre	3,154,021	3,508,291	3,666,702	3,700,025	3,647,168	3,700,017
Summer paddy acreage		no	1,421,860	336,057	586,815	603,181	-
- Total production	basket (in thousand)	190,207	370,943	213,425	264,533	264,940	15,640
-Regional rice sufficiency	percent	202	296	294	297	298	295
Progress in acreage of							
Beans and pulses	acre	271,720	1,407,104	1,390,588	1,651,787	1,673,191	84,482
Sugarcane acreage	acre	-	304	268	291	311	339
Maize acreage	acre	6,406	70,064	16,827	12,764	6,774	298
Rubber acreage	acre	92	2,310	6,607	11,995	16,139	19,050
Oil palm acreage	acre	-	-		5	5	5
Pepper acreage	acre	-	3,057	6,012	6,656	6,865	7,023
Edible oil crops							
Groundnut acreage	acre	85,257	107,559	89,060	107,649	106,620	32,107
Sesame acreage	acre	45,250	32,658	-	-	-	22,200
Sunflower acreage	acre	136,474	237,708	156,970	350,022	400,052	3,230
Jatropha	acre turn	-	-	11,553	219,062	451,198	463,494
Land reformation by machine	station	2,293,076	-	-	-	2,372,287	25,670,463
Tractor station		14	-	-	-	18	14

***Source*:** Various issues of the Chronology of National Development.

The government reclaimed virgin and vacant land after 1988. Consequently, the area of cultivable land increased year by year, with total sown acreage also increasing from 4.2 million acres in 1988 to 9.1 million acres in 2009.

However, Cyclone Nargis, one of the severest natural disasters in the history of Myanmar, hit on May 2, 2008. The cyclone destroyed a large number of houses, schools, hospitals, dispensaries, office buildings, mills and factories, storehouses, power lines, and telephone lines in Ayeyarwady Delta. The toll on human and animal lives was also significant. Sea water destroyed salt lands, cultivated lands, wells, and lakes. Although the devastation was unprecedented, the government and the people were able to get relief and rehabilitation efforts going within a short period. The state, ministries, NGOs, and other entities spent a huge amount of money for relief and rehabilitation and for instituting long-term mitigation measures against natural disasters in the cyclone-hit areas. Thanks to the support of the government, crop cultivation in the whole delta did not decrease considerably, although there was a decrease in the total output of paddy rice and in the cultivated areas of edible oil crops, beans and pulses, and maize due to Cyclone Nargis.

There was progress in the breeding of livestock, fish, and prawns (table 4.2) as a result of the government's promotion of, and support for, this activity. This was intended to raise farm incomes and the standard of living of the rural populace.

Table 4.2. Progress of Livestock Breeding in Ayeyarwady Delta

Subject	Count	1988	2005	2006	2007	2008	2009
Extended livestock breeding							
Buffalo	head	297,006	321,000	338,000	345,052	216,386	222,519
Cattle	head	1,118,522	1,190,000	1,240,000	1,263,993	1,144,364	1,166,754
Sheep/Goat	head	31,007	64,000	77,000	83,197	80,482	86,290
Pig	head	606,224	843,000	1,067,000	1,162,202	1,106,232	1,193,780
Chicken	head	5,460,701	9,237,000	12,176,000	13,558,132	13,013,924	14,227,780
Duck	head	1,788,643	2,374,000	2,932,000	3,158,814	2,720,465	2,904,566
Turkey, Goose, Muscovy duck	head	311,971	358,000	394,000	406,749	342,353	352,006
Quail	head			10,000	11,524	12,270	13,803
Fish and prawn breeding							
Fish breeding pond	acre	979	84,796	104,909	111,553	111,553	112,207
Prawn breeding pond	acre		40,158	56,855	56,855	56,855	56,855

***Source*:** Various issues of the Chronology of National Development.

The government believes that providing better health care to the rural people contributes to their productivity and their ability to work and earn income. It has thus increased the number of rural health centers. Table 4.3 illustrates the increase in the number of rural health centers from 1988 to 2009.

Table 4.3. Number of Rural Health Centers in Ayeyarwady Delta

Subject	Count	1988	2005	2006	2007	2008	2009
Rural health centers	center	185	195	195	196	196	203

***Source*:** Various Issues of the Chronology of National Development.

Regarding the government's programs for comprehensive development, the twenty-four Development Zones for Economic and Social Infrastructure are actively being created and the pursuit of rural development based on the five rural development principles are being actualized to promote socioeconomic progress (Kan Zaw 2006).

4.3 Support for Sustainable Rural Development

The activities initiated by the government and international organizations in support of rural development aim to boost crop production, crop diversification, and crop and livestock farming. Such activities also aim to effect community development through the construction of village roads and the provision of agricultural credit and other agricultural inputs. In addition, the government, with the technical and financial assistance of the UNDP and FAO, implemented the Integrated Rural Development Project to facilitate the conduct of self-sustaining improvement in human capability and welfare.

In 1989, the State Peace and Development Council (SPDC) turned its attention to developing the rural border areas. These areas quickly developed within a few years' time due to the effective coordination and cooperation among the agencies involved in the initiatives. The government then launched a nationwide rural development program based on the following ideas:

- to strengthen and develop agriculture, livestock, and fishery production for economic development
- to provide proper social services, such as health care, education, nutrition, and sanitation
- to provide water for the irrigation of cultivated crops and for household use

- to build roads and bridges for better communication and transportation with other areas within and outside the region
- to develop rural industries based on the agricultural products and other available materials within the area

International agricultural research centers (IARCs), the FAO, and UNDP have also implemented many approaches to make sustainable agricultural and rural development possible.

5. Findings, Conclusions, and Recommendations

The review and analysis of agriculture in Ayeyarwady Delta highlighted the optimistic hope, prospects, and potential for sustainable development in the delta region. It was found that rice farming, in general, is the most important economic activity and the principal means of livelihood in the delta. Since the geographical features and the climate is most favorable for rice, the majority, or nearly all, peasant farmers in the area grow rice as the main crop and other exportable crops like green gram, black gram, chick peas, and pigeon peas.

The government allowed the establishment of rice specialization companies in 2008 to develop the rice industry. There are currently thirty-seven rice specialization companies, of which twenty are operating in the Ayeyarwady region. Rice specialization companies provide agricultural credit to farmers with an interest rate of 2 percent to help them purchase inputs, such as seeds, fertilizers, pesticides, and the like. For this type of credit, farmers have to repay their loans in cash or in kind upon harvest.

Agriculture is the primary livelihood in the delta region, but it has undergone different policy reforms and measures for more than a century. The sector obviously needs further investment and technological advancement to sustain the level of production. As agriculture development reaches higher levels, the cost and price structure also increases. To meet increasing cost conditions, the agriculture credit policy should be reviewed and updated to keep up with the current trends of development. On the other hand, the repayment system should be enforced to maintain an effective credit system. Furthermore, private banks should be encouraged to provide service in the rural areas to supplement the government's credit scheme.

One of the most important reforms to be considered is the reform in land-use policy and agrarian structure. At present, all lands are owned by the state and farmers have the right to use land through the legacy of ancestors or through the law of inheritance. The government has issued thirty-year leases for the use of cultivable land up to 2,000 hectares (or 5,000 acres) for private farming.[13] As technology advances and profits from farming become more favorable to farmers with large landholdings, they will buy land-use rights to further expand their landholdings. These issues should be seriously considered if rural development is to remain sustainable in the future.

In general, infrastructure development in the delta has totally shifted the marketing channel from the dendritic market system prevalent in postcolonial times to the intermatch market system in practice today. The stronger the rural and local infrastructure grows, the stronger will be the rural-urban linkages. In fact, in this case, the linkages between the farming rural region and the city (Yangon) has become more integrated through the road networks that have been built.

Finally, the government has undertaken many development programs in Myanmar's rural regions. Not all of these interventions have been successful. Training is essential to promote efficiency, increase knowledge, and built the capacity of the rural populace. To improve farm income, support in the form of agricultural inputs (e.g., fertilizers, agro-chemicals, quality seeds, irrigation, credit) is also necessary. Decisions on the necessary training programs and agricultural inputs, however, should originate from the community instead being imposed from external or central sources. The same is true for decisions involving crop production, livestock farming, and other income-generating activities. Past experience has shown that rural development initiatives based on a centrally planned approach are not successful. Therefore, a decentralized approach would be best in the implementation of Myanmar's rural development programs.

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[13] The Committee for the Management of Cultural Land, Fallow Land, and Waste Land, which is under the Ministry of Agriculture and Irrigation, allows investors to cultivate or utilize up to a maximum of 20,000 hectares for a thirty-year period.

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Chapter 8

Philippines: Food Security versus Agricultural Exports?

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CHAPTER 8

Philippines: Food Security versus Agricultural Exports?

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1. Introduction

Like many developing countries, the Philippines places a high priority on strengthening food security. In the past, food security was defined as food availability and was equated with self-sufficiency. Food self-sufficiency generally emphasizes the ability of a country or household to produce or procure various food items, especially staple food crops, to meet its food needs. However, food analysts argue that food self-sufficiency does not necessarily imply food security and that food security should be gauged through income since poverty causes food insecurity (Cabanilla 2006; Minot 2010). At present, the most widely accepted definition of food security is the one given by the 1996 FAO World Food Summit. The definition states that food security is achieved when people at the individual, household, regional, national, and global levels have physical and economic access to food at all times to meet their dietary needs and food preferences in order to maintain an active and healthy life. Thus, it is not only food availability over time that is considered but also the capacity of individuals, including the poor, to access food by producing it or obtaining it from the market. The ability of individuals to gain access to food with reference to food prices and income is thus recognized. This suggests that income generation is key to achieving food security.

In the Philippines, agricultural development and food security have always been part of government policies. The government recognizes that success in achieving food security relies greatly on the agricultural sector because this sector produces the bulk of the country's food needs. Food security can be promoted by creating an environment that will enable poor farmers to respond to domestic, regional, and international market opportunities. It can be achieved if a country increases imports and/or produces food according to its comparative advantage and purchases some of its food requirements from the market. As pointed out by Balisacan and Ravago (2003), food security issues can be addressed through investment and institutional reforms that will promote agricultural productivity and economic growth. Further, Cabanilla (2006) emphasized that agriculture induces the economy's overall performance by fuelling the growth of the nonagricultural sector. It acts as the resource reservoir and source of intermediate products for the nonagricultural sector.

However, considering the growth rate of the population and the slowdown in agricultural productivity, there are questions about the capacity of the agricultural sector to supply the food needs of the rapidly increasing population. As shown in table 1, the growth of rice production has been unpredictable over the past two decades. Rice production dropped 24 percent in 1998 because of the El Niño phenomenon and bounced back the following year, after which it has been generally stable during the period 2000–07 (except for a slowdown in 2003 and 2005). However, the Philippines' annual population growth rate of 2.1 percent—as of 2009, the population of the country was estimated at 92 million—could lead to increasing dependency on food imports. Projections drawn up by the United States Department of Agriculture (USDA) indicate that the Philippines will still be importing an estimated 3.5 million tons of rice in 2019 (see appendix table 1) because of its limited ability to expand production (USDA 2010). This poses serious problems for the country's food security unless rice production stays a step ahead of population growth.

Table 1. Rice Supply (kg/capita/yr) and Population

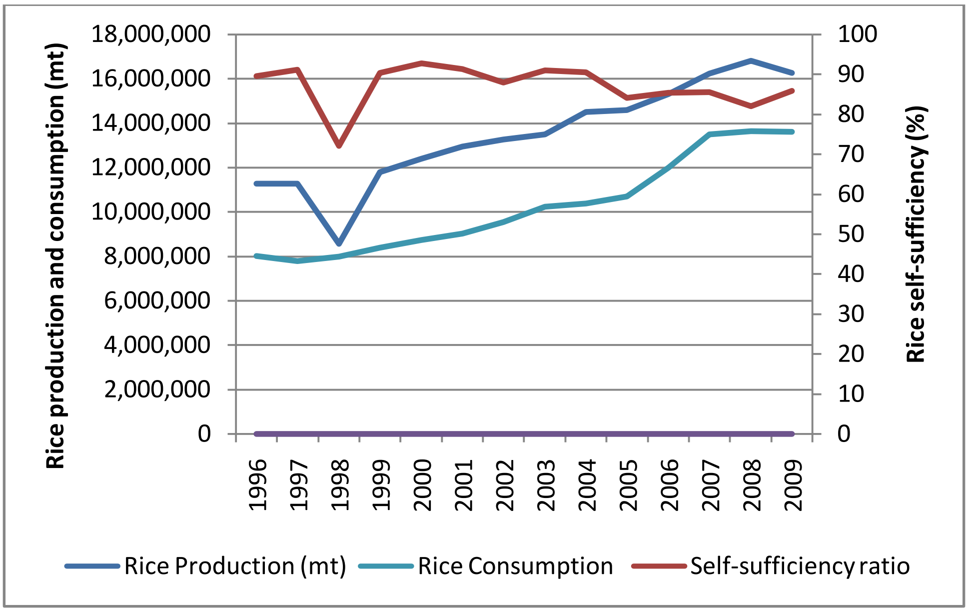
	Rice Production (mt)	Rice Supply (kg/capita/yr)		Population (in millions)		
Year		Milled Equivalent	Paddy Equivalent	Rural	Urban	Total
1990	-	93	139	31,962,870	30,464,610	62,427,480
1991	-	84	126	32,065,394	31,860,831	63,926,225

1992	-	87	131	32,137,666	33,289,179	65,426,845
1993	-	88	132	32,180,599	34,750,764	66,931,363
1994	10,538,054	89	133	32,195,729	36,247,572	68,443,301
1995	10,540,649	92	138	32,183,922	37,781,126	69,965,048
1996	11,283,568	99	148	32,245,363	39,252,116	71,497,479
1997	11,268,963	97	146	32,283,284	40,755,819	73,039,103
1998	8,554,824	92	138	32,296,272	42,290,961	74,587,233
1999	11,786,625	100	150	32,282,562	43,855,556	76,138,118
2000	12,389,412	104	155	32,241,088	45,448,281	77,689,369
2001	12,954,870	104	156	32,218,628	47,020,497	79,239,125
2002	13,270,653	109	163	32,170,159	48,618,789	80,788,948
2003	13,499,884	108	161	32,097,678	50,246,288	82,343,966
2004	14,496,784	117	175	32,003,793	51,907,568	83,911,361
2005	14,603,005	121	181	31,889,979	53,605,944	85,495,923
2006	15,326,706	121	182	31,843,437	55,255,680	87,099,117
2007	16,240,194	129	194	31,778,854	56,939,331	88,718,185
2008	16,815,548			31,694,232	58,654,205	90,348,437
2009	16,266,417			31,586,997	60,396,105	91,983,102

***Sources*:** FAOSTAT, 2010 for rice supply data; World Development Indicators, 2009 for population data; Bureau of Agricultural Statistics (BAS) for rice production (paddy).

As shown in figure 1, rice self-sufficiency ratio is high but the country still relies heavily on imports to meet consumption needs. Given the country's significant dependence on rice imports (with a 14.2 percent import-dependency ratio in 2009), the task of ensuring food security is not only a domestic problem but an international challenge as well (Tolentino 2002). Several studies suggest that the best way to achieve rice self- sufficiency is to invest in agricultural research and infrastructure (e.g., farm-to-market roads) and reallocate resources to improve the production of commodities other than rice (e.g., high-value commodities) in which the country has a comparative advantage and the income from which can be used to finance food imports (Dawe 2004; Habito and Briones 2005; Cabanilla 2006).

Figure 1. Rough rice production and consumption and rice self-sufficiency ratio, 1996--2009



***Source*:** Bureau of Agricultural Statistics (2010).

Research objectives

This paper aims to investigate whether the government should continue to invest heavily in increasing rice productivity (through bolstering irrigation capacity and providing high-yield seeds and postharvest facilities) to achieve food self-sufficiency or expand income generation by increasing the production of high-value agricultural crops for export in order to achieve food security. This objective is divided into four research questions:

1) What are the patterns and main drivers of food insecurity in the Philippines?
2) Is rice self-sufficiency associated with better access to food and higher standards of living in the Philippines? If so, then this will support the government's promotion of rice self-sufficiency by 2013.
3) What are the patterns and trends in the production of export crops and import-competing crops? What are the costs and returns to farmers from switching from staple food crops to export crops?
4) Would investment in the production of export crops improve food security or would it contribute to food insecurity by reducing domestic food production?

Data and methods

The description of patterns and trends in agricultural production and trade is based largely on secondary statistics from the Department of Agriculture's Bureau of Agricultural Statistics (BAS) and the National Statistical Office (NSO). In some cases, data from the Asian Development Bank (ADB), the World Bank (WB), and the Food and Agriculture Organization (FAO) were used. The analysis of the costs and returns of export crop production was based on BAS's Selected Statistics on Agriculture 2010.

For household-level analysis, we used the 2006 Family Income and Expenditure Survey (FIES) for the Philippines in order to explore the relationship between self-sufficiency and food security and the effect of export crop production on income and food security. The 2006 FIES was conducted by the NSO. A national sample consisting of about 51,000 households was interviewed for the survey. The data provided information on family income and expenditure and demographic characteristics affecting income and expenditure levels and patterns in the Philippines at the national and regional levels. To capture seasonal patterns in consumption and expenditure, the households were interviewed in two separate operations, each covering a half-year period: January to June and July to December. The sample design used stratified random sampling, with barangays as the primary sampling unit (PSU). The PSUs were stratified according to rural or urban within each province; each province was selected using systematic sampling with probability proportional to size. At least 500 households were systematically sampled from each barangay based on the 2002 Population Census List of Households.

We used this data to calculate for self-sufficiency and food security indicators as well as infer the effect of trade on domestic food production and food security.

From the FIES data, we calculated three indicators of food self-sufficiency:

- Home-produced food as share of all food consumed
- Home-produced cereals as a share of all cereals consumed
- Home-produced rice as a share of all rice consumed

We also calculated four measures of food security:

- Per capita real value of food consumption
- Nonstaples as a share of food consumption
- Animal products as a share of food consumption
- Reported number of months per year that the household has sufficient food (as a measure of food shortage)

In addition, we considered the relationship of both types of indicators to the measure of general well-being measured in terms of per capita consumption and expenditure, including the value of home-produced food and nonfood goods.

Organization of the paper

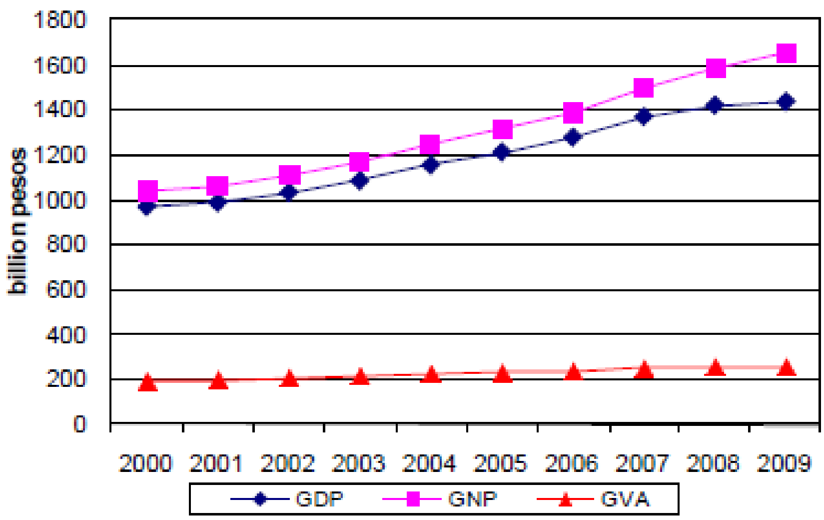
This paper is organized around the four research questions posed above. Section 2 examines agricultural growth and performance and focuses on the patterns of food insecurity and the key indicators of food security in the Philippines, both at the macro and micro levels. The next section explores the relationship between self-sufficiency, food security, and standard of living at the household level. Section 4 examines the patterns and trends of agricultural export crops and compares the costs and returns of each of these crops relative to rice production. The last section summarizes findings and discusses the implications for food security policy in the Philippines.

2. Agricultural Growth and Development

Trends in Philippine Agricultural Growth

Agriculture's vital role in the Philippine economy has stimulated government intervention in the input and output markets to promote agricultural growth and development. A number of studies assessing Philippine agricultural performance over the years have shown that the agricultural sector has not been performing well (David, Ponce, and Intal 1992; David 1995; Cabanilla and Velasco 2003; and Cabanilla 2006). As figure 2 shows, the share of agriculture value added in total Gross Domestic Product (GDP) has been gradually declining from 22 percent in 1994 to 20 percent in 2000 and then to 18 percent in 2009. Despite this decline, agriculture continues to employ approximately 30 percent to 40 percent of the labor force, a rate that is increasing an average of 3.2 percent (highest growth rate relative to the manufacturing and services sectors). Table 2 presents these data.

Figure 2. Share of agriculture value added to total GDP (%)



Source**:** Key Indicators for Asia and the Pacific (2010); Country sources; ADB staff estimates using CEIC data.

Table 2. Labor Force Employment (in thousands)

	Total Employed	Employed in Agriculture	Employed in Manufacturing	Employed in Mining	Employed in Others
1990	22,212	9,981	2,236	129	9,865
1991	22,915	10,290	2,374	141	10,110
1992	23,696	10,727	2,523	147	10,300
1993	24,382	11,139	2,457	135	10,652
1994	25,032	11,286	2,539	111	11,097
1995	25,677	11,147	2,617	107	11,806
1996	27,187	11,645	2,696	113	12,734
1997	26,365	10,416	2,720	122	13,106
1998	26,631	10,091	2,715	114	13,711
1999	27,742	10,774	2,759	97	14,111
2000	27,453	10,181	2,745	108	14,419
2001	29,156	10,850	2,906	103	15,295
2002	30,062	11,122	2,869	113	15,958
2003	30,635	11,219	2,941	104	16,372
2004	31,613	11,381	3,061	118	17,054
2005	32,539	11,719	3,105	121	17,594
2006	32,963	11,815	3,059	141	17,949
2007	33,560	11,785	3,059	149	18,567
2008	34,089	12,030	2,926	158	18,974
2009	35,061	11,325	2,893	166	20,678

***Source*:** Key Indicators for Asia and the Pacific (2010); Country sources; ADB staff estimates using CEIC data.

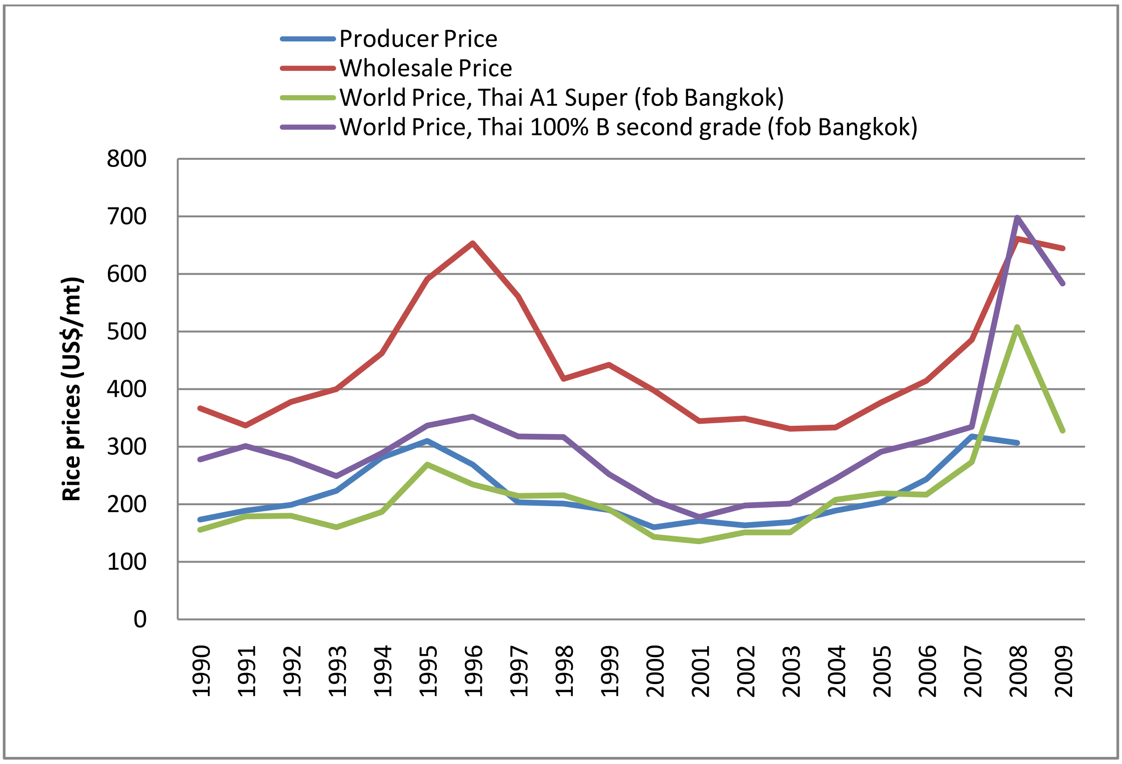
A study done by David (1995) revealed how economic policies and agricultural incentives have affected agricultural development over the years. She found that there had been remarkable growth in the agricultural sector until the early 1980s with the adoption of modern rice varieties, after which the sector experienced a decline. The slowdown could have been caused by the setback in the expansion of crop areas, the increase in input prices, and the sharp decline in the real price of rice. In the 1990s, the domestic price of rice was set higher than world market price (shown in figure 3) in contrast to the pricing policy in the 1980s when the domestic price of staple crops (such as rice and corn) was set below world price (Cabanilla 2006).

Domestic prices soared after the country's ascension to the WTO in 1996, with nominal wholesale price almost twice (91 percent) as much as the world price. Wholesale prices continued to remain above world prices while input prices other than wages declined up to the onset of the Asian financial crisis in late 1997 and 1998. These developments proved favorable for the growth of rice production. However, as discussed below, the government's effort to support the price of rice through quantitative import restrictions hurt landless workers and small farmers (who are net buyers of rice) as well as urban workers. The volatility of domestic rice prices could have serious implications for farmers' incentive to invest in rice production as they would tend to adopt low-risk technologies due to the uncertainties of the market.

Government efforts, such as increased investment in irrigation in the 1990s and maintaining output prices above world prices to increase agricultural growth, were not enough to reverse the downward trend. Input prices also declined as a result of the Asian financial crisis in 1997—98, which could have been favorable for growth in rice production. However, the investments the government made in the agriculture sector were not in the areas where the gains were expected to be high in terms of improvement in long-term productivity.

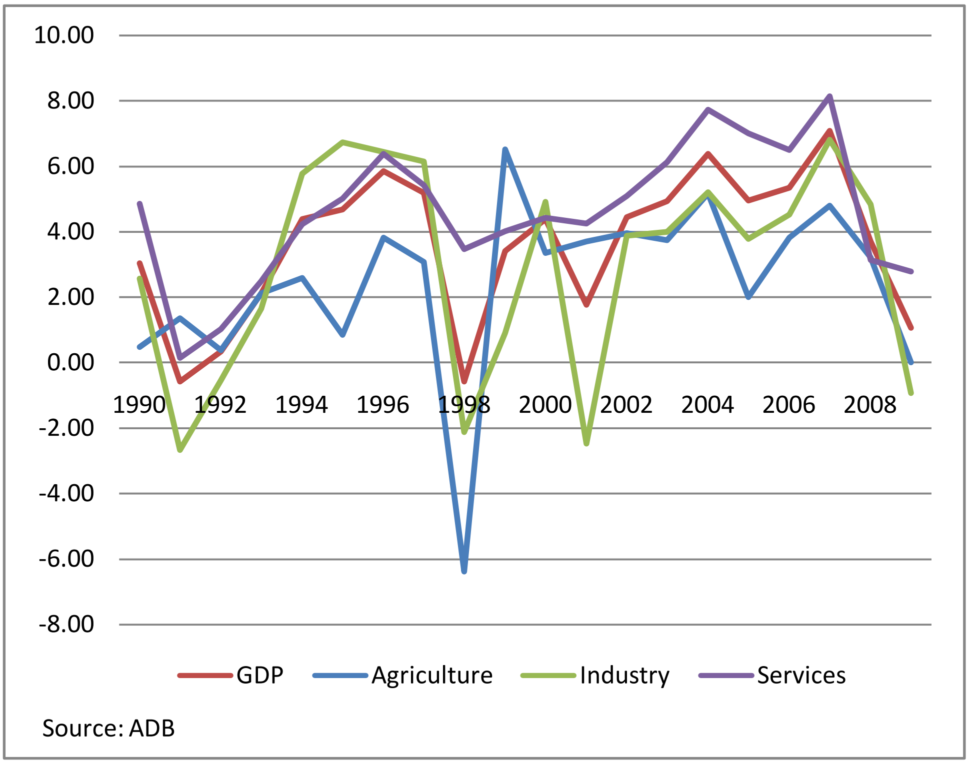
After experiencing negative growth in 1998, the Philippines recovered and achieved an average GDP growth rate of 4.8 percent from 1999 to 2009 (figure 4). Growth rate in the agriculture sector, however, declined from 2000 to 2009 (table 3). While the output of the agriculture sector had been largely stagnant through the years, the output shares of industry and especially services significantly increased, surpassing the slower pace of growth in agriculture by a relatively large percentage, particularly in the past two decades (figure 4 and table 3). Table 3 also shows that the value added of agriculture to the current GDP was only about 15 percent in 2009.

Figure 3. Trends in rice prices (US$/mt)



Sources: FAOSTAT for producer prices and world prices; Bureau of Agricultural Statistics for wholesale prices.

Figure 4. Annual growth of output (% change)



Source: Key Indicators for Asia and the Pacific 2010; Country table for Philippines.

Table 3. Percent of Value Added of Agriculture and Other Sectors to Total GDP

	Agriculture	Industry	Services	Agriculture Real Value Added
1990	21.90	34.47	43.62	0.48
1995	21.63	32.06	46.31	0.85
2000	15.76	32.27	51.97	3.36
2001	15.12	31.64	53.24	3.71
2002	15.11	31.83	53.06	3.95
2003	14.64	31.94	53.41	3.76
2004	15.07	31.70	53.23	5.18
2005	14.30	31.87	53.83	2.00
2006	14.16	31.66	54.19	3.82
2007	14.19	31.56	54.25	4.81
2008	14.88	31.69	53.43	3.22
2009	14.82	30.20	54.98	0.01

Source: Bureau of Agricultural Statistics (2010).

Recent figures from the Department of Agriculture (DA) show that the El Niño phenomenon caused contractions in agricultural performance in the first half of 2010. The phenomenon affected the crops subsector. There was also a reduction in fish production while the poultry and livestock subsectors showed production gains. The poultry, livestock, and fisheries subsectors, which collectively account for about 56 percent of total agricultural output, posted positive growth of 3 percent, 1 percent, and 0.7 percent, respectively (not shown in table 3). Cabanilla (2006) noted that poultry and livestock have always been sources of agricultural growth. These sectors, however, are constrained by the high price of maize, the main component of animal feeds.

It is a common observation that the poor performance of the Philippine agricultural sector in recent decades can be traced not so much to weaknesses in production but to failures and shortcomings in the policy and institutional environment within the sector (Habito and Briones 2005). David (2003) and Habito and Briones (2005) contend that the policy regime has not established an appropriate incentive structure for the rapid development of agriculture. The reversion of price policies towards agricultural protection in the 1990s favored import-competing sectors such as rice, corn, and chicken rather than export-oriented sectors such as coconut and banana (see table 4). This continued the regime of distortions while further eroding the competitiveness of labor-intensive industries (i.e., because of artificially high food prices that raise the cost of wage goods).

Table 4. Nominal Protection Rates (%) By Agricultural Commodity

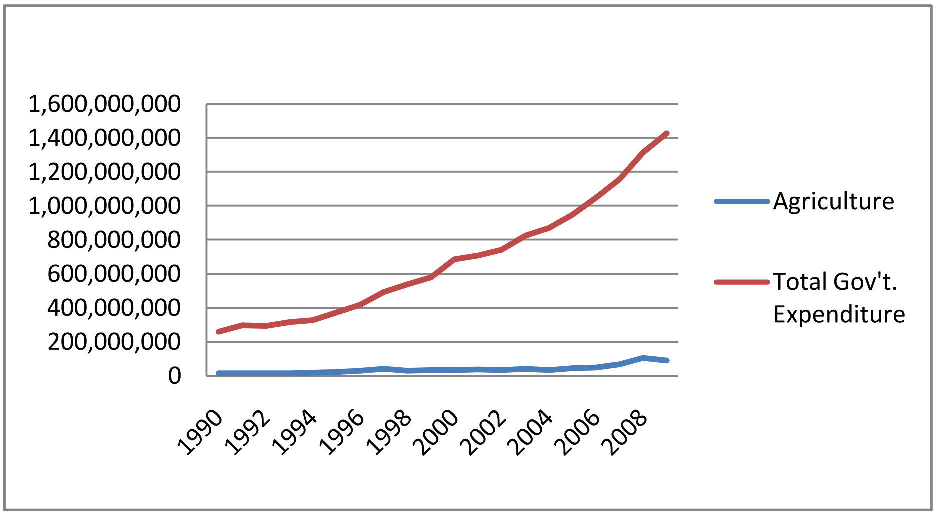
Year	Rice	Corn	Sugar	Oil	Copra Coconut	Beef	Chicken	Pork
1960-64	20	53	9	-16	-24	30	115	-13
1965-69	12	44	86	-29	-31	-32	163	-24
1970-74	4	19	-37	-31	-35	-53	84	-38
1975-79	-13	30	-26	-20	-28	-25	91	-39
1980-84	-13	25	19	-28	-37	15	100	-28
1985-89	16	67	122	-16	-31	6	56	2
1990-94	26	70	51	-7	-26	31	69	43
1995-99	67	86	107	-12	-20	103	43	88
2000	87	104	82	-17	-33	73	23	53

2001	83	79	73	-21	-33	26	8	37
2002	63	51	111	-13	-18	18	5	76
2003	49	30	86	21	-20	28	-2	49
2004	21	41	47	-10	-30	-1	-5	32
2005	15	53	15	-16	-34	5	0	47
2006	19	51	2	-11	-32	16	22	80
2007	27	32	80	-10	-28	26	27	94

***Sources*:** David, Intal, and Balisacan (2007) for 1960—2005 figures; International Monetary Fund, IMF Commodity Prices (2008) and Bureau of Agricultural Statistics, CountrySTAT, Philippines (2008) for 2006 and 2007 figures.

The government has also failed to provide an adequate quantity and quality of investments in irrigation and other agriculture-related infrastructure. Figure 5 shows that government expenditure on agriculture remained low at 5 percent to 7 percent since 1990 while total expenditure in other sectors increased. Irrigation investments have declined from the 1980s through the early 1990s. Similarly, investments in rural roads and ports have plummeted, significantly raising the cost of access to rural areas. Research and development (R&D) is badly underfunded, resulting in research-intensity ratios far lower than those in other countries. Moreover, the bulk of research resources is inordinately focused on rice, several times out of proportion to that commodity's contribution to Gross Value Added (GVA). Instead of agricultural support policies specializing in expanding credit access and providing extension services, scarce resources were allocated to fund high-cost activities such as the provision of postharvest facilities, marketing, and credit subsidies, which are probably better off left to the market (Tolentino et al. 2001). A case in point is the tremendous fiscal and deadweight burden imposed by the National Food Authority's (NFA) activities on rice trade (Roumasset 2000). Another policy with adverse, unintended consequences for agricultural investments is land reform. Due to its slow pace of implementation, landowners yet to be subject to the Comprehensive Agrarian Reform Program (CARP) have scaled back their investments significantly (Habito et al. 2003; Briones 2002); thereby, contributing to the overall slowdown in investments in the sector.

Figure 5. Government expenditure on agriculture (in PHP)



Source: ADB

As David (1995) emphasized, the Philippine government's support for agriculture is relatively low compared to the support provided by the governments of other Asian countries to their agriculture sector. She criticized the misallocation of funds for agriculture and underinvestment in programs that have long-term effects. David, Ponce, and Intal (1992) likewise noted the lack of support services for agriculture. They argued that government intervention in agriculture has relied primarily on short-term price and trade regulations, with minimal or no tangible positive impact. The use of scarce resources has instead imposed heavy and unnecessary transaction costs on farmers. Francisco and Bordey (2009) added that the overlapping functions and roles of R&D institutions constrain the present R&D system.

Cabanilla and Velasco (2003) revealed that though there is limited room for expansion of agricultural land in the Philippines, there seems to be enough suitable rice lands to provide for the country's needs for the next twenty-five years. It is therefore not an issue of land area but of agricultural productivity. The study assessed that Philippine agriculture is constrained by inadequate irrigation, frequent typhoons, and the lack of investment in infrastructure. The Philippines is visited by an average of nineteen typhoons a year. Hence, crop yields during the wet season are relatively lower than during the summer season.

In terms of water resources, the Philippines is not as well endowed as Thailand and Vietnam. It has an annual average of only 6,332 cubic meters per capita of available water compared to the 6,526 and 11,406 cubic meters per capita of Thailand and Vietnam, respectively (Cabanilla

2006). In fact, only about 0.6 million hectares of rice land in the Philippines have reliable sources of irrigation while the rest are rainfed. According to Cabanilla (2006), whatever agricultural growth the Philippines has enjoyed can be attributed to the high prices of commodities on the world market, adoption of modern varieties, increased fertilizer use, and expansion of irrigation. The slowdown in agricultural performance, on the other hand, can be attributed to depressed world prices at that time and the country's inability to cope with the technological advances necessary for the growth and development of the sector. Problems related to the land reform program, farmers' limited access to credit, and the conversion of agricultural lands for urban and industrial uses further aggravated the situation.

Experts suggested ways by which agricultural growth can be improved. One way is to promote the use of agricultural resources and to diversify cropping systems (Lozada et al. 1999). Another is to create an efficient incentive and institutional structure to support the delivery of services through complete deregulation, improved allocation of government funds, and restructured agricultural bureaucracy (David, Ponce, and Intal 1992). Briones (2010), on the other hand, pushes for agricultural growth through productivity improvement rather than land expansion, input intensification, or costly subsidies. Another alternative is to promote agricultural trade combined with public investment in productivity-enhancing support services (Balisacan and Ravago 2003).

In principle, productivity growth coupled with agricultural trade would assure food security. The success of trade is highly dependent on the capacity of the domestic market to adjust to technological changes to meet the demands of the world market.

International trade poses certain challenges to Philippine agriculture. The capacity of developing countries like the Philippines to penetrate the world market is constricted by the heavy protection given to the agricultural sector of developed countries; imposed tariffs may also lead to a reduction in agricultural income. Aside from tariffs imposed on agricultural trade products, nontariff measures are another barrier for Philippine produce. Nontariff measures limit the penetration of Philippine exports in the international market. Varying standards per country that deviate from internationally accepted standards make international trade more costly (Pasadilla and Liao 2007). Although the standards established by nations are meant to protect their citizens from inferior, deficient, or dangerous products, technical standards entail additional costs that may offset the competitive advantage of a country. Otsuki et al. (2001)

added that developing countries are vulnerable to regulatory changes because their scarce resources limit their ability to comply with restrictive standards.

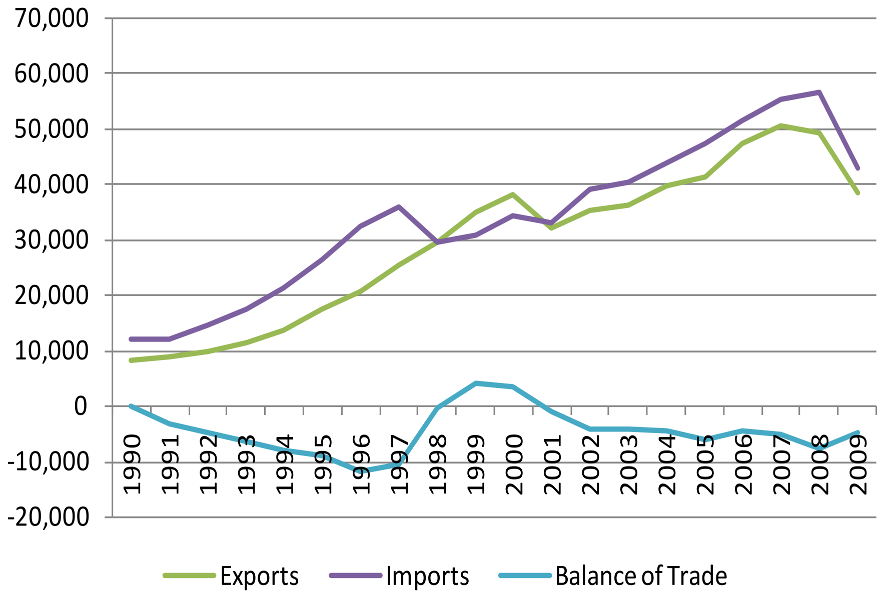
Indeed, Philippine agriculture faces many constraints both in the domestic and international markets. It is, however, important to note that agricultural growth is a way to food security, and international trade is an important development strategy for agricultural growth.

3. Food Security and Food Self-Sufficiency

Macro-level food security situation

The most common food security indicator is the ratio of total exports to food imports. This ratio reflects the relative cost of access to food in the country. This indicator has the advantage of capturing both the demand for imports and the capacity of a country to export; that is, it captures the fact that as long as a country generates enough foreign exchange from exports to finance food imports, it is considered food secure. Figure 6 shows a situation where macro-level food security has rapidly deteriorated due to increasing food imports; thus, the relative cost for access to food is high.

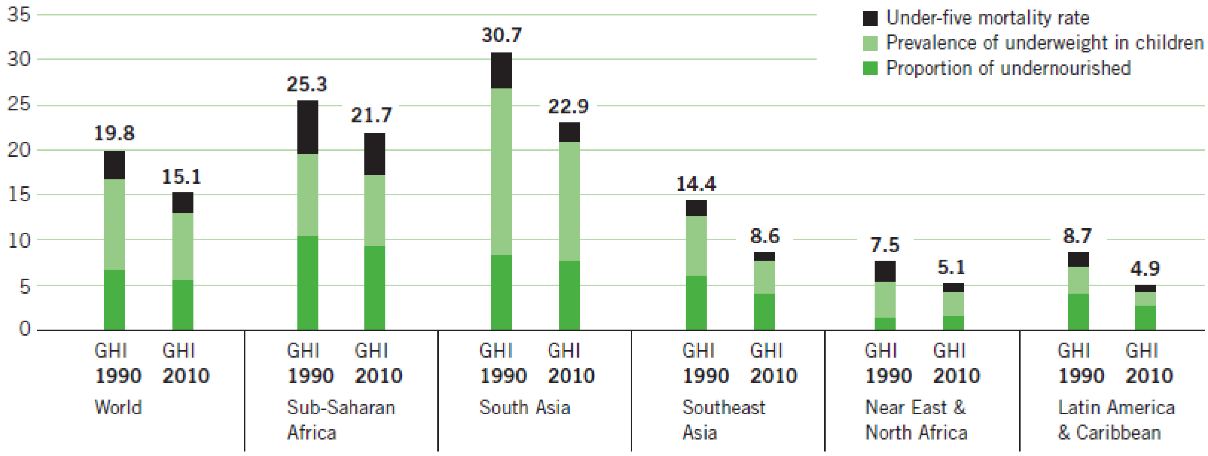
Figure 6. Food trade balance (ratio of total exports to food imports)



The Global Hunger Index (GHI) is another food security indicator. The GHI combines three equally weighted indicators: (1) the proportion of undernourished as a percentage of the population (reflecting the share of the population with insufficient dietary energy intake); (2) the prevalence of underweight in children younger than five (indicating the proportion of children suffering from weight loss); and (3) the mortality rate of children younger than five (partially reflecting the fatal synergy between inadequate dietary intake and unhealthy environments, i.e., lack of nutrients will create a high risk of illness, cause poor physical and cognitive growth, and ultimately result in death) (Grebmer et al. 2010).

Figure 7 shows some improvement in the 2010 GHI over the 1990 world GHI by almost one-quarter, from 19.8 down to 15.1 GHI.[1] The improvement in the three GHI indicators—namely, the proportion of the undernourished, the proportion of underweight children, and the under-five mortality rate all contributed to the world GHI. However, despite this improvement, world GHI remains at a serious level. In fact, the number of hungry people has increased and reached 1,020 million people, although new estimates by the FAO suggest that the number may have dropped to 925 million in 2010 (One World.net 2010).

Figure 7. Contribution of undernourished, underweight, and under-five mortality rate to 1990 GHI and 2010 GHI by region



***Source*:** Grebmer et al. 2010.

[1] The GHI ranks countries on a 100-point scale, with zero being the best score (no hunger) and 100 being the worst, though neither of these extremes is achieved in practice. Values less than 4.9 reflect low hunger, values between 5.0 and 9.9 reflect moderate hunger, values between 10.0 and 19.9 indicate a serious problem, values between 20.0 and 29.9 are alarming, and values of 30.0 or higher are extremely alarming. Data for the 2010 GHI are from 2003 to 2008. Specifically, the data on the proportion of undernourished are for 2004–06; data on child mortality are for 2008; and data on child malnutrition are for the latest year in the period 2003–08 for which data are available. For more information, see von Grebmer et al. (2010).

At the regional level, South Asia and Sub-Saharan Africa had the most number of undernourished people in 1990 and 2010 (figure 7). The 2010 GHI score fell by 14 percent in Sub-Saharan Africa compared with the 1990 score, and by about 25 percent in South Asia. The 2010 GHI in Southeast Asia shows progress with the GHI scores decreasing by 40 percent and more. It is worthwhile to note that about 10 percent and 22 percent of the population of China and India (two of the most populous countries in the world), respectively, are undernourished (table 5). The Philippines' 2010 GHI also shows some improvement over its 1990 GHI, falling from 19 to 13, or a 30 percent decrease (table 5). While the contribution of the proportion of underweight children under five in the GHI declined by 9.2 points and the under-five mortality rate as well as the proportion of undernourished also improved, the GHI remains serious.

Table 5. Data Underlying the Calculation of the 1990 and 2010 Global Hunger Indices

	Proportion of undernourished in the population (%)		**Prevalence of underweight in children under five years (%)**		**Under five mortality rate (%)**		**GHI**	
Country	1990—92	2004—06	1988—92	2003—08	1990	2008	1990 (with data from 1988--92)	2010 (with data from 2003--08)
South Asia								
Afghanistan	-	-	-	32.8	26.0	25.7	-	-
Bangladesh	36.0	26.0	56.5	41.3	14.9	5.4	35.8	24.2
Bhutan	-	-	34.0	12.0	14.8	8.1	-	-
India	24.0	22.0	59.5	43.5	11.6	6.9	31.7	24.1
Nepal	21.0	16.0	47.2	38.8	14.2	5.1	27.5	20.0
Pakistan	22.0	23.0	39.0	25.3	13.0	8.9	24.7	19.1
Sri Lanka	27.0	21.0	33.4	21.1	2.9	1.5	21.1	14.5
East and Southeast Asia								
Cambodia	38.0	25.0	44.7	28.8	11.7	9.0	31.5	20.9
China	15.0	10.0	15.3	6.0	4.6	2.1	11.6	6.0
Indonesia	19.0	16.0	31.0	19.6	8.6	4.1	19.5	13.2
Lao PDR	27.0	19.0	44.4	31.6	15.7	6.1	29.0	18.9

Malaysia	2.0	2.0	22.1	7.0	1.8	0.6	8.6	<5
Mongolia	30.0	29.0	10.8	5.3	9.8	4.1	16.9	12.8
Myanmar	44.0	17.0	32.5	29.6	12.0	9.8	29.5	18.8
Philippines	21.0	15.0	29.9	20.7	6.1	3.2	19.0	13.0
Thailand	29.0	17.0	17.2	7.0	3.2	1.4	16.5	8.5
Vietnam	28.0	13.0	40.7	20.2	5.6	1.4	24.8	11.5

***Source*:** Grebmer et al. (2010).

In Southeast Asia, Indonesia has the most number of undernourished people, averaging 27.8 million from 1990 to 2007 and growing at a rate of 4.2 percent on average. This is followed by Viet Nam, the Philippines, and Myanmar with 15.2, 14.3, and 14.1 million undernourished people, respectively. While Viet Nam ranked second with the most number of undernourished people, the rate of increase in this figure has gone down by 22.9 percent, which contributed to a remarkable reduction in its GHI score by more than 13 points (table 5). Myanmar also performed very well in terms of reducing the number of undernourished people from 44 percent in 1990—92 to 17 percent in 2004—06 (table 5). The Philippines was also able to reduce the proportion of undernourished people to 15 percent in 2004—06 from 21 percent in 1990—92 (table 5).

In addition to the GHI, another food security indicator that would capture both the macroeconomic and household-level dimensions of the status of food security is agricultural potential (i.e., food production per capita). Statistics for the Philippines showed that the country has generally improved its food security status in terms of food production per capita. From 1990 to 2006, FAO data showed that there was an increase in dietary energy supply (DES), averaging at 2,403 kcal/person/day. This has grown 3.11 percent on average. DES indicates the food available for human consumption. On the other hand, over the same period, the average minimum dietary requirement was 1,735 kcal/person/day (table 6). This means that there was more food available for consumption than the minimum energy requirement (FAO 2009). The Food Balance Sheet (FBS) in 2001 also indicated that the total supply of food in the country was more than adequate to address the nutrient needs of the population. The per capita food supply reached 1.19 kg, which exceeded the recommended dietary allowance of 1.03 kg. On average, per capita energy supply grew 0.45 percent while the mean per capita food consumption remained steady at 1,684 kcal/day.

Table 6. Food Supply and Consumption Requirement in the Philippines, 1990—2007

Supply and Consumption Indicator	1990—1992 Amount (kcal/person/day)	1990—1992 Growth rate (%)	1995—1997 Amount (kcal/person/day)	1995—1997 Growth rate (%)	2000—2002 Amount (kcal/person/day)	2000—2002 Growth rate (%)	2004—2006 Amount (kcal/person/day)	2004—2006 Growth rate (%)
Dietary energy supply (DES)	2,290	-	2,380	3.93	2,430	2.10	2,510	3.29
Minimum dietary energy requirement (MDER)	1,720	-	1,730	0.58	1,740	0.58	1,750	0.57
Average dietary energy requirement (ADER)	2,150	-	2,170	0.93	2,190	0.92	2,210	0.91

***Source*:** FAOSTAT, UN Food and Agriculture Organization (accessed November 2010)

On average, Filipinos allocate 42.6 percent of income to food items (NSO-FIES 2009). Grains, especially rice, constitute the bulk of the food consumed in the country. As the prime staple food in the country, rice (and its supply) is politically and socially considered as a key indicator of food security in the Philippines. Hence, achieving rice self-sufficiency can be equated with attaining food security. In 2006, rice contributed 48 percent to the daily energy supply of Filipinos, which underscores its importance in the meal (FAO 2006). Production data in the period 1994—2009 showed that, in general, there has been an increasing trend in the volume of rice supply in the country, with an average growth rate of 3.6 percent. Although the same trend has been observed in terms of area planted and yield, growth rate for these is a dismal 1.8 percent and 1.6 percent, respectively (table 7). The improvement in yield, particularly in the 1990s, may be attributed to technological interventions and infrastructure development. These include varietal improvement on rice, construction of farm-to-market roads, and expansion of irrigation facilities. The production growth rate of 2.8 percent in the 1990s can also be attributed to the rising real domestic price (despite falling world prices during that period) and falling real input prices (except wages). The 24.1 percent decline in production in 1998 was due to the El Niño phenomenon, but this decline was easily recovered in 1999 when output increased by 37.8 percent. However, imports increased starting 1998 and since then, the Philippines has continued to import rice.

In addition to the volume of rice it produces, the Philippines has also been constantly importing rice. From 1998 to 2006, the NFA's rice imports accounted for about 15 percent of rice production (assuming a rice-recovery rate of 65.4 percent from palay) and 10 percent of the net available rice in the country. It is worthwhile to note that the country's rice consumption is less than the production of local farmers (figure 8). During the period 1994—2009, rice consumption averaged about 9.9 million metric tons (MT) (IRRI 2010) while local production was 13.1 million MT (table 8). Although this may imply a rice surplus, the seemingly lower consumption level may be attributed to gaps in the distribution system and the poor purchasing power associated with low income and poverty. It may also be attributable to the Philippines' "hoarding" behavior to increase domestic stocks of rice in the effort to protect itself against future shortages (like what happened in 1998 because of the El Niño phenomenon) and to keep a lid on domestic price increases especially during food crises.

Table 7. Annual Production, Area, and Yield of Rice in the Philippines, 1994—2009

Year	Rice Production (Paddy)		Rice Area Harvested		Yield	
	Amount (mt)	Growth rate (%)	(ha)	Growth rate (%)	Amount (mt/ha)	Growth rate (%)
1994	10,538,054	-	3,651,530	-	2.89	-
1995	10,540,649	0.02	3,758,691	2.93	2.80	-2.83
1996	11,283,568	7.05	3,951,136	5.12	2.86	1.83
1997	11,268,963	-0.13	3,842,270	-2.76	2.93	2.70
1998	8,554,824	-24.09	3,170,042	-17.50	2.70	-7.99
1999	11,786,625	37.78	3,999,839	26.18	2.95	9.19
2000	12,389,412	5.11	4,038,085	0.96	3.07	4.12
2001	12,954,870	4.56	4,065,441	0.68	3.19	3.86
2002	13,270,653	2.44	4,046,318	-0.47	3.28	2.92
2003	13,499,884	1.73	4,006,421	-0.99	3.37	2.74
2004	14,496,784	7.38	4,126,645	3.00	3.51	4.26
2005	14,603,005	0.73	4,070,421	-1.36	3.59	2.12
2006	15,326,706	4.96	4,159,930	2.20	3.68	2.70

2007	16,240,194	5.96	4,272,889	2.72	3.80	3.16
2008	16,815,548	3.54	4,459,977	4.38	3.77	-0.80
2009	16,266,417	-3.27	4,532,310	1.62	3.59	-4.81
Average	**13,114,760**	**3.59**	**4,009,497**	**1.78**	**3.25**	**1.55**

***Source*:** Bureau of Agricultural Statistics

***Note*:** (-) means no data

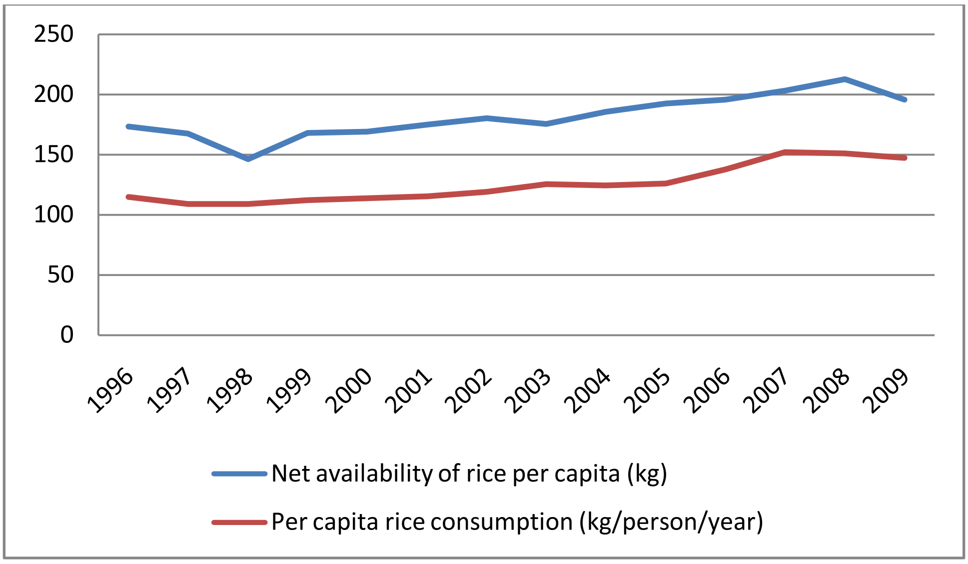
Table 8. Annual Rice Net Availability and Consumption of Rice in the Philippines, 1994—2009

Year	Rice Production (paddy)(mt) (a)	Rice Imports (mt) (b)	Net Availability (a) + (b)=(c)	Rice Consumption (mt) (d)	Difference (c) - (d)
1994	10,538,054	-	10,538,054	7,142,000	3,396,054
1995	10,540,649	-	10,540,649	7,509,000	3,031,649
1996	11,283,568	866,949	12,150,517	8,027,000	4,123,517
1997	11,268,963	724,902	11,993,865	7,800,000	4,193,865
1998	8,554,824	2,178,135	10,732,959	8,000,000	2,732,959
1999	11,786,625	838,071	12,624,696	8,400,000	4,224,696
2000	12,389,412	642,294	13,031,706	8,750,000	4,281,706
2001	12,954,870	810,903	13,765,773	9,040,000	4,725,773
2002	13,270,653	1,200,588	14,471,241	9,550,000	4,921,241
2003	13,499,884	888,984	14,388,868	10,250,000	4,138,868
2004	14,496,784	1,003,414	15,500,198	10,400,000	5,100,198
2005	14,603,005	1,829,604	16,432,609	10,722,000	5,710,609
2006	15,326,706	1,723,277	17,049,983	12,000,000	5,049,983
2007	16,240,194	1,809,828	18,050,022	13,499,000	4,551,022
2008	16,815,548	2,438,932	19,254,480	13,650,000	5,604,480
2009	16,266,417	1,784,141	18,050,558	13,614,000	4,436,558
Average	**13,114,760**	**1,338,573**	**14,286,011**	**9,897,063**	**4,388,949**

***Source*:** Bureau of Agricultural Statistics; UNCOMTRADE

***Note*:** (-) means no data

Figure 8. Availability and consumption of rice per capita (kg/capita)



Ironically, while statistics shows that the Philippines has more than enough supply of food to feed its growing population, the country is confronted by food security issues. The Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) considered 49 (63 percent) out of the 77 provinces in the country to be prone to varying levels of food insecurity (FIVIMS 2010). The small-area poverty estimates (SAPE) conducted by the National Statistical Coordination Board (NSCB) in 2003 stated that four out every ten Filipinos are poor. Cabanilla (2006) emphasized that hunger could be prevalent even in surplus areas. In his integrative report, Cabanilla cited a survey conducted by the Social Weather Station (SWS), which pointed out that many Filipino families live with food deficit primarily due to lack of economic access to food. A case in point is Mindanao, which occupies one-third of the country's area, contributes 40 percent of the country's food requirements, and is the source of the country's top agricultural exports. Despite this, Mindanao has the most number of areas considered vulnerable to food insecurity due to poverty. According to the NSCB, of the 40 poorest municipalities in the Philippines, about 70 percent, or 28 municipalities, are in Mindanao. This clearly suggests that the availability of food alone is not a sufficient condition for the attainment of food security. Economic accessibility as represented by income is also an important factor to consider. According to Ajani et al. (2006), the level of income distinguishes the food-secure family from the food-insecure one since increasing household income also increases the family's command over bundles of food.

Household-level food security situation

Food security and food self-sufficiency at the household level

From the FIES data, we calculated three indicators of food self-sufficiency:

- Home-produced food as a share of all food consumed
- Home-produced cereals as a share of all cereals consumed
- Home-produced rice as a share of all rice consumed

We also calculated four measures of food security:

- Per capita real value of food consumption
- Nonstaples as a share of food consumption
- Animal products as a share of food consumption
- Reported number of months per year that the household has sufficient food

Table 9 shows the average values of the measures of self-sufficiency, food security, and standard of living in urban and rural areas.

Rural households produce, on average, 15.2 percent of the cereals they consume (and buy the remaining 85 percent) and 15.3 percent of the rice they consume (table 9). As expected, urban figures are lower than rural figures (except for animal products and nonstaples as a share of food consumption) while the national averages lie between the two.

In addition, we considered the relationship between self-sufficiency and food security indicators and the measure of general well-being (per capita expenditure). We found that there is a positive and significant relationship between per capita expenditure, a measure of standard of living, and per capita food expenditure as shown in table 10. A negative correlation between self-sufficiency and food security measures means that households that are more self-sufficient in food in general (i.e., households that produce what they consume) tend to be poorer and less food secure, as indicated by the share of nonstaples and animal products. These households are perhaps far from markets and roads and lack economic access to food so that they are not able to produce anything for the market and are forced to grow crops for which they may not have comparative advantage.

Per capita expenditure is positively correlated with the measures of food security except for the number of months with sufficient food. The percentage of households with sufficient food for six months is positively correlated with food-cereal-rice self-sufficiency indicators. These findings mean that some households (particularly rural households) may be forced into food self-sufficiency by lack of market access but encouraging household self-sufficiency in food is not a useful strategy for achieving food security or reducing poverty.

Table 9. Average Values of Measures of Self-Sufficiency, Food Security, and Standard of Living

Indicators	**Urban**	**Rural**	**Overall**
Households with sufficient food for the past 6 months (as % of total)	17.50	39.86	28.60
Cereal self-sufficiency (%)	4.27	15.16	9.76
Rice self-sufficiency (%)	5.10	15.28	10.16
Per capita food expenditure (%)	27.74	27.50	27.62
Share of nonstaples in food (%)	67.30	62.17	64.71
Share of animal products in food (%)	34.31	30.84	32.56
Per capita food expenditure (Php/mo)	3,013.12	1,772.61	2,387.73

***Source*:** Analysis of data from the 2006 FIES.

Table 10. Correlation of Self-Sufficiency Indicators and Food Security Indicators Among Rural Households

	Food security indicators			
	Per capita food expenditures	**Share of nonstaples in food (%)**	**Share of animal products in food (%)**	**Households with sufficient food for the past 6 months (%)**
Food self-sufficiency (%)	0.0019	-0.0707*	-0.0645*	0.8051*
Cereal self-sufficiency (%)	0.0543*	-0.0890*	-0.0731*	0.5980*
Rice self-sufficiency (%)	0.0588*	-0.0344*	-0.0284*	0.6077*
Per capita expenditure (Php/month)	0.3812*	0.2844*	0.2540*	-0.1934*

***Source*:** Analysis of data from the 2006 FIES.

4. Trends in Agricultural Exports

Turning now to agricultural trade performance, the sector is not considered a significant contributor in terms of foreign earnings (Cabanilla 2006). But agricultural trade contributes to food security by augmenting domestic supplies to meet consumption needs and by reducing variability in supply.

Agricultural exports accounted for 8.2 percent of the total value of Philippine exports in 2009 (tables 11 and 12). The country's total export earnings amounted to US$3,135.75 million in 2009, which was 19.37 percent lower than the 2008 record (table 12). The most valuable agricultural export is coconut oil, followed by fresh bananas, pineapples, and tuna. These top earners among agricultural exports collectively account for 52 percent of total agricultural exports. Coconut oil was shipped mostly to the United States and the Netherlands, Japan (5 percent), Italy (4 percent), and China (3 percent) (table 11). The major markets for fresh banana were Japan, Iran, South Korea (8 percent), Singapore (6 percent), and China (4 percent). Tuna was shipped to the United States, Germany, the United Kingdom (including Great Britain) and Ireland (12 percent), Japan (8 percent), and France (5 percent). Pineapples and pineapple products were exported mostly to United States and Japan, Singapore (6 percent), South Korea (5 percent), and the Netherlands (4 percent). The composition of agricultural exports has shifted away from traditional commodities like sugar, tobacco, abaca, and forest products in favor of bananas, pineapples, tuna, and other nontraditional export crops.

Table 11. Value of Agricultural Imports Relative to Agricultural Exports

Value of total agricultural exports	P 149 billion f.o.b. (US$3,136 million f.o.b.)
% agriculture in total exports	8.2%
Top agricultural export commodities	coconut oil (19%), fresh bananas (11%), tuna (11%), pineapples and products (8%)
Major markets	
coconut oil	USA (44%), Netherlands (35%)
fresh bananas	Japan (60%), Iran (12%)
tuna	USA (28%), Germany (18%)
pineapples and products:	USA (51%), Japan (16%)
Value of total agricultural imports	P 290 billion c.i.f. (US$6,079 million c.i.f.)
% agriculture in total imports	13.3%
Top agricultural import commodities	rice (17%), wheat and meslin (13%), soya bean oil/cake meal (7%), milk and cream and products (6%)
Major suppliers	
rice	Vietnam (95%)
wheat and meslin	USA (57%), Ukraine (23%)
soya bean oil/cake meal	Argentina (56%), USA (39%)
milk and cream and products	New Zealand (45%), USA (18%)
Agricultural trade deficit	P 140 billion

***Note*:** Peso per US dollar rate was 47.64 in 2009.

Table 12. Top Agricultural Exports: Volume and Value, Philippines, 2007—2009

	2007	**2008**	**2009P**	**Annual growth rate (%)**
VOLUME OF TOP EXPORTS ('000 mt)				
Coconut oil	888.85	850.08	832.94	-2.1
Banana, fresh	2199.32	2192.55	1664.05	-8.9
Tuna	73.93	108.24	105.25	12.5
Pineapple and pineapple products	587.82	586.15	487.7	-6.0
Desiccated coconut	130.72	142.66	116.42	-3.8

Tobacco, manufactured	17.68	20.01	17.24	-0.8
Seaweed and carageenan	26.18	26.25	24.08	-2.7
Tobacco, unmanufactured	18.9	23.64	30.09	16.8
Milk and cream and products	35.94	37.96	26.61	-9.5
Fertilizer, manufactured	255.85	213.46	324.96	8.3
Mango, fresh	26.34	20.84	20.38	-8.2
VALUE OF TOTAL AGRICULTURAL EXPORTS				
(FOB in million US$)	3168.07	3889.3	3135.7	-0.3
VALUE OF TOP EXPORTS (FOB in million US$)				
Coconut oil	733.81	1039.61	594.49	-6.8
Banana, fresh	396.28	405.56	344.43	-4.6
Tuna	210.87	388.78	334.82	16.7
Pineapple and pineapple products	247.42	388.78	334.82	10.6
Desiccated coconut	157.43	240.36	145.76	-2.5
Tobacco, manufactured	97.89	125.26	109.36	3.8
Seaweed and carageenan	91.64	122.03	98.68	2.5
Tobacco, unmanufactured	42.98	63.03	96.85	31.1
Milk and cream and products	138.76	162.5	95.62	-11.7
Fertilizer, manufactured	53.64	55.81	92.5	19.9
Mango, fresh	23.28	19.58	15.98	-11.8

***Source*:** NSO (2010).

In terms of imports, the country has been a net importer of rice and corn since 1995 when it acceded to the WTO, and it continues to be a net food importer to this day. Agricultural imports accounted for 13.3 percent of the total value of Philippine imports in 2009 (table 11). Agricultural and import expenditures reached US$6,079.80 million in 2009, which was 20.88 percent lower than the 2008 level (tables 11 and 13). Rice and wheat and meslin accounted for 31 percent of total agricultural imports. The bulk, or 95 percent, of rice imports came from Viet Nam while the major sources of wheat and meslin were the United States and Ukraine (table 11). Corn (maize) displaced rubber from the eighth place in the list of major agricultural imports.

Table 13. Top Agricultural Imports: Volume and Value, Philippines, 2007—2009

	2007	**2008**	**2009P**
VOLUME OF TOP IMPORTS ('000 mt)			
Rice	1805.61	2432.85	1755.18
Wheat and meslin	1,871.80	1,703.46	3,028.18
Soya bean oil cake/meal	1,322.49	1,203.16	1,267.63
Milk and cream and products	262.27	234.26	256.64
Tobacco, unmanufactured	58.81	60.73	46.77
Urea	462.6	524.59	626.64
Meat of bovine animals	104.52	109.25	84.02
Food preparations for infant use	17.14	21.27	19.91
Corn	152.31	22.97	303.12
Coffee	30.79	36.03	51.09
VALUE OF TOTAL AGRICULTURAL IMPORTS (CIF in million US$)	4918.29	7684.74	6079.8
VALUE OF TOP IMPORTS (CIF in million US$)			
Rice	657.14	1956.78	1039.64
Wheat and meslin	424.44	618.43	816.45
Soya bean oil cake/meal	392.02	506.58	422.16
Milk and cream and products	588.72	724.37	385.68
Tobacco, unmanufactured	182.49	223.46	192.53
Urea	123.35	199.87	185.93
Meat of bovine animals	139.27	209.17	143.83
Food preparations for infant use	97.97	124.99	125.5
Corn	48.46	25.41	104.21
Coffee	69.86	91.09	88.13

Source**:** NSO (2010).
Note: P stands for preliminary data.

The rapid growth in the production of fruits and vegetables, and fish and livestock products contrasts with the relatively slow growth in cereals production. This can be partly explained by the fact that as consumer income rises, the share of spending allocated to basic staples declines while the proportion spent on animal products, fruits, vegetables, and processed goods tends to rise. In addition, rising incomes in China, India, and neighboring countries create a demand for

Philippine high-value products, such as bananas, pineapples, mangoes, nuts, and seafood. The rising demand for these high-value commodities (HVCs) is transmitted to farmers in the form of remunerative prices. Will this motivate farmers to expand the areas planted to these crops beyond what it would be without trade? We have comparative advantage in producing these HVCs. We have also achieved self-sufficiency for these HVCs, so expanding production for the export market is promising (table 14). If farmers divert land for the production of export crops, will they raise the price of agricultural commodities and contribute to food insecurity by reducing the domestic production of staple crops?

Table 14. Self-Sufficiency Ratio, by Exportable Commodity, By Year

	Coconut	**Sugarcane**	**Banana**	**Pineapple**	**Mango**	**Milkfish**	**Shrimps and Prawns**	**Crabs**
1996	100.04	100	142.11	109.8	105.39	100.08	116.78	106.4
1997	100.03	100	135.03	109.84	104.75	100.07	129.89	110.54
1998	100.03	100	138.87	108.05	105.5	100.1	136.3	110.86
1999	100.02	100	140.59	108.87	104.22	99.89	131.54	108.68
2000	100.01	100	148.03	109.51	104.82	100	100.62	112.14
2001	100.01	100	146.28	110.46	104.4	100.16	136.2	112.8
2002	100.01	100	146.94	112.23	103.86	100.1	155.95	112.65
2003	100.01	100	151.68	112.94	103.69	100.11	169.83	111.48
2004	100.02	100	146.43	113.11	103.6	100.18	144.95	100.4
2005	100.02	100	147.36	113.36	103.28	100.21	132.37	100.17
2006	100.01	100	151.56	116.68	102.93	100.35	133.57	99.83
2007	100.01	100	141.62	115.88	102.64	100.43	120.73	104.19
2008	100.01	100	133.76	115.21	102.41	100.47	114.01	103.72
2009P	100.01	100	122.64	110.26	102.71	100.67	113.22	107.16

***Source*:** BAS
Note: P stands for preliminary data.

This does not necessarily mean that the prices of HVCs are higher than those of staples such as rice and corn. As table 15 shows, the price of rice (palay) is currently higher than the price of pineapple, one of the top export crops. This could mean that rising demand could make these HVCs more profitable than they already are. The table further shows that net returns are significantly higher for almost all commodities compared to cereal crops. However, farmers usually do not select their crops solely on the basis of profit or net returns. They give high priority to meeting a certain proportion of their food needs first by growing paddy rice or corn for their own consumption. Farmers with enough land and a tolerance for a certain degree of risk may find the profitability of HVCs attractive. The net returns per hectare from growing HVCs like pineapple is appealing, with a net profit-cost ratio of 2.1. Compare this to palay, which has a net profit-cost ratio of 0.44 and the cost per kilogram for which is PHP10.17.

Table 15. Cost and Returns of Growing Rice and Corn versus Export Commodities

Commodities		**2002**	**2009P**
All Palay			
	NET RETURNS	5619	16005
	NET PROFIT-COST RATIO	0.26	0.44
	Cost per kilogram in pesos	6.86	10.17
	Yield per hectare in kilograms	3188	3587
	Farmgate price in pesos per kilogram	8.62	14.63
All Corn			
	NET RETURNS	2431	8959
	NET PROFIT-COST RATIO	0.22	0.45
	Cost per kilogram in pesos	5.81	7.55
	Yield per hectare in kilograms	1915	2621
	Farmgate price in pesos per kilogram	7.08	10.97
Mango			
	NET RETURNS	64059	43635
	NET PROFIT-COST RATIO	1.66	0.73
	Cost per kilogram in pesos	6.09	14.64
	Yield per hectare in kilograms	6352	4101
	Farmgate price in pesos per kilogram	16.17	25.28
Pineapple			
	NET RETURNS	126949	133076
	NET PROFIT-COST RATIO	2.81	2.1
	Cost per kilogram in pesos	1.24	1.7
	Yield per hectare in kilograms	36457	37375
	Farmgate price in pesos per kilogram	4.72	5.26
Coffee			

	NET RETURNS	4542	18041
	NET PROFIT-COST RATIO	0.26	0.66
	Cost per kilogram in pesos	21.95	34.65
	Yield per hectare in kilograms	808	786
	Farmgate price in pesos per kilogram	27.57	57.6
Cabbage			
	NET RETURNS	36015	93965
	NET PROFIT-COST RATIO	0.61	0.87
	Cost per kilogram in pesos	5	7.34
	Yield per hectare in kilograms	11711	14701
	Farmgate price in pesos per kilogram	8.08	13.73
Eggplant			
	NET RETURNS	57193	40931
	NET PROFIT-COST RATIO	1.6	0.37
	Cost per kilogram in pesos	4.14	11.63
	Yield per hectare in kilograms	8630	9492
	Farmgate price in pesos per kilogram	10.77	15.94
Tomato			
	NET RETURNS	10999	57723
	NET PROFIT-COST RATIO	0.21	0.7
	Cost per kilogram in pesos	5.95	7.36
	Yield per hectare in kilograms	8938	11268
	Farmgate price in pesos per kilogram	7.18	12.48
Mongo			
	NET RETURNS	7029	12343
	NET PROFIT-COST RATIO	0.77	0.97
	Cost per kilogram in pesos	12.12	17.8
	Yield per hectare in kilograms	749	716
	Farmgate price in pesos per kilogram	21.46	35.04
Peanut			
	NET RETURNS	303	23566
	NET PROFIT-COST RATIO	0.02	0.92
	Cost per kilogram in pesos	18.01	15.59
	Yield per hectare in kilograms	1002	1649
	Farmgate price in pesos per kilogram	18.31	29.88
Milkfish			
	NET RETURNS	15973	36120

NET PROFIT-COST RATIO	0.71	1.1
Cost per kilogram in pesos	31.84	37.84
Yield per hectare in kilograms	708	868
Farmgate price in pesos per kilogram	54.4	79.45

***Source*:** Data on costs of production and returns from Bureau of Agricultural Statistics 2010.
***Note*:** P stands for preliminary data.

To shed light on this question, let us make a distinction between farmers growing HVCs and other farmers. For those growing HVCs, the income earned from sales would most likely allow them to purchase rice and other staples; otherwise, they would stop growing HVCs. On the other hand, farmers who do not grow HVCs may be adversely affected by the diversion of land for the production of export crops, but the effect is likely to be small for the following reasons. First, any reduction in the production of a staple crop such as rice would be compensated by higher imports, so the domestic price will most likely not be affected. Second, the area planted to HVCs is small. The area under all fruits and vegetables is only about 13 percent of the cropland under fruits and vegetables (table 16) and only 7 percent of the total cropland. The area planted to bananas and pineapples, for example, is only about 5 percent of the total cropland. Exports account for 20 percent of banana and pineapple production. If we apply this percentage to the area used for banana and pineapple production, it would mean that the area used to produce the exported quantity of bananas and pineapples is only 1.4 percent.
In the absence of exports, an increase in domestic supply would lower the price, so domestic demand would likely increase. Thus, expanding the production of export crops will not displace cropland and will not have a significant effect on the availability or prices of staple crops.

Table 16. Share of Fruit and Vegetable SubSector in Agricultural Output and Area

	Fruits and vegetables		**Agricultural crops excl. rice and corn**		**Fruits and vegetables**	
	Value of production[1]	**Area planted[2]**	**Value of production[1]**	**Area planted[2]**	**% of agri production**	**% of area planted**
1990	13,176.35	442,926.84	70,260.58	4,852,302.02	18.75	9.13
1991	12,610.94	451,141.39	69,735.79	4,886,055.40	18.08	9.23
1992	12,965.40	458,712.01	70,672.92	4,912,670.31	18.35	9.34
1993	13,293.35	470,540.98	71,637.73	5,037,325.47	18.56	9.34
1994	13,994.83	488,720.02	72,324.37	5,038,751.63	19.35	9.70
1995	16,999.91	506,122.37	76,070.73	4,981,476.64	22.35	10.16

1996	19,309.78	523,407.45	78,527.00	5,144,861.21	24.59	10.17
1997	21,467.31	537,985.88	83,898.43	5,121,361.82	25.59	10.50
1998	18,640.95	545,080.17	71,271.00	4,988,939.73	26.16	10.93
1999	20,519.15	568,143.31	77,273.50	5,150,558.06	26.55	11.03
2000	21,311.38	580,584.70	66,213.28	5,114,771.45	32.19	11.35
2001	21,961.07	590,054.47	68,069.96	5,109,079.85	32.26	11.55
2002	23,134.09	616,605.09	69,679.43	5,170,880.61	33.20	11.92
2003	23,634.23	635,149.57	71,400.50	5,268,505.46	33.10	12.06
2004	23,978.60	645,669.13	72,607.56	5,323,668.88	33.02	12.13
2005	25,245.16	656,315.90	73,910.42	5,305,753.37	34.16	12.37
2006	25,706.68	676,033.92	75,088.86	5,445,098.09	34.24	12.42
2007	28,771.02	703,685.09	77,992.86	5,516,439.64	36.89	12.76
2008	30,172.27	713,786.24	81,511.02	5,570,651.78	37.02	12.81
2009	29,817.57	723,150.81	80,786.81	5,613,215.61	36.91	12.88

Effect of agricultural trade on the volatility of prices

The food crisis of 2007—08 emphasizes the volatility of prices in world markets, particularly rice markets. We used two measures of volatility to study the volatility of prices: the coefficient of variation (CV) and the average percentage change in annual prices,[2] with an underlying assumption that consumers are risk averse and that they prefer a higher, more stable price than a lower, more volatile price. The coefficient of variation is a standard measure of relative volatility, but it lacks a simple intuitive interpretation. The average percentage change is less commonly used but more easily understood.

One simple measure of the volatility in prices in imports is the historical volatility in rice prices. The increase in the global price of rice that occurred in 2007—08 heightened in April and May 2008 when the average price of rice reached over US$1,000/ton (for 5 percent broken Thai white rice) from an average of US$330/ton between January and October 2007. The increase in the price of rice on the world market increased the domestic price of rice by 22.9 percent. This, in turn, reduced the average standard of living by 1.9 percent (Son 2008).

[2] The coefficient of variation (CV) in annual prices is defined as the standard deviation of prices and divided by the mean price. The standard deviation σ is defined as: $\sigma = (1/N)\ \Sigma\ (P_t - \mu)^2$ where μ is the mean price defined as: $(1/N)\ \Sigma\ P_t$, where P_t is the annual price in year t, and N is the number of years of data. The average percentage change in annual prices is defined as: $(100/(N-1))\ \Sigma\ (P_t-P_{t-1})/P_{t-1}$ where P_t is the annual price in year t and N is the number of years of data.

Son estimated that in 2007—08, the increase in food prices (including rice) contributed to a 9.4 percent decrease in the average standard of living. Rice farmers, in particular, were affected by the 2008 price increases since they are also net consumers of, and have to purchase, rice. Furthermore, poorer households are much more vulnerable to price increases since 18 percent of their total expenditure goes to rice and 60 percent goes to food commodities. Despite strong, food-related policy measures passed by the government to prevent global price hikes from affecting domestic prices, the inflation in food prices surged to 9.6 percent (Timmer 2008; Keats et al. 2010).

One of the methods used to study volatility in prices was to examine wholesale prices. Table 17 shows that the CV of the annual average wholesale price in the 1990—2007 period was 22 percent, with an average annual change of 2.7 percent (which is low). However, it can be argued that these figures do not represent volatility in rice prices under free trade because of the policies passed by the Philippine government to stabilize rice prices and the NFA's procurement and distribution activities.

The better measures of the volatility of rice prices on the world market would be the prices of the Thai "A1 Super broken rice" and the Thai "100 percent B second-grade rice," which are widely used as benchmark for rice prices in the international markets. From 1990 to 2007, the CV for these prices was 21 percent and 19 percent, respectively, indicating a level of volatility slightly lower than wholesale rice prices and roughly similar to producer prices. However, if we include 2008—09, the CV in the prices of both Thai rice varieties increased substantially (40 percent and 41 percent, respectively). In addition, the average percentage change from one year to the next was quite low at 7.4 percent and 7 percent, respectively. However, if we take the average percentage change from one year to the next until 2008, the average percentage change becomes 18 percent and 17 percent, respectively.

Table 17. Measures of Actual Rice Price Volatility under Trade

	Time period	**Mean** (US$/mt)	**Coefficient of variation (%)**	**Average percentage change (%)**
Producer price	1990—2007	207	21	2.3
Producer price	1990—2009	281	24	3.5
Wholesale price	1990--2007	424	22	2.7
Wholesale price	1990--2009	447	26	4.3
Thai A1 Super broken	1990--2007	193	21	5.1
Thai A1 Super broken	1990--2009	216	40	7.4
Thai 100% B second grade	1990--2007	274	19	2.1
Thai 100% B second grade	1990--2009	310	41	7.0

5. Summary and Conclusions

One of the important goals of the current administration is to achieve its objective of food security and self-sufficiency in rice by 2016. To meet this goal, the government continues to invest heavily in irrigation; build farm-to-market roads and postharvest facilities; provide subsidy for the procurement of quality genetic materials like seeds; provide services in the areas of production, credit support (to help buy inputs), research and extension, information, regulation, and policy and planning. Irrigated land increased to 1.5 million ha in 2009, boosting production and income of farmers.

This paper investigates the food security situation of the country and explores alternative pathways to achieving food security. Results of the investigation about the Philippines' food security status reveal that the country is still far from being food secure. At the macro level, the food-trade balance shows that food security has rapidly deteriorated due to increasing food imports (dominated by rice imports); thus, the relative cost for access to food is high. It is projected that the Philippines will continue to import rice because of its limited ability to expand production. This poses serious problems for the country's food security unless productivity growth rapidly increases at a phase faster than the population growth rate.

We also looked at the relationship between food security and food self-sufficiency and well-being. The results indicate that food self-sufficiency is negatively correlated with all four indicators of food security as measured by the value of food consumption, the share of nonstaples, the share of animal products, and the proportion of households with sufficient food. This means that households that are more self-sufficient in food in general tend to be less food secure. Furthermore, rice self-sufficiency is positively correlated with food security, and per capita expenditure, a measure of standard of living, is positively correlated with all four measures of food security. As expected, there is a strong relationship between per capita expenditure and per capita food expenditure. This implies that encouraging household food self-sufficiency is not a useful strategy for achieving food security or reducing poverty.

Finally, we investigated the relationship between agricultural exports and food security. In particular, we looked into whether expanding the production of high-value crops (i.e., export crops) would contribute to food insecurity by reducing domestic food production. Results revealed that net returns are significantly higher for export crops such as pineapple, milkfish, mango, peanuts, and legumes (mongo) than cereal crops (palay and corn). However, farmers usually do not select their crops solely on the basis of the profit or net returns. They give high priority to meeting a certain proportion of their food needs first by growing paddy rice or corn for their own consumption. Farmers with enough land and a tolerance for a certain degree of risk may, however, find the profitability of HVCs attractive. The net returns per hectare from growing HVCs like pineapple are appealing with a high net profit-cost ratio of 2.1. Finally, we found that expansion of export crop production will not displace cropland and will not have a significant effect on the availability or prices of staple crops for two main reasons. The first is that the area planted to HVCs is small compared to the total land area devoted to fruits and vegetables and even to total cropland. Second, a reduction in the production of a staple crop like rice would be compensated by higher imports so the domestic price would most likely remain unaffected.

To summarize, agriculture can play an important role in food security on both the macro and household levels but it should not be burdened. Research is needed to assess country-level growth options such as paying attention to the agricultural export sector and estimating the economic benefits and costs of agricultural exports vis-à-vis the welfare of producers and consumers. Promoting public investment in agriculture by making improvements in agricultural infrastructure and introducing appropriate technologies to increase productivity would help shield against another food crisis in the future.

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Appendix Table 1. Rice Trade Long-Term Projections

	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18	2018/19	2019/20
						Imports, million metric tons						
Importers												
Canada	0.35	0.34	0.36	0.36	0.37	0.37	0.38	0.38	0.39	0.39	0.40	0.40
Mexico	0.50	0.60	0.61	0.62	0.63	0.65	0.67	0.69	0.71	0.73	0.75	0.77
Central America/Caribbean	1.27	1.53	1.60	1.67	1.72	1.78	1.85	1.91	1.97	2.01	2.06	2.11
Brazil	0.47	0.75	0.52	0.62	0.65	0.72	0.77	0.76	0.76	0.74	0.73	0.72
Other South America	0.64	0.57	0.71	0.76	0.79	0.82	0.85	0.86	0.87	0.89	0.90	0.92
European Union 1/	1.35	1.40	1.38	1.41	1.46	1.50	1.53	1.57	1.61	1.65	1.69	1.73
Former Soviet Union 2/	0.36	0.33	0.35	0.35	0.36	0.35	0.34	0.33	0.32	0.31	0.29	0.28
Other Europe	0.10	0.10	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Bangladesh	0.60	0.70	0.75	0.81	0.87	0.94	1.00	1.07	1.13	1.20	1.27	1.34
China	0.33	0.35	0.40	0.40	0.43	0.46	0.49	0.52	0.55	0.58	0.63	0.67
Japan	0.70	0.70	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68	0.68
South Korea	0.26	0.30	0.36	0.38	0.40	0.42	0.44	0.44	0.44	0.44	0.44	0.44
Indonesia	0.25	0.30	0.42	0.40	0.50	0.60	0.72	0.89	0.96	1.03	1.08	1.15
Malaysia	1.02	0.83	0.87	0.89	0.92	0.95	0.97	1.01	1.04	1.07	1.10	1.13
Other Asia & Oceania	2.52	2.56	2.28	2.34	2.37	2.39	2.42	2.47	2.51	2.57	2.63	2.68
Iraq	1.00	1.10	1.08	1.09	1.12	1.16	1.19	1.22	1.25	1.28	1.31	1.34
Iran	1.70	1.70	1.58	1.52	1.52	1.52	1.56	1.60	1.63	1.67	1.72	1.76
Saudi Arabia	1.36	1.37	1.40	1.43	1.46	1.49	1.52	1.54	1.57	1.59	1.62	1.64
Other N. Africa & M. East	2.05	2.10	2.06	2.18	2.24	2.29	2.34	2.39	2.45	2.50	2.55	2.61
Sub-Saharan Africa 3/	6.53	6.68	6.70	6.89	7.08	7.30	7.50	7.73	7.96	8.19	8.41	8.65
Republic of South Africa	0.59	0.75	0.86	0.84	0.85	0.86	0.88	0.90	0.91	0.93	0.95	0.97

United States	0.61	0.67	0.70	0.72	0.75	0.77	0.79	0.82	0.84	0.87	0.89	0.92
Other foreign 4/	0.79	1.35	2.04	2.10	2.10	2.11	2.11	2.08	2.14	2.19	2.19	2.19
Philippines	2.60	2.60	2.68	2.78	2.85	2.90	2.98	3.05	3.16	3.25	3.38	3.50
Total imports	27.94	29.67	30.51	31.36	32.24	33.15	34.09	35.03	35.97	36.89	37.81	38.73
Philippines' share of imports	9.3%	8.8%	8.8%	8.9%	8.8%	8.7%	8.7%	8.7%	8.8%	8.8%	8.9%	9.0%
						Exports, million metric tons						
Exporters												
Australia	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Argentina	0.50	0.60	0.56	0.57	0.57	0.58	0.59	0.61	0.62	0.64	0.65	0.66
Other South America	1.69	1.61	1.29	1.31	1.33	1.31	1.35	1.37	1.39	1.43	1.45	1.47
European Union 1/	0.14	0.14	0.14	0.13	0.13	0.13	0.13	0.14	0.14	0.14	0.15	0.15
China	0.80	1.30	1.53	1.64	1.80	1.90	2.11	2.32	2.48	2.62	2.71	2.80
India	2.00	1.50	1.50	1.80	2.22	2.53	2.82	3.00	3.23	3.40	3.60	3.78
Pakistan	3.00	3.30	3.30	3.30	3.30	3.30	3.30	3.32	3.39	3.47	3.56	3.66
Thailand	8.50	10.00	10.28	10.38	10.46	10.70	10.93	11.26	11.50	11.75	12.00	12.30
Vietnam	5.80	5.50	5.81	5.99	6.05	6.20	6.23	6.30	6.40	6.52	6.67	6.80
Egypt	0.30	0.45	0.65	0.61	0.57	0.56	0.54	0.53	0.50	0.47	0.44	0.42
United States	2.99	3.07	3.20	3.29	3.36	3.42	3.49	3.55	3.61	3.68	3.74	3.77
Other foreign	2.20	2.16	2.22	2.30	2.40	2.49	2.54	2.62	2.68	2.74	2.80	2.87
Total exports	27.93	29.66	30.51	31.36	32.24	33.15	34.09	35.03	35.97	36.89	37.81	38.73

***Source*:** USDA Agricultural Projections to 2009, 2010.

Note: These projections were completed in November 2009.

1/ Covers EU-27, excludes intra-trade.

2/ Covers FSU-12. Includes intra-FSU trade.

3/ Excludes Republic of South Africa.

4/ Includes unaccounted.

Chapter 9

R & D and Performance of the Thai Agriculture and Food Processing Industry: The Role of Government, Agribusiness Firms, and Farmers

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CHAPTER 9

R&D and Performance of the Thai Agriculture and Food Processing Industry: The Role of Government, Agribusiness Firms, and Farmers

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1. Introduction

Thailand is the world's thirteenth-largest exporter of agricultural products and food, with a market share of 2.2 percent of world food exports (**figure 1.1**). It is the largest exporter of rice, rubber, cassava, shrimp, and canned tuna. It is also one of the major exporters of sugar, canned pineapple, chicken, fruits and vegetables, and animal feeds. Between 1988 and 2010, the annual growth rates of agricultural and food exports were impressive, averaging 10.5 percent, and 12.2 percent, respectively. There is no doubt that this high export growth is due to Thailand's huge comparative advantage in agriculture. There are also other important factors on the demand and supply sides that affect export growth. This paper will emphasize one of the most important supply side factors—technology—because it is the most significant source of long-term growth in output, which does not only contribute to export growth but also to the low cost of living.

The Thai agriculture and food processing industry has undergone rapid transformation and modernization in the last three decades. The exhaustion of the land frontier in the 1980s, the labor shortage, and the overvaluation of the Thai baht caused by the industrial and financial booms in the 1986—96 periods used to be the major concerns of economists and policy makers. Yet Thai agriculture has, time and again, escaped malaise and managed to stay resilient and grow quite well. Farmers and agribusiness firms have responded to the opportunities and shocks that caused changes in relative output and input prices in several ways. The government has also changed its policies in response to the malaise in the agriculture sector. In fact, during the period of rapid economic growth in 1980—95, agriculture was the only sector that posted positive growth in total factor productivity (TFP). As a result, the annual growth rate of agricultural GDP averaged 3.4 percent between 1960 and 2009. This study will explain the sources of productivity growth in Thai agriculture, emphasizing the role of public research and technology.

Food manufacturers and exporters have also played important roles behind the structural transformation. Thai food exporters began experiencing a series of crises in the early 1990s, starting with the increase in nontariff barriers imposed by developed and developing countries; the depletion of fish stocks in the Gulf of Siam; environmental degradation, particularly water pollution and the destruction of mangrove forests; and the bird flu outbreak. Most agribusiness firms, with government support, successfully adjusted their production and marketing strategies towards food safety. As a result, Thailand has been able to maintain its position as one of the world's largest exporters of agricultural products and food for decades. This study wants to explain the performance of the Thai food processing, its sources of growth, and the role of agribusiness firms in research and development (R&D).

However, both the agricultural and food processing sectors are now facing a new set of internal constraints and external challenges, one of which is the decline in investment in agricultural R&D that started in the mid-1990s. In response to this, several public agencies that focus on funding agricultural research have begun to commission policy research to tackle the problems. This study will identify a few major challenging issues in public research and discuss some implications for R&D policy.

After a brief discussion of the performance of Thai agriculture and the food processing industry, the paper will explain the importance of technology in this industry, the trend in agricultural R&D as well as the role of the government, farmers, and agribusiness firms in R&D. Some critical problems in agricultural R&D investments will then be analyzed.

Finally, the paper will discuss some major challenges facing the Thai agriculture and food processing industry as well as some policy implications of investment in R&D.

2. Performance, Structural Change, and Modernization of the Thai Agriculture and Food Processing Industry

Thai agriculture grew at moderate to high rates of 3.4 percent per year over the last fifty-three years (**table 2.1**) despite the agricultural malaise that caused the boom-bust cycles. Exports of agricultural products and food also grew impressively as has already been mentioned. This part will explain the performance, structural change, and modernization of the Thai agriculture and food processing industry, emphasizing the investment and technology in the industry.

2.1 Growth and Structural Change of Thai Agriculture

There are two important growth trends in Thai agriculture. The first is that the growth rate in agricultural value added is declining (except for the crop subsector). The second is that Thai agriculture has exhibited a boom-and-bust pattern (**table 2.1 and figure 2.1**). The decline began in the mid-1980s and continued in the early 1990s when the Thai economy experienced an industrial boom followed by the asset-price bubble. When the economic crisis broke out in 1998, the gross domestic product (GDP) for the agriculture sector suffered negative growth due to the sharp fall in the world prices of agricultural products and the drought, which more than offset the gains from the currency depreciation. After the crisis, agricultural output rebounded and grew impressively, thanks to the low exchange rates and the higher world prices of food starting 2006. Over the 1998—2009 period, the real value added for fishery grew at 3.54 percent per annum, livestock at 3.1 percent per annum, and crops at 2.8 percent per annum.

The decline in agricultural growth rates together with the faster growth of the nonagricultural sector resulted in the declining share of agriculture in real GDP. However, the recent boom in world commodity prices has stimulated the growth of agricultural output relative to that of the nonagricultural output. As a consequence, the share of agriculture in GDP has stabilized at 10 percent to 11 percent.

The structural change in Thai agriculture can be discerned from the changes in the share of agricultural subsectors (i.e., crops, livestock, fishery, and forestry) and the share of products within each subsector. As shown in **figure 2.2**, the share of crops in agricultural value added dropped by almost 10 percent between the 1970s and the early 1990s. Since the economic crisis in 1997—98, its share has increased, thanks to the baht depreciation and the increasing demand for agricultural products from China. The share of fisheries in agricultural value added increased rapidly in the 1980s and the 1990s (**figure 2.2**). After that, its share sharply declined due to the overexploitation of natural resources and the environmental impact of shrimp and fish farming. Shrimp exports declined sharply for a few years in the early 1990s due to a chemical residue found in the exported shrimp product and the shortage of brood stocks for black tiger shrimp. However, Thai agribusiness managed to regain its position as the world's largest exporter of shrimps. The share of livestock value added increased in the 1970s and 1980s, but fell in the 1990s (figure 2.2). It then increased slightly before Thailand was hit hard by an outbreak of the avian flu in late 2003. The outbreak wiped out more than two-thirds of chicken exports. Although the industry successfully switched to the export of cooked chicken, the total export value of chicken substantially declined. Consequently, the share of livestock in agricultural value added has also been on the decline. Finally, the share of forestry in agricultural value added has steadily dropped to the level that it no longer plays any significant role in Thai agriculture.

The changes in the composition of agricultural products can be described in another way using the concept of traded and nontraded goods. Table 2.2 classifies agricultural products according to their trade orientation. Over the period 1980—85, traded crops, traded livestock, and fishery products had the fastest growth rate, thanks to Thailand's abundant land and cheap supply of labor. Between 1985—90 and 1990—96, the nontraded and noncompeting products had the highest growth rates. These were the periods of industrial boom in the mid-1980s, followed by the asset-price bubble in the early 1990s, which resulted in the Dutch disease effect. As resources were drawn away from the agricultural sector to the nontraded and booming manufacturing sectors, the growth of the nontraded products increased relative to that of traded products. The growth of import-competing products can be explained by the high wall of tariff and increasing per capita income. During the period 1996—98 (the crisis years), both nontraded crops and import-competing products suffered negative growth because of the fall in real GDP and the sharp depreciation of the baht. As a result, exports of traded products expanded.[1] After the economic recovery, the growth rate of nontraded and import-competing products rebounded. Only chicken products, which are traded goods, still had the highest growth rate among the livestock subsectors, thanks to the bovine spongiform encephalopathy (BSE) disease. However, the avian influenza outbreak in the 2003 seriously affected the chicken industry. The higher prices of food on the world market which began in 2006 also had a positive effect on the growth of exportable products in the crop and fishery subsectors.

2.2 A Brief History of Thai Agricultural Growth

Before discussing a brief history of agricultural growth in Thailand, it is worth noting that the main source of comparative advantage of Thai agriculture is abundant land. In 1995, the agricultural land per worker was 3.31 rais, compared to 1.88 rais in Myanmar, 1.25 rais in the Philippines, and 0.75 rais in Viet Nam. The high land-labor ratio was the consequence of agricultural expansion into forests. Then the exhaustion of forest land and increasing population pressure caused the land-labor ratio to decline after the mid-1980s. The exodus of the young population from agriculture in the period 1990—2000 has reversed the trend of declining land labor ratio (**figure 2.3**).

As a consequence, Thailand has comparative advantage in land-intensive crops (e.g., rice, some field crops and permanent trees, particularly rubber) as evidenced by the pattern of land uses shown in **table 2.3.** According to table 2.3, paddy lands still account for the largest share of agricultural land despite the fact that their share has steadily declined over the last five decades. Rice is grown in every region, with the northeast having the largest areas (most of which are rain-fed). Most of the irrigated lands in the Central Plains and in the north are used for growing rice and vegetables. Most upland areas in all regions are suitable for field crops, especially cassava and sugar cane. Southern Thailand is dominated by rubber trees, oil palm, and, to a lesser extent, fruit trees. Recently, farmers in the northeast have begun growing

[1] The low growth rate of traded crops was the result of drought and the financial crisis, which spread to other Asian countries.

rubber, thanks to the higher prices of rubber and the government subsidy. Eastern Thailand specializes in fruit trees. The fact that only a small but increasing share of agricultural land is devoted to oil crops (e.g., oil palm, soybean, and coconut) indicates that Thailand does not have much comparative advantage in these protein-based crops, mainly because of the agronomic constraints.

Thailand's agricultural transformation can be divided into four periods: the golden growth period of 1960—85, the period of declining comparative advantage in 1985—96, the crisis in 1997—98, and the growth revival period in the 2000s. It can be argued that, in addition to the increase in export demand, long-term agricultural growth has been made possible by investment and technology.

During the 1960—85 period, agriculture was the engine of Thailand's economic growth. At that time, it was not only the largest economic sector but it also enjoyed the highest GDP growth, thanks to the abundance of land, sound macroeconomic management policy, and public investment in infrastructure. The conservative fiscal policy and disciplined monetary policy resulted in price stability. Public investment in irrigation which began in the late 1950s, rural roads in the 1970s, and rural electrification in the 1980s, made it possible for farmers to expand and sell their output at higher farm gate prices while compulsory primary education contributed to the higher productivity of commercial farms. In 1966, the Bank for Agriculture and Agricultural Cooperatives was established. Its mission was to provide credit to farm households. Thanks to its innovative lending approach of group-guarantee lending, more than 90 percent of farm households now have access to the bank's credit, which, in turn, allows farmers to increase their agricultural investment.

The expansion of land for traditional crops (e.g., rice, rubber) and upland crops (e.g., jute, maize, cassava, and sugar cane) resulted in the rapid increase in commodity exports.

After 1970, Thailand began to export high-value agricultural products, especially chicken, canned tuna, frozen shrimp, and high-value vegetables to Europe and Japan. The emergence of export markets for high-value products is attributed to several factors. On the demand side, the 1973 commodity boom and the increased demand in developed countries provided an export opportunity for local agribusiness firms. But without imported technology, it would not have been possible for these firms to exploit such an opportunity. To capture the external benefits arising from the use of new technologies in poultry farming (particularly new breeds, feeds, and modern farming practices), Charoen Phokaphan (CP) introduced the American contract farming system to its farmer-contract growers. After that, an American agribusiness company introduced contract farming to tomato farmers in the irrigated area of one northeastern province. Since then, contract farming has become a popular business model for agribusiness companies exporting high-value agricultural products to Japan and Europe.

In the mid-1980s, Thai agriculture began to lose its comparative advantage due to dwindling land frontier and increasing agricultural real wages resulting from massive rural-urban migration. In addition, world prices of agricultural products declined drastically as a result of the expansion of global food production and the protectionist policies of developed countries. Consequently, the growth rate in agricultural GDP slowed down from 4.1 percent in 1960—80 to 2.45 percent in 1981—85 before slightly increasing to 3.5 percent in 1985—96. The asset-price bubble in the early 1990s also had a serious negative effect on agriculture as the prices of traded agricultural products declined sharply relative to the prices of nontraded agricultural products. In response to the malaise, farmers began to hire illegal migrants and mechanize their farm operations. As a result, investment in farm machines increased dramatically (see **figure 2.4**). In fact, there is evidence that farmers in the irrigated areas of the Central Plains began to mechanize land-preparation tasks in the late 1970s. Meanwhile, some farmers have also begun to produce organic or safe products by adopting Good Agricultural Practices (GAP) while others have adopted integrated farming methods, which helped reduce the price and output risks of the mono-cropping approach.

After the economic crisis of 1997—98 and the ensuing El Niño-induced drought, agricultural growth rebounded, thanks to the depreciation of the baht. In response to the problems caused by the chemical residues found in chicken and shrimp exports, the government and the private sector jointly tackled food safety problems in the supply chain. The increases in the prices of agricultural products and food, which began in 2006, also stimulated the growth of Thai agriculture.

The preceding discussion shows that agricultural growth in Thailand can be attributed to several factors—namely, land expansion, labor, investment in infrastructure, capital investment by farmers, and technology. Part 3 will provide measures on the relative importance of these factors using the growth accounting method.

2.3 Modernization of Thai Agriculture

The malaise that threatened the agricultural sector also stimulated it to undergo a transformation and modernization process. Many farm tasks are now mechanized in response to the labor shortage, resulting in larger farm sizes. Meanwhile, professional farmers have adopted modern farm-management methods to reduce cost, increase productivity, and produce safer food. They now employ modern and more efficient logistic and marketing systems. To address the problem of food safety and to guard against the possibility of exporting unsafe agricultural products and food, farmers and agribusiness firms have had to adopt GAP and new farming technologies (e.g., biosafety farms). Perhaps the most modern farms can be found in the livestock subsector. When domestic and foreign demand for chicken meat began to rise in the 1970s, one agribusiness firm began to introduce new production technologies and modern farm management to farmers. The swine industry experienced a similar scaling-up transformation, thanks to the growth of domestic demand and a university's research and extension efforts. As a result, poultry and swine production in Thailand is now more like an industry than traditional agriculture.

Malaise-inducing events in the late 1990s and early 2000s (i.e., the nitrofuran residue found in chicken meat and shrimp exports, the bird flu outbreak) prompted farmers to reduce the use of antibiotics and replace their open farms with the closed-farm system, resulting in larger farm sizes. Food processing firms were also forced to produce cooked chicken meat and ready-to-eat products. The swine industry likewise rapidly modernized and adopted sanitation measures in response to the growing need to tackle water pollution and the foul odor that usually emanates from a swine farm. These air and water pollution issues caused conflicts between farm owners and their neighbors since most swine farms in Thailand are located in densely populated suburbs. A large number of swine farms are also located near rivers. Due to advancements in technology and the labor shortage, Thai swine farms are large in scale and are as advanced as farms in more developed countries.

2.4 Pattern and Structural Change in the Food Processing Industry

Thailand is a major food-exporting country. Its food and beverages subsector is one of the largest subsectors in the country's manufacturing sector. In 2009, the share of this subsector in the value added of the manufacturing sector was 18.4 percent; in 1985, its share peaked at 24 percent. If other agriculture-related manufacturing products (e.g., leather, pulp) are included, this share will increase to 25 percent. The food subsector is also the largest employer in the manufacturing sector, employing 1.7 million workers in 2009, or about 13 percent of manufacturing workforce.

The Structure and Pattern of the Food Industry

Among the three subsectors (i.e., food, beverages, and simple agricultural processed products), beverages is the largest, accounting for 27 percent of food value added in 2005, according to the 2005 input output table. It is followed by food and then by simple agricultural processed products, the shares of which have both declined (table 2.1). Unfortunately, there is no data on simple agricultural processed products after 2001.

It is possible to measure the relative size of the industries from the input-output table. Within the food subsector, the largest industries are, in descending order, rice milling and flour products, sugar and confectionery, slaughtering and preserving meat, and canning and preserving of fish and seafood. Together, these industries accounted for 34.2 percent of food value added in 2005 (see **table 2.4**).

The pattern of food exports is slightly different from the pattern of value added. The largest food exports are seafood, sugar, fruits and vegetables, animal feed, and rice and flour products (**table 2.5**). The difference reflects the differential pattern of domestic and foreign demand.

The input-output table also reveals some interesting characteristics of the food industry. First, contrary to general belief, the current share of value added in the output of the food industries is not much higher than the output of the other manufacturing sectors. The industries with the highest share of value added in output are beverages, sugar, dairy products, meat products, and seafood (**table 2.4**). However, the wage share in the industry value added is the lowest in beverages and highest in rice products, meat products, fruits and vegetables, and seafood (**table 2.4**). The share of operating surplus in food value added, which averages at 50 percent, is higher than that of the other manufacturing products (47 percent). The profit share is highest in fishmeal and feed, oil products, and meat products and lowest in beverages (**table 2.4**). Finally, the use of imported raw materials in the food industry has increased over the 1980—2005 period, reflecting either the depletion of domestic raw materials or the increasing sophistication of the demand for food products.

According to the Ministry of Industry, there were 7,094 food and beverage factories in 2009, an increase from the 6,812 factories in 1997. There were another 43,348 basic agro-processing factories, the largest number among all the manufacturing factories. The industries with the largest number of factories are, in a descending order, ice making, flour mills canning and preserving of fruits and vegetables, meat canning, food ingredients (e.g., fish sauce, soy sauce), and tea and coffee (**table 2.6**).

The size distribution of the food industry has barely changed. According to factory registration data, the food industry is dominated by small factories that employ more than fifty employees. These small factories account for 90 percent of all new food factories. The share has either remained almost constant or slightly declined between 1980—85 and 2000—09 (**table 2.7**). The share of medium-scale factories employing 51 to 200 employees has stayed constant. The share of large-scale factories has increased slightly from 1 percent to 4 percent in 1980—85 to 2 percent to 4 percent in 2009.

There is no official information on the ownership of food factories. Casual observation suggests that the food industry is dominated by large-scale Thai companies, especially in poultry products, seafood, rice export, canned fruits and vegetables, dry grocery products, sugar, etc. Multinational companies (MNCs) play an important role in a few sectors but they usually dominate their respective product niches (i.e., soft drinks, coffee, imported whisky, ice cream, health food, soup mixes like chicken soup and bird nest soup). The industries with a relatively high concentration of Thai firms are poultry products, canned and frozen seafood, canned and preserved fruits and vegetables, sugar, dairy products, and beer. A few firms in some of these industries have a vertically integrated structure. For example, there are at least three vertically integrated companies in the broiler industry. Their operations cover research on genetic improvement, breeding of grandparent and parent stock, hatcheries, contract farms for growing broilers, production of animal feeds, production of drugs and premixes, slaughterhouses and meat-processing plants, restaurants, and exports. A few companies in the seafood industry also have a vertically integrated structure, that is, these companies have their own fishing boats, cold storage, processing plants, retail outlets, and export arms. One of the companies owns a well-known American brand of canned tuna.

Some food industries that produce high-quality food products have to have some form of contract farming to ensure a stable supply of quality raw materials or products. These include the poultry industry, the canned pineapple industry, exporters of fresh vegetables, sugar factories, the dairy processors, and even the exporters of quality Jasmine rice.

Structural Changes in the Agribusiness Sector

The Thai food processing industry has come a long way from producing simple processed foods to producing high-quality and sophisticated foods and from exporting resource-intensive foods to high-value foods over the last four decades. **Table 2.5** shows that between 1980 and 2010, exports of some food items increased by 43 to 104 times. These items include preserved and canned fruits (104 times); preserved and canned seafood (42.8 times); fresh and frozen vegetables (58.7 times); fresh, chilled, and cooked poultry products (79.6 times); and fresh and frozen fruits (47.8 times). This section will explain the factors underlying the structural changes in the agribusiness sector.

There are at least six major trends underlying the structural changes in the agribusiness sector: a shift from resource-intensive and labor-intensive products towards high-value products; a shift from domestic resources towards imported raw materials; the increase in the domestic demand for safe food; emergence of national brands and the growth of the large-scale distributors; the rapid rise of foreign retailers; increasing intra-ASEAN trade in food; the development of contract farming and the vertical integration of food producers. This paper postulates that the structural changes in agribusiness are the result of over half a century of industrialization, which, in turn, is influenced by certain important economic forces. Before explaining those forces, the seven trends will be briefly explained.

First, one important structural shift in the process of Thai industrialization is the shift from resource- and labor-intensive industries towards skill- and knowledge-intensive industries (Poapongsakorn et al. 2004). There have been two types of shifts in the food industry, in particular: (1) a shift from the use of domestic, resource-dependent materials to imported, resource-oriented materials and (2) a shift towards high-value products.

The food industry experienced rapid growth in the 1980s due partly to rapid industrialization and rising per capita income. It resulted in a shortage of raw materials for some agro-business industries, especially the seafood and the livestock industries. The expansion of the poultry industry for the export and domestic markets turned Thailand from being a net exporter of maize to being a net importer of both maize and soybean. The growth in seafood exports forced manufacturers to import more fish and shrimp. They, therefore, lobbied the government to abolish import duties and other import restrictions in the 1980s. The fishing industry also asked the government to negotiate fishing rights in the territorial waters of neighboring countries such as Myanmar, Indonesia, and India.

In response to higher labor costs in the 1990s and the increasing scarcity of raw materials, food exporters and manufacturers had to improve efficiency and produce higher-value products. Factories producing canned fruits and pineapple have improved logistics and the transportation of raw materials, which allows them to increase the yield from each ton of raw materials. Chicken exporters who used to export labor-intensive frozen chicken breast diversified into cooked and ready-to-eat chicken and other processed chicken products because of increased labor costs and the avian flu problem.

The second trend is that food products have increasingly higher value, better quality, more varieties, and are safer. As per capita income increases, consumers will demand higher-quality and safer products. For example, increases in the domestic demand for fruit juices and better-tasting beverages have resulted in the expansion of the modified starch industry which produces fructose and glucose. Modified starch is one of the cassava-derived products with the fastest growth rate in the last decade (Poapongsakorn et al. 2007). There are now more varieties of dry grocery goods, such as sauces and noodles, than the simple products available in the old days. The types and supplies of ready-to-eat foods have dramatically increased as working, married women do not have time to cook. Diets have also shifted towards more processed meat, dairy products, bakery products, and other Western types of food.

One of the consequences of increased demand for food safety is the development of private and public standards for food safety in the domestic market. Thai food manufacturers and exporters of frozen foods (e.g., chicken, seafood, vegetables and fruits) have successfully exported safe and organic foods to markets in developed countries for more than 10 to 15 years. In the past, however, Thai consumers did not benefit from such standards because the local demand for safe food was low. Thanks to increasing health consciousness, increasing awareness of the risks of food hazards, and the growth of modern supermarkets, foods that are sold in the supermarkets must now adhere to certain safety and quality standards.

The third trend is that the industrial organization of some food industries has significantly changed in the last twenty-five years. There have been three types of organizational and structural changes in the food industry: (1) the emergence of contract farming which has already been discussed; (2) the vertical integration of agribusiness companies; and (3) the increasing concentration of the agribusiness market and the retail market.

One of the unique characteristics of the organization in the agribusiness sector is the vertical integration of companies in the poultry and seafood business. In poultry, most large-scale agribusiness firms are vertically integrated. Their business covers genetic research, breeding farms to produce the grandparent and parent stock, hatcheries, contract farms, feed factories, drug companies, slaughterhouses and meat-processing plants, restaurants, and exports. In the early years, CP established the Bangkok Livestock Trading Company as a vertically integrated entity. In recent years, however, with the rapid expansion of its agribusiness interests worldwide, the holding company CP Group (CPG) reorganized its business into four major companies and a number of smaller companies. CPG has four major companies in the food business, including CPF, which deals with livestock, shrimp, and fishery; CP All, which runs the 7-Eleven convenient stores; and CP Inter Trade, which is involved in rice trading. In addition, CPG also owns CP Seeds, a small company in the business of corn seeds, rubber seedlings, etc. It should be noted that the Chiarawanond family, which is the major shareholder of CPG, also controls Chia Tai Company, which is the family's first agribusiness firm. Chia Tai Company produces vegetable seeds, fertilizers, and drugs.

A few large-scale companies in the seafood industry have adopted the vertically integrated structure, the notable ones being CP, Surapon Seafood, and Union Frozen. These companies have their own farms or contract farms, cold storage, production plants. They handle their own marketing, research, and export. Some companies have their own farms while others depend on contract farms or maintain a close and long-term relationship with wholesalers who supply the required raw materials.

There are a few important reasons for vertical integration. In the early period of the industrialization of the broiler, frozen shrimp, and canned seafood businesses, the companies may have dealt with the uncertainty and risks involved in depending on the market for supplies of raw materials. After the bird flu outbreak and the discovery of chemical residues on chicken and shrimp bound for export, many companies reacted by investing in the closed-farm system for broilers. CP is now experimenting on an ambitious closed-farm system for shrimp production. The rationale for such an integration effort is traceability and biosafety. The transaction costs of enforcing safety standards and traceability with smallholders are still too high. The second reason is that a vertically integrated structure allows firms to exploit tax laws so that the tax burden is reduced. In addition, vertical integration also helps reduce transaction costs when there are a large number of activities that need to be efficiently coordinated.

The agribusiness industry has also become more concentrated. In poultry, CP is the dominant oligopolist, followed by Betagro and Saha Farm. The bird flu outbreak pushed many companies to bankruptcy, which left only a few integrated firms standing. The shrimp and seafood business has more large-scale companies than the poultry industry. The leading firms in the shrimp and seafood business are CP, Union Frozen, Surapon Seafood, and Pran Tha-le. Other highly concentrated industries are fertilizers (dominated by four companies, most of which are MNCs), drugs (also dominated by a few MNCs), rice export (dominated by five Thai exporters), and seeds (dominated by a few MNCs and CP).

The fourth trend, which began in the late 1980s, is the development of national brands of dry grocery products. In the past, there were a variety of local brands of grocery products such as fish sauce, chili sauce, soy sauce, and dried egg noodles. These products were usually available in markets in the urban areas that were too far from Bangkok for Bangkok products to compete with, thanks to high distribution costs. However, due to the increased demand for food in the 1980s, producers in Bangkok began to enjoy economies of scale. In addition, the distribution system began to change. The old distribution system in which small wholesalers who bought products from factories in Bangkok and then sold them to small retailers in other provinces was rapidly replaced by the modern distribution system of large-scale distributors in Bangkok. These distributors have lower average transaction costs than the traditional wholesalers and the manufacturers. In addition, the distributors and the manufacturers also advertised their branded products. As a result, branded food products from Bangkok replaced the local brands.

The fifth trend is the emergence of foreign supermarkets that introduced a modern procurement system, private labels, and strict product standards. These supermarkets rapidly increased in number during the economic crisis of 1998—99 because the asset-price deflation allowed them to acquire prime locations for their branches. Consequently, they enjoyed economies of scale in purchasing and distribution as well as increased bargaining power with suppliers. This, in turn, allowed them to pass on part of the cost savings to the consumers. The emergence of foreign supermarkets had a tsunami-like effect on retail and wholesale markets. First, their rapid expansion and low-price strategy caused a large number of traditional grocery stores to go bankrupt. Other grocery stores had to restructure their business in order to survive. Second, hypermarkets began asking their suppliers to produce some products bearing the hypermarkets' private labels. The suppliers, including those of private-label goods, have to comply with the standards imposed by the hypermarkets. Such practice has enabled foreign retailers to export goods to (or import goods from) their branches in other countries, resulting in a global or regional sourcing network. Finally, some supermarkets have begun to source directly from farmers' associations. This issue will be discussed later.

The final trend is that the establishment of ASEAN Free Trade Area (AFTA), the ASEAN+3, and other bilateral free trade agreements (FTAs) has begun to have an impact on intra-

ASEAN trade and trade among FTA partners. The market-access agreements have enabled some multinational food companies to establish regional production centers in one country and export the products to other ASEAN countries, thus enjoying economies of scale.

There are a number of factors that influenced these trends. This study postulates the five factors that influenced the industrialization process of the agrifood sector.

First, as the food industry started to expand rapidly in the 1980—90 period, supplies of domestic raw materials were insufficient to meet the demand. This resulted in a shortage of raw materials, particularly fish, maize, and soybean. The government responded to complaints from the private sector by reducing import tariffs and surcharges and by relaxing import restrictions. The industries also responded to the shortage by sourcing more raw materials from neighboring countries and reducing loss and waste in the production process.

The rapid industrialization that happened in 1985—96 also resulted in a labor shortage and higher real wage rates. The response of labor-intensive industries, particularly the small- and medium-scale seafood factories, was to hire illegal foreign migrants from neighboring countries. In the early 2000s, the government finally agreed to allow employers to hire foreign workers by issuing temporary permits to workers who registered with the Ministry of Labor.

The second factor, which was a direct consequence of industrialization, was the increasing per capita income and the shift in the lifestyle of the middle class toward the Western way of life. As their per capita income increased, Thais began to switch from their main staple diets, which have low or negative income elasticity of demand (see part 3), to goods and services with high income elasticity. They demanded not only high-quality foods but also safe foods and foods that are readily edible such as ready-to-eat dinner packages and instant noodles. This was because the time cost is more expensive. Since information cost is always high, consumers tend to make buying decisions based on the brand names of products.

Third, firms began to master tacit knowledge as they grew during the different stages of industrialization. In the beginning, Thai entrepreneurs learned and absorbed the technology of foreign companies either as joint-venture partners or as former employees. In the 1960s and

1970s, many of the canned-seafood companies in Thailand were foreign firms that received investment privileges. The industry is now dominated by Thai entrepreneurs who were able to absorb tacit knowledge and to develop their own technology. Many Thai companies are now able to export high-quality foods that meet the stringent sanitary and phytosanitary (SPS) standards of the European Union (EU), the United States, and Japan, thanks to the skills and knowledge transferred by these companies' Japanese partners.

Fourth, the rapid growth of the food industry can be partly attributed to the industrialization policy. In the first four national economic development plans, the industrialization strategy was to promote import-substituting industries. The fifth national plan (1982—86) marked the first time that the government began to promote export-oriented industries. Agro-business industries had 1,021 projects with investments amounting to THB 1.49 billion that received tax and nontax incentives from the Board of Investment, Thailand's most important agency in industrial development. The number of promoted projects declined to 975 (with investments worth THB 0.89 billion) in the sixth plan and 235 projects (worth THB 0.22 billion) in the seventh plan. The projects included large plantations, cattle farms, frozen and canned seafood, frozen chicken, canned pineapple, and canned fruits and vegetables.

In 1995, the government also approved policy measures and development plans to promote twelve groups of agro-business industries, including canned and preserved foods, fresh and frozen foods, modified starches, animal feeds, dry grocery products, and ready-to-eat food. The policy measures included tariff exemptions for imported raw materials, improved procedures for claiming tax rebates, tariff reforms (which were carried out in 1990 and 1999), promotional and assistance measures for export goods, registration of foreign migrant workers, and trade negotiation for market access with important trading partners (TDRI 1998). As has been previously discussed, Thailand has, since 2003, signed FTAs with many trading partners. These FTAs have already increased trade volume for both Thailand and its partners. The tariff reforms have reduced the average tariffs for manufactured products from 42.7 percent in 1989 to 20.4 percent in 1994 and then to 9.9 percent in 2006. These also almost eliminated the negative bias against some food-exporting industries such as rice milling, starch factories, canned food, and monosodium glutamate (TDRI 1998; Poapongsakorn et al. 2007). The study finds that the number of food industries that used to be penalized by the tariff system (i.e., industries with negative effective rate of protection) was reduced from sixteen industries in 1995 to thirteen industries in 2006 (Poapongsakorn et al. 2007).

Other important policies include the provision of cheap credit for food industries through the Industrial Finance Corporation of Thailand (IFCT), the Small Industry Finance Corporation, and farm credit from the Bank for Agriculture and Agricultural Cooperatives (BAAC) as well as the promotion of eleven contract-farming projects in 1987—92 and new contract-farming projects in 1993—96 (see further discussion below).

2.5 Growth of the Food Industry and Food Export

The growth of food value added—6.7 percent per year during the 1970—2009 period—is quite impressive compared to the growth of manufacturing value added of 16.33 percent. Except for the periods 1980—85 and 1996—98, the growth of the food sector was slower than that of manufacturing value added (see **table 2.1**). This is not surprising because the income elasticity of demand for food is lower than one while many manufactured products have higher income elasticity. Nevertheless, the food sector grew almost as fast as real GDP.

The food sector grew fastest in 1985—96, which were the years of the industrial boom and the financial bubble. During these periods, beverage value added had the highest growth rate among the three subsectors in **table 2.4**. The food sector (excluding beverages) registered negative growth during the crisis years of 1997—98. After the crisis, its growth slowed down to only 3.56 percent per year (**table 2.4**).

It is possible to identify the growth performance of twenty-one food subsectors using the input-output tables for 1980—2005. The largest subsectors were canned and preserved seafood, rice milling, slaughtering, breweries, sugar refinery, soft drinks, and canned and preserved fruits and vegetables (see table 2.4). The subsectors that experienced increasing share in manufacturing GDP were canned and preserved fruits, vegetables, and seafood; breweries; canned and preserved meat; dairy products; palm oil; confectionery and snacks; and coffee. These are mostly products with high income elasticities of demand and health foods. The industries with declining share in manufacturing value added produced products with low income elasticity of demand (e.g., rice milling, flour and tapioca milling, sugar refinery, distilling of low-grade spirits, bakery, animal feeds, and ice).

The growth performance of the food industries reflects the comparative advantage of each subsector, which can be measured by an index of domestic resource cost (DRC). The DRC is the social cost of domestic resources that are used to earn (or to save) one unit of foreign currency. The social costs of domestic resources are measured at world prices (i.e., all of the distortions created by the policies are eliminated from the costs). The industries are competitive if the DRC is less than one. **Table 2.8** shows the DRC of the food industries that are export-oriented (i.e., export is higher than import) and import-substituted. The results confirm that Thailand has high comparative advantage in the production of flour, leather products, rubber products, monosodium glutamate, seafood, and canned fruits and vegetables, among other commodities.

Performance of Thai Food Exports

Food exports grew by more than 6 percent per year during the 1988—2010 period.[2] Exports of agro-industrial products grew the fastest while agricultural exports had the lowest growth rate (**table 2.5**). These differential growth rates changed the pattern of food exports. Though exports are still dominated by agricultural products, their importance declined from almost 63 percent in 1988 to about 52 percent in 2005. The share of agro-industrial exports increased by ten percentage points to almost 35 percent in 2010. Livestock exports also enjoyed a slightly high share despite the avian flu outbreak in 2003. The share of fishery exports declined, reflecting the fact that fish and shrimp culture and the marine fishing industry are not environmentally sustainable.

Exports of traditional crops such as rice, rubber, and cassava have remained robust. These three commodities have remained the most important exports of Thailand for the past few

[2] Note that during the 1988—96 period of asset-price bubble, food exports grew at impressive annual rates, even reaching 8.5 percent. Then growth surged to 33.5 percent when the Thai baht was depreciated from THB 25 to a US dollar to THB 52 in the early 1998. After that, export growth slowed down but was still higher than it was during the 1988—96 period (**table 2.5**). As a result, Thailand's share of the world agricultural and food export increased from about 1.2 percent in the early 1960s to more than 2 percent in 2006 (**figure 1.1**).

decades for the following reasons. First, the share of consumption in total production is low (i.e., 20 percent for rubber, 30 percent for cassava, 42 percent for rice). Second, Thailand has abundant land. Therefore, any increase in planted areas or farm productivity would certainly boost Thai exports. Thailand has also maintained its position as one of the top four exporters of canned pineapple, sugar, canned tuna, and frozen shrimps for the same reasons.

Compared to other developing countries, Thailand has undisputedly high comparative advantage in many processed foods. The revealed comparative advantage indices for five groups of processed foods are high compared to other developing countries. Viet Nam and Bangladesh have higher RCA than Thailand for low-value products, that is, for more labor-intensive and simple processed products such as frozen shrimp. However, Thailand has higher comparative advantage in high-value products such as canned tuna and canned fruits. There are varieties of these ready-to-eat foods that can meet the demand of different consumer groups. **Table 2.10**, however, shows a worrisome sign—a declining trend in the RCAs for all four products.

Chutikul (2006) analyzed the weaknesses and strengths of two product groups--fresh food and processed food. First, although Thailand's market share in both products ranked 11th out of 173 exporting countries in 2003, exports had concentrated markets as measured by their rank in market spread and market diversification. Their ranks for product spreads are in the top twenty out of 173 countries. Second, the performance of both products between 1999 and 2003 worsened because their market shares declined relative to the market shares of other countries. The decline in market share was due to reduced competitiveness and changes in geographic specialization. Adaptation capability, however, improved.

The strength of Thai exports is in its adaptability. When food export data are disaggregated and analyzed, one will find that the share of the top eighteen agricultural exports declined from 11.8 percent in 1990—94 to 9.96 percent in 2000—05 (Poapongsakorn 2006). This implies that some of the less important products registered higher export shares.

The export destinations of agricultural products differ from that of processed foods. The largest markets for traditional agricultural exports are mostly developing countries, especially Asian countries. For example, four of the top five largest markets for Thai rice are China, Iran, Iraq, and Benin. The largest markets for cassava are China, Japan, Indonesia, and Taiwan. All of the top six destinations for Thai maize and palm oil are Asian countries. The only exception is rubber, which is used as the raw material for the rubber product industries in developed countries. In Asia, China is the largest market for Thailand's rubber while the other top destinations are developed countries.

The main destinations for processed-food exports are mainly developed countries. The largest export markets are the United States, Japan, and the EU. The demand for processed foods is income elastic; hence, the main demand for these products come from consumers in rich countries.

Table 2.9 decomposes the sources of the value-added growth in the food sector. The result shows that domestic demand is the largest source of growth, followed by exports. Export growth is the largest source of value-added growth in fruits and vegetables, fish and seafood, rice and flour, and sugar. It is not surprising that private consumption plays a major role in the value-added growth of oil products, meat products, and dairy products because these are import-competing industries. Part 3.2 will discuss the role of technology as the source of growth.

3. Technology and R&D in Agriculture and in the Food Processing Industry

Aside from infrastructural investment and capital investment, technology also determines agricultural growth. Unlike investment in capital, which is subject to the law of diminishing returns, the returns on investment in technology and knowledge are not subject to such a law, according to the endogenous growth theory. This part will explain the role of technology as a major source of economic growth and investment in R&D.

3.1 Sources of Agricultural Growth: Technology and Rates of Return to R&D[3]

To measure the relative importance of each factor, particularly the role of technology, this study will decompose the sources of agricultural growth. Using Solow's growth accounting model, Poapongsakorn and Anuchitworawong (2006) estimated the growth in total factor productivity (TFP) of three agricultural subsectors in 1980 and 2003—crops, livestock, and fishery (**table 3.1**). Waleerat (2009) also provided similar estimates for 1980—2006. The paper will then provide an estimate of the impact of R&D on TFP and the rates of return on investment in R&D.

During the 1980—95 period, the agricultural sector was the only sector with positive TFP growth (Tinnakorn and Sussangkarn 1998). The estimates made by Poapongsakorn and Anuchitworawong (2006) for the 1981—2003 period show that the growth rate in agricultural TFP was higher than the 1980—95 estimates obtained by Tinakorn and Sussangkarn (1998). The estimates for the 1981—2003 period also confirmed the previous findings that TFP is the second-largest source of agricultural growth after capital expansion (**table 3.1**). The decomposition of the sources of growth of the three agricultural subsectors shows interesting results. TFP was found to be the largest source of growth of crop value added, accounting for 75 percent of agricultural growth (3.57 percent per annum) in 1981—2003. In livestock, labor was the most important growth contributor (almost 74 percent), followed by TFP (34.6 percent). This finding is consistent with the fact that there have been increasing numbers of highly educated labor in the poultry and swine sectors, which are dominated by large commercial farms run with modern management methods. The increasing growth in TFP between 1985—96 and 1996—98 can be explained by the scaling-up effect (due to the adoption of evaporative housing), improved nutrition feeds, and better farm management.

The most interesting finding was that TFP was negative in fishery and that the most important source of growth in this sector was capital. This is not surprising because fishermen have been overexploiting natural resources for years, resulting in a sharp decline in output from 2.752 million tons in 1993 to 2.164 million tons in 2010. The catch per unit of fishing effort drastically declined from 131.8 kg in 1966 to 22.1 tons in 2002. Tokrisna

[3] This section draws heavily from the author's previous work (Poapongsakorn and Anuchitworawong 2006).

(2009) found that the actual catch of surface-water fish (0.39 million tons in 2008) in the Gulf of Siam is already lower than the maximum potential catch (0.4 million tons), an evidence of overfishing.

The third decomposition using similar method and data was that of Waleerat (2009). The results are similar, that is, TFP was the second most important source of growth for the agriculture and livestock subsectors. While capital growth was the most important factor behind agricultural growth, labor played the most important role for the growth of the livestock subsector. The only difference was that capital was the most important source of the growth for the crop subsector, followed by TFP. This is plausible given the increasing mechanization in the 2000s in response to labor shortage.

Since TFP is the proxy of technological change, it is interesting to measure the impact of research and extension (which create technology) on TFP. Waleerat (2009) found that a one percent increase in crop research will increase the TFP of crops by 0.15 percent (**table 3.2**). In addition, the elasticity of private research was estimated at 0.10 while the spillover of the research done by the Consultative Group on International Agricultural Research (CGIAR) had a TFP elasticity of 0.15 (**table 3.2**). Waleerat (2009) also estimated the TFP elasticity of extension (**table 3.2**). The last finding confirmed the importance of the technological spillover effect.

The final question is whether or not agricultural research pays off. There are some studies that provide estimates of the rates of return on investment in agriculture. Most estimates peg the rates of return at about 40 percent (**table 3.3**). The latest estimates by Waleerat (2009) showed that the rate of return is 29.5 percent for crops and 104 percent to 144 percent for livestock. A study on the return on investment for research on disease-tolerant Chainart HV is 200 percent (Orachos 2010) while the return for the Kor Kor-6 sticky rice is 47 percent to 57 percent (Warin 2009). Finally, a study on the benefit of organic fertilizer management for corn revealed that the benefit is 19.4 times higher than the cost.

Since Thailand has established several research departments and invested in agricultural research since the late 1950s, it has developed many innovations and new technologies. Part 3.3 will describe those technologies as well as the technology developed by agribusiness firms and farmers, followed by an analysis of public investment in agricultural research and research intensity. Before that, however, the following section (3.2) will discuss the sources of growth in the food industry.

3.2 Sources of Growth and Role of Technology in the Food Industry

The discussion on the structure and growth of the food sector in parts 2.4—2.5 reveals that domestic consumption is the sector's main source of growth. Export demand is an important source of growth for a few subsectors (e.g., fruits and vegetables and rice and flour products). A more interesting question, however, is the contribution of the key structural factors, particularly technology, on sectoral growth. This study will report the results of the decomposition exercise in a study done by Chedtha (2010). The method of decomposition used was the historical/decomposition simulation technique, which is typically used to sort out the effects of each of the categories of structural changes. The CAMGEM-H model (a genre of computable general equilibrium or CGE) was used to compute the necessary changes in the structural parameters and to decompose the sources of growth. The data used came from the 2000 and 2005 input-output tables.

The result shows that technology and trade were the most important sources of growth, contributing 43.1 percent and 27.3 percent, respectively, to GDP growth between 2000 and 2005. The sectoral decomposition in **table 3.4** confirms that technology and trade are indeed the two most important sources of growth in most manufacturing sectors, including food and agriculture. According to estimates of the impact of the four different types of technological changes, increased efficiency in using primary inputs (land, labor, and capital) contributed the most to the growth of all sectors, including agriculture and food. The small negative contribution of intermediate input-saving technology for food and agriculture should be interpreted cautiously, that is, that said technology probably had no significant impact. On the other hand, the estimates incorrectly showed that food and agriculture suffered a decline in labor-saving technology given the fact that these sectors experienced a 5.6 percent and 6.8 percent respective increase in labor requirement per unit of output. The estimates are contrary to the fact that in response to the labor shortage, Thai farmers widely adopted labor-saving technologies. The problem with the estimates is that the input-output table only reports the wage bill, with no information on labor units.

3.3 Agricultural technology

Previous research shows that TFP has been the second most important factor explaining the growth of agricultural output; the major factor explaining TFP growth is R&D. The question is, what kinds of technology and innovation make up the output of agricultural R&D? Who invests in the technology?

Table 3.5 lists the technologies used in Thai agriculture according to their objectives (e.g., genetic improvement to enhance yield, impart biotic and abiotic tolerance, save labor, etc.). A few main observations can be drawn from the table. First, the most important agricultural technology is yield-enhancing genetic improvement. A large number of high-yield varieties (HYVs) have been successfully developed for all major crops in Thai agriculture. For example, the Department of Rice and other public research agencies have been able to develop many HYVs for rice including RD6, RD15, RD21, RD25, Supan Buri 60, Chainat 1, and others. There are at least thirty-two varieties for sugar cane, more than eight varieties for cassava, and twenty-three varieties for rubber. In fisheries, the most important technologies involve reproduction and cultivation methods. The Department of Fishery, in cooperation with an international research agency, also successfully bred many high-yielding varieties of fish (e.g., tilapia). Thailand depends heavily on imported breeds in the livestock sector. The parent stocks of chicken, for example, are imported to produce day-old chicks. Some companies also import grandparent stocks for their parent stock farms. Pure lines of swine and cows are imported for reproduction and adaptation to heat. Some imported pure lines of swine and cows are crossed with native breeds to produce the appropriate breed for local conditions (e.g., heat-tolerant swine). In addition, appropriate feed formulae have been developed so that the feed-meat conversion ratio can be reduced.

Thai plant breeders have also attempted to breed varieties that produce high-quality plants. In the beginning, when the local breeders cross-bred the IR variety with the native variety to achieve higher yield, the resulting new rice varieties (RD1, RD2, RD3, and RD4) were not popular among Thai consumers. They had to improve the cooking quality of the rice and, at the same time, breed the varieties that produce long-grain rice with a minimum length of 7 millimeters. Examples of these improved varieties are RD23 (which was the result of multiple crossings of IR 8 with the native variety Hleung Thong Na Prang, IR 32, and RD7), RD11, and RD21. Consequently, Thai rice commands a relatively higher price in the world market, thanks to its quality. The Pathum Thani 1 variety, which has similar characteristics as the high-value jasmine or Dok Mali rice but has higher yield, has also been developed.

Later on, research on genetic improvement began to shift towards the development of heat-tolerant breeds that also resistant to diseases and floods. For example, the Chainat and IR-6 are disease resistant while the Cholasit breed can withstand floods for up to twenty-one days.

As a result of the development of HYVs, the productivity of crops, livestock, and fisheries increased significantly (see **table 3.6**), benefiting millions of farmers and consumers. For example, the development of the Chainat rice reduced production cost for several million farmers, with a rate of return of 200 percent (**table 3.3**).

The most important livestock technologies include improved feeds and new hybrid breeds with a shorter raising period and lower feed-conversion ratio. In the 1990s, evaporative housing, which was modified from the expensive imported system, was introduced. This housing helps increase the number of chickens per farm unit and enhances the productivity of chicken farms. In response to the avian flu outbreak, agribusiness companies adopted the closed chicken farm system (the so-called compartmentalization). An agribusiness company has been experimenting with an environment-friendly closed shrimp farm system. A large number of shrimp farms have also adopted the biosafety farming method that eliminates the use of antibiotic drugs.

Perhaps the second most important agricultural technology is farm mechanization. It began with the use of the small hand tractor to replace buffaloes in the 1970s. Since then, all land-preparation and harvesting tasks have been mechanized due to the labor shortage that began in the early 1990s. The combined harvesters are now widely used for rice harvesting throughout Thailand. In some large-scale farms, the owners have begun to mechanize the task of planting rice seedlings. In sugar cane harvesting, sugar mills have imported large cane-cutting machines. These machines, however, are so large that they are not economical and need further modification.

In addition to the hardware technology, Thai farmers have also actively embraced the so-called "software" technology. Modern farm management methods, such as the GAP, are an example of this software technology. The GAP makes it possible to adopt the traceability system. New organization systems, which include contract farming and the central procurement system, are another example of software technology. The central procurement system was introduced by modern supermarkets in the late 1990s so that these supermarkets can impose standards on the agricultural products that they procure either directly or indirectly from the farmers. The product standards, which cover quality, safety, service level, and the like, are demanded by consumers. Farmers able to produce products adhering to the required standards can command higher prices. At the same time, the standards enable the supermarkets and the suppliers to achieve economies of scale in their procurement.

Contract farming was adopted as a means for agribusiness firms to introduce new technologies to farmers and allow them to internalize the external benefits of these technologies. Since Thailand is one of the first among developing countries to successfully adopt the contract farming system, the case of contract farming in Thailand is worth analyzing.

Contract farming was successfully developed starting in the 1970s for chicken and tomato farms. Since then, it has been widely applied to a large number of high-value crops and livestock. The success cases include the contracts to produce vegetables (e.g., baby corn, tomato seeds, potato, asparagus, okra, peas) and organic vegetables for export. There are also other forms of contract farming in which the contractor will provide credit to the farmers. Most sugar mills provide such credit to ensure that they will secure an adequate supply of sugar cane during the four-month production period. There are also many cases of failed contract farms (e.g., the contracts to grow Indica rice, Japonica and Basmati rice and raise swine).

As already mentioned, the first group of contract farms consisted of the modern broiler farms introduced by CP in the 1970s, thanks to the export opportunity in the Japanese market. Contract farming is a means for agribusiness companies to introduce new technologies to farmers and to capture some benefit from the farmers by tying the production contract to the sale of the required inputs. Before 1970, most chicken farms employed traditional technology. The new technology includes new breeds with low feed-conversion ratio and high-nutrition feeds. It also requires modern farm management methods, including investing in a modern chicken house, good sanitation, and ventilation. Since new technology represents an uncertain prospect to farmers, agribusiness firms have to offer a contract to buy their products at the minimum guaranteed prices, which are generally higher than the prices in the spot market. There are two types of contracts: the guaranteed-price contract and the wage (or hired labor) contract. The former eliminates the price risk for farmers but they have to bear the output risks. Under the wage contract, most risks are transferred to the contractor but the farmers still have to be accountable for some of the loss. The contractor also helps the farmers secure the large loan contract required for investment in a modernized farm. In the early years, the guaranteed-price contracts were the most popular contracts. But as chicken markets rapidly expanded, the market for contracts had to give way to the wage contract (or hire for a fixed fee) due to the contestability in the contract market (Poapongsakorn et al. 2003).

What factors can explain the success of contract farming in Thailand? The first is the high net income earned from contract farms. Some studies show that the net income gained by contract farmers is significantly higher than the net income of farmers who grow the same products but sell their produce in the spot market (see **table 3.7**). In addition to the higher yield and lower loss (e.g., lower mortality rate) generated by the new technology, the products of the contract farms are of higher quality and safer. Their products are sold at very high prices in high-income countries. Part of the high income is the return on the farmers' effort because contract farming is care- and time-intensive. Second, the contract market in Thailand has been contestable because of minimum government regulations. Thus, contractors have to compete with one other to offer the best possible deals to farmers. There are, however, many cases of failure as either side try to cheat each other by not complying with the contractual terms (TDRI 1996). Some agribusiness firms have also tried to introduce contract farming in a number of agricultural products but failed because the contractual arrangement for many products do not result in higher net income for both parties. Contract farming involves high transaction costs for both sides. Most of the success cases are where the contractors put serious effort in screening the farmers.

Despite its popularity, the 2003 Agricultural Census found only 260,330 farms (about 4.5 percent of farm households) with some form of contractual arrangement. However, this number decreased to 165,000 in 2008. To date, no research has been done to explain the cause of the decline. One hypothesis is that there was a shortage of family labor (contract farming is very labor-intensive). In recent years, there have been studies showing that many farmers have complained about the unfairness of contracts. For example, many farmers were required to unfairly bear the risk of disease outbreak and that some contractors did not allow the farmers to keep a copy of the contract (Portphant 2009).

Technology is not manna from the sky. It is the output of R&D, which is actively carried out by the government, the farmers, and the private sector. To understand the issues related to who undertakes research activities, it might help to divide the factors that influence technology into three categories: genetic base, resource base and environment (research on the relationship between the plant and its resource base), and support (fertilizers and pesticides) and postharvest inputs (storage, transport, and processing). The classification of livestock production has to be expanded to include the fields of animal nutrition and health (Siamwalla 2001).

It is clear that the private sector plays an important role in the third category of technology because this sector can capture the entire benefit (either through patents or trade secrets) from its investment in research. The technology referred to in the second category is mostly the work of scientists in the academe. MNCs in developed countries have also recently become involved in such research, thanks to intellectual property laws. Research on animal nutrition is mostly the effort of large-scale farmers and agribusiness firms. In Thailand, the academe has also been actively involved in such research because most farmers are smallholders with no incentive to do this kind of research. Research on animal health is done mostly by multinational drug companies.

Traditionally, agricultural research, particularly genetic improvement, has been the domain of the public sector due to two reasons: economies of scale in gene banks and research being a public good. But some of the research in genetic improvement is also carried out by the private sector (or farmers) because they can benefit from their research effort. Siamwalla (2001) lists three categories of genetic-improvement research according to the ability of the private sector and farmers to capture the benefits. The first category is research on self-pollinating crops (e.g., rice) and crops that undergo vegetative propagation (e.g., cassava and sugar cane). This type of research is usually done by the public sector since the private sector cannot recover the research cost due to the fact that the farmers who obtain the improved germplasm can simply use the seeds from the harvested grain for future crops.

The second category in genetic-improvement research includes cross-pollinating crops (e.g., hybrid maize and sorghum) and small animals like chicken and swine. Crops that propagate themselves by cross-pollination have a high rate of outcrossing. The quality of seeds from experiment stations can rapidly degrade in succeeding generations. Because of this, a private commercial maize seed industry arose to supply farmers' needs. Private companies can benefit from their research from the sale of seeds. In Thailand, there are a few MNCs and Thai firms that do research and supply the maize seeds to farmers and export the seeds as well. Interestingly, the private maize-seed industry came about after a public university successfully developed a new variety, Suwan, which was resistant to downy mildew. The research on hybrid rice in Thailand was also done first by the public sector. It took decades, however, before a private company began to sell hybrid rice seed in 2009.

The poultry breeding industry is organized somewhat similarly to the hybrid maize seed industry, with a few MNCs dominating the industry. In Thailand, it was CP that introduced imported chicken breeds together with the contract farming system in the 1970s. Since then, the poultry-raising industry has become industrialized. CP also entered the swine-raising industry in the 1980s using a similar but unsuccessful business model. Although CP has a large market share in the pig-feed industry and operates its own pig farms and slaughterhouse, the swine industry is still dominated by a large number of medium- and large-scale pig farms, thanks to the research on heat-tolerant breeds and improved pig feeds done by a public university and the Department of Livestock Development.

The third category of genetic-improvement research deals with tree crops (e.g., rubber) and large animals (e.g., cows). Since the generation length of these crops and animals is counted in years, it is very costly to crossbreed on a trial-and-error basis. As a result, the private sector has less incentive to do research. Thus, most crossbreeding activities are done by farmers and public research agencies. The role of private firms, however, will increase with the advent of modern cloning technologies.

3.4 Technology in the Food Processing Industry: The Role of Agribusiness Firms

Most of the technologies used in the food processing industry have been introduced or adapted by agribusiness firms. Since food processing includes activities like product grading, handling and transportation, processing, stocking, distribution and marketing, the type of technologies required should incorporate those activities as well. These technologies include (1) genetic improvement (e.g., production of hybrid seeds, disease-tolerant seeds, etc.) and farm machinery; (2) postharvest technologies (e.g., product-grading machines, grading stations, and mechanization of handling tasks); (3) processing technologies involving new, automatic machines and more efficient use of raw materials and energy; (4) management methods and other software technology (e.g., Good Manufacturing Practices or GMP, Hazard Analysis and Critical Control Points or HACCP, Total Quality Control or TQC) and new organizational techniques to improve the efficiency of doing business such as contract farming and, more recently, central procurement and the implementation of private product standards developed by the modern supermarkets, which has already been discussed in section 3.3; (5) logistics, which involves storage and transportation (e.g., refrigerated trucks); and (6) product development. These technologies can be grouped into two broad categories—hardware and software technologies. **Table 3.8** lists some of the key technologies. It should be noted that, unlike agribusiness firms in developed countries, most Thai firms tend to adopt the last four types of technologies, particularly the ones considered software technologies. Although some companies have been active in R&D on hybrid seeds, most of the hybrid breeds used in Thailand are imported and adapted to the local environment (e.g., white shrimp and hybrid broilers). In general, Thai companies have not had adequate resources to develop their research capability, given their business scale. When business expands, they will have to use other strategies to quickly obtain critical technology. CP, for example, decided to take over an American research company that controls the chicken-breeding technology, but it did this only after it successfully expanded its poultry business in China, which is the world largest market for chicken.

After describing the technology-upgrading activities of the food-processing industry, the factors affecting the firms' decision to adopt such technologies will be analyzed.

Technology Upgrading

In response to the changes in the relative prices of inputs and output as well as external shocks, firms have to adopt and adapt new technologies, change their marketing strategy, and sometimes reorganize their organizations. There are four important strategies employed by agro-business companies: technology, management, organization, and marketing strategies.

There have been a few studies (Archanun 2006; Bhanupong 2007; Phatarapong 2010; and Poapongsakorn et al. 2010) analyzing the technology-improvement and technology-upgrading activities of agribusiness companies in some food industries. Some of these activities also involve technological improvements in the agricultural sector. Some of the findings of these studies are as follows.

First, agribusiness companies in all food sectors have adopted some kind of technology improvement. Contrary to the popular argument in the literature (e.g., Doner 2008) that most Thai companies are good at diversification but not at technology upgrading, a few studies (Archanun 2006; Phatarapong 2010; Poapongsakorn et al. 2010) found that some large-scale food companies have actively engaged in technology improvement, if not upgrading. It is the large-scale firms that have a long-term strategy on research and have put serious effort and large investments in R&D. For example, CP (the animal group) invests more than one billion baht per year on R&D. It hires several hundred researchers, many of whom are poached from university and public research centers. Although there are only a few firms that adopt and adapt new technologies in each subsector of the food industry, one can argue that the fact that each industry has a few leaders who put in serious effort in technology improvement means that, sooner or later, there will be a spillover effect as other firms begin to copy and adapt the new ideas. Though most small- and medium-scale firms are still not investing in R&D (Phatarapong 2010), these same firms are quick copycats.

Second, the comparative advantage of Thai food exports does not only depend on the availability of domestic raw materials produced by the agriculture sector but also on other, more important factors, especially the companies' ability to constantly add value and improve the quality of their products so that they can overcome the pressure resulting from the increasing scarcity of raw materials and labor shortage. A few examples should be sufficient to illustrate the point.

CP, the largest agribusiness company in Thailand, has successfully exported frozen chicken since 1970s and frozen shrimp since 1980s to markets in developed countries (i.e., Japan, the EU, and the United States). As labor cost became more expensive, it gradually switched to the higher-value, ready-to-eat chicken products and new product varieties. In the past, its export success was attributed to cheap labor and its ability to exploit market opportunities in Japan by seeking investment privileges to establish a modern slaughterhouse, introduce new chicken-raising technologies, and engage in contract farming as discussed in part 1. Later on, it successfully adopted new technologies for food processing, which enabled it to improve its food-safety standards in response to the stringent demand of consumers in the developed world. When the chicken industry was almost brought to its knees by the bird flu outbreak in the early 2000s, CP was able to quickly shift from exporting frozen and fresh chicken to cooked chicken meat and ready-to-eat products, thanks to its prior investment in new processing factories. Its partnership and coordination with Japanese importers also provided CP with the necessary information on the types of products and food safety standards that are required in the world market. More recently, its partnership with Tesco in the Tesco-Lotus supermarket in Thailand has enabled CP to gain access to the British retail market for its ready-to-eat chicken products. This access is made possible by its ability to satisfy the complex requirements of England's strict animal welfare standards.

Other chicken exporters were also able to quickly respond to the export opportunity for safe food. When South Korea abandoned its import quotas on chicken in 2001 and reduced import tariffs, Thai exports of processed chicken wings to South Korea significantly increased after thirty-three Thai factories successfully obtained food safety certificates (Nidhiprabha and Chamchan 2005). CP was one of those exporters.

A second example is that of Chor Heng, a large-scale flour producer and the first Thai exporter to successfully export rice flour to the United States despite the stringent standards imposed by the U.S. Food and Drug Administration (FDA). These examples show that Thai exporters have been more than able to meet the food safety standards for high-end markets and that they were able to develop this capability ahead of other developing countries (Nidhiprabha and Chamchan 2005).

The third example focuses on exporters of canned tuna. Thailand is the largest exporter of canned tuna in the world. Its success implies efficient scale of production, high quality standards, and well-known brand names. Some Thai companies have already established their brand names as premium quality products (e.g., Nautilus brand of Pattaya Food Industry; Sealect brand of Thai Union Manufacturing Co., more recently known as TUF). The product range has also been expanded from the original product range of tuna in oil or tuna in springwater to value-added products such as spicy tuna and mayonnaise tuna spread. But perhaps the most important factor is that majority (94 percent) of the Thai seafood-processing companies have obtained at least one quality standard certification, either ISO 9000 or HACCP, or even both certifications (ibid.). This clearly shows that most Thai companies are aware of the need to comply with SPS norms. Their effort to have their brand names identified with products meeting high food safety standards has become the industry norm in Thailand (ibid.).

Thailand is also one of the leading exporters of canned pineapples with exports of more than 358 million tons, accounting for more than 80 percent of total production in 2002. The exports have encountered significant trade barriers. Being the largest exporter of this commodity, Thailand has been accused of dumping by producers in the United States. It also has to compete with African and Caribbean products, which are given preferential tariff treatment by major importers. A sharp decline in Thai pineapple exports from 500 million to 700 million tons in the early 1990s to less than 400 million tons in the early 2000s can be partly attributed to those factors. But Thai exports have remained competitive, thanks to manufacturers' continuous effort to upgrade product quality standards in order to meet the requirements of international customers. Some companies (e.g., Dole Thailand) have minimized the use of pesticides though integrated pest management (IPM). This has been made possible by adopting the vertically integrated structure, which combines plantation, processing, canning, shipping, and market operations (Nidhiprabha and Chamchan 2005).

Finally, the food export industry has shown its willingness to invest in a public good to help solve problems in the export market. In response to the nitrofuran incident in 2002, which involved eighty-five cases of Thai exports of chicken and shrimps, the private sector acted swiftly by pooling resources to buy chemical-residue testing devices (Elisa test kits) worth THB 5 million. The private sector thus effectively worked around the delay in the approval of the government budget, which would have funded the purchase of the testing devices. The testing devices were deployed to wholesale seafood markets in Samut Sakorn and Nakorn Srithammarat. It should also be noted that the nitrofuran incident helped speed up the establishment of the Bureau of Agricultural Commodity and Food Standards (ACFS) in 2002. The main responsibility of this bureau is to establish and enforce food safety standards, build cooperation among concerned entities or agencies, and negotiate on issues relating to international standards setting, which affects international trade. Realizing the export benefits of having standards in agricultural production, the food industry supported the ACFS in establishing national standards (GAP) for poultry and dairy farms and the Agricultural Standards Act was quickly legislated.

How and Why Firms Acquire and Upgrade Technology

Most Thai firms acquired technological capability through four channels (Archanun 2006; Phatarapong 2010). The first channel is through MNCs who are the buyers (MNE buyers). Their products have to comply with the food safety regulations of the importing countries. MNE buyers play critical role not only in providing information on required regulations but also in giving technical advice on how to comply with the new regulations. Another important role of the MNE buyers, particularly the Japanese MNEs, involves product development. The MNE buyers constantly carry out market research on the new food products their customers demand. They will thus ask their suppliers to produce the new products by providing details on formula and required ingredients. After successful production, some Thai suppliers begin experimenting with cheaper ingredients. In the process, Thai suppliers acquire the capability to develop new products. As a result, these companies (e.g., CP, Betagro, TUF) will establish a research unit in their company. CP, for example, does not only put billions of baht in R&D but is now also hiring hundreds of researchers in diverse fields. These researchers include food scientists, food engineers, home economics graduates, restaurant management graduates, animal scientists, plant breeders, and veterinarians. Thus, R&D activities have gradually become an important channel through which a few large-scale firms have been able to develop their technological capability and upgrade their technology.

The third channel is labor mobility. Hiring skilled labor from other companies is the most important means by which small and medium enterprises (SMEs) can acquire technology. The last channel is the copying and demonstration effect. When new food products have become popular, other firms—large and small—begin to imitate the originator of the product. The Thai food market has experienced such phenomena in recent years. As a result of the competition among food companies, consumers have benefited from lower food prices and more choices in food products.

Agribusiness firms, in general, decide to adopt new technologies or upgrade their existing technologies for four reasons: higher revenues, cost reduction, response to increasing pressure for food safety by the consumers, and, last but not the least, market opportunity and threats. Agribusiness firms invest in breeding technologies and improved animal feeds because these result in higher production and higher revenues. Examples include new chicken breeds and improved shrimp larvae. Firms also adopt various technologies to reduce production and logistic costs (e.g., grading machines, waste-management technologies, energy-saving devices, truck-handling stations, GPS units and truck-fleet monitoring devices, truck queueing-in for the sugar mills, among others). In response to the demand for safe food and adherence to food safety regulations, firms have adopted a number of management processes and standards (e.g., HACCP, GMP, GAP, traceability, and other international standards). The last reason is market opportunity and threats. The increase in consumers' income and changing consumption behavior have encouraged many firms to introduce new high-value products such as ready-to-eat and ready-to-cook products, organic products, hydroponic vegetables, and biodegradable products. CP's chicken products comply with the strict animal welfare requirements of the United Kingdom (UK). Some canned-seafood firms have bought international brands (e.g., Bumble Bee and Star Kist). Other food companies pack their products in retort pouch packages so that the product will taste better than canned food.

4. Some Problems of Public Research in Agriculture

This part will describe the pattern and trend of R&D expenditure in Thai agriculture and food processing industry followed by a discussion of some critical problems in agricultural R&D of the public sector.

The Thai government has always played the biggest role in agricultural research. Research efforts began a century ago when the government sent students to study agricultural science abroad. One of the graduates began to collect the best native rice breeds, and one of these breeds won a competition in Canada. Major effort was expended on the training of hundreds of plant breeders after the Second World War. In the late 1960s, hundreds of agricultural students received scholarships to study abroad. The formal organization of public research in agriculture began in the late 1950s and early 1960s when the government established important research departments in the Ministry of Agriculture (MOAC)--the Department of Rice, Department of Agriculture, Department of Fishery, and Department of Livestock. The research system of these departments consists of national research centers that are responsible for specific product groups (e.g., the Rubber Institute, Field Crops Institute, etc.), regional research centers, research stations, and disciplinary research in the national centers (e.g., plant protection, biotechnology, postharvest, etc.). In addition, public universities, particularly Kasetsart University, also play an active role in research. In 1983, the National Center for Genetic Engineering and Biotechnology was established. In 1991, it was merged with the independent National Sciences and Technology Development Agency (NSTDA). Its scientists conduct agricultural research with emphasis on biotechnology. A few private agribusiness firms are active in research on livestock, fishery, and seeds while farmers usually carry out their own R&D on fruit trees, orchids, flowers, and fisheries.

There are five public funding agencies: the National Research Council (NRC), NSTDA, the Thai Research Fund (TRF), the Agricultural Research Development Agency (ARDA), and Thailand Tapioca Development Institute (TTDI). While the NRC is a government agency, the other three (NSTDA, TRF, and ARDA) are independent public agencies. TTDI is a foundation. The NRC is also responsible for the approval of research proposals submitted by all government agencies, including public universities. The TRF funds applied research that is mostly carried out by university professors and graduate students. The last two funding agencies finance agricultural research. The ARDA finances commercially feasible agricultural research while the TTDI takes charge of cassava research.

The first three agencies source their funds from the fiscal budget. The ARDA is funded by a loan from the ADB while the TTDI has an endowment fund from the proceeds of the cassava auctions in the early 1990s.

The budget for agricultural research at the MOAC began to increase from THB 78.3 million in 1961 until it peaked at THB 10,872 million in 1997. After declining for a few years, the budget began to increase again in 2003, reaching THB 12,509.1 million in 2009. If the budgets of the other public funding agencies are included, the total expenditure for agricultural research amounted to THB 13,736.3 million in 2009 (**table 4.1**). In 1988 prices, the real research expenditure peaked in 1977. Although it increased in recent years, the real expenditure in 2009 was still lower than that in 1977. It should also be noted that the research budget is prone to cuts during economic crises, such as what happened in 1998 and 2008 (**table 4.1**).

The private sector recently increased its role in agricultural research. Casual observation suggests that private research in agriculture has increased in the fields of hybrid seeds (e.g., baby corn, vegetable seeds, hybrid rice, etc.), genetic improvement of rubber trees, cultural practices, and postharvest technology. A survey by the NECTECH found that a few agribusiness firms spent THB 869.71 million on agricultural research in 2007, which is about 30 percent of all agricultural research expenditure. This is much higher than the 13 percent estimated by Fuglie (2001).

In recent years, many policy makers (especially those in funding agencies) and scientists have raised their concerns about a decline in Thailand’s competitiveness. One of their main concern is that Thailand’s investment in research is very small, compared to other countries. Public research in agriculture has also experienced similar financing problems in addition to other problems.

The first problem is that agricultural research intensity, measured by the ratio of the MOAC's research budget to agricultural GDP, peaked at 0.92 percent in 1993 and never recovered. It was only 0.37 percent in 2009 (**figure 4.1**).

Second, agricultural research has always been less important than extension services. Ever since its establishment, the Department of Agricultural Extension's (DOAE) budget has always increased faster than the research budget until it reached its highest level in 1998 (see **figure 4.2**). The extension budget was as high as 62 percent of the total research budget in 1996—97. After 2005, the research budget began to increase at a faster rate. However, this is misleading. Bureaucrats and politicians have managed to increase the extension budget and hide this increase in the research departments. Interviews with senior officers in all research departments of the MOAC show that the bulk of the research budgets of the research departments have been diverted to "development" activities under the guise of R&D. In fact, the budget is used for extension activities because such activities have immediate political impact. One reason for the ease with which this move has been carried out is that there is no clear distinction between "development" and "extension." Interviews with officers at some research departments reveal that about 80 percent to 90 percent of their R&D budget is used for the "D" activities.

Third, the allocation of the research budget has been without a clear direction, which results in inefficient allocation (**table 4.2**). One cannot immediately identify the objectives or the criteria for budget allocation. The research intensities (measured by ratio of research expenditure to output value) for crops, animals, and fish vary widely. Rice and rubber, which are the two largest crops, have a research intensity of only 0.05 percent and 0.037 percent, respectively. Orchids and oil palm, which account for less than 0.6 percent of agricultural output, have a research intensity of 0.32 percent and 0.35 percent, respectively. It should also be noted that many research projects that should be carried out by private companies (e.g., orchids and swine) received more budget than the crops whose research should be funded by public funds (e.g., cassava). The problems of research-budget allocation are not caused by the lack of a national research strategy. Rather, the problem is caused by the fact that each research agency has its own research agenda determined by the department heads, the researchers, and their minister. For example, the Department of Livestock Development (DLD) has to give the highest priority to R&D programs on goats because of the conflicts in the four southern provinces in recent years. There is no systematic process of taking into account the changes in the demand and markets in the process of budget consideration (see further discussion on the role of funding agencies below).

Fourth, the research budget is fragmented. Since there were 4,020 projects between 2007 and 2010, the average budget for each project works out to only about THB 0.98 million. The problem is caused by the fact that there are too many research funding agencies, each with its own mission. Moreover, these agencies are subject to the "divide and rule strategy" of the budget bureau because they have to negotiate their budget requests with this powerful body.

Fifth, since the allocation of the budget is also on an annual basis, many medium- and long-term research projects may not receive enough budget in some years. Thus, researchers are forced to downsize their research, affecting research output and the effectiveness of the projects. Given the fact that agricultural technology usually takes five to eight years to develop, the yearly budget allocation process is not an efficient way of investing. In fact, the four public funding agencies have begun to finance some projects on a four- to five-year basis. Nevertheless, some problems remain when their budget request is cut by the budget bureau. In addition, the long lag in the budget consideration process also means that it takes two years for the research proposal to be funded.

Sixth, most research and extension programs are bureaucratically and politically driven. This is because the board members of the public funding agencies who make decisions on budget allocation are dominated by senior government officials. About 40 percent to 74 percent of the board members on the board of directors of four funding agencies consists of senior government officials. Members belonging to the private sector are in the minority, accounting for 0 percent to 15 percent of the board of directors. The only agency with 44 percent of its board of directors coming from the private sector is the NSTDA.

Finally, Thailand has begun to experience a shortage of high-caliber agricultural researchers. Although there are more researchers in agriculture than in other sciences, there is a smaller number of agricultural researchers with PhDs (**figure 4.3**). Moreover, a number of senior researchers (some with PhDs) have already retired and more will retire within the next few years. It will be difficult to replace these senior researchers because of the low government salary and lack of attractive incentives. In the last five years, eleven rice researchers retired with no replacement. Within the next seven years, sixty-four rice researchers will retire, seven of whom have PhDs. The number of research staff at the Department of Agriculture also dropped by 6 percent between 1994 and 1998. In addition, Thailand now has smaller number of agricultural researchers than Viet Nam, the Philippines, and Indonesia (**figure 4.4**).

5. Conclusion and Some Challenging Issues

This study explained the sources of growth of Thai agriculture and the food processing industry. Besides land abundance and good macroeconomic policies, the critical factors are public investment in infrastructure and education; the investment made by farmers, which has been made possible by the establishment of the BAAC; and the investment made by agribusiness firms. Although the growth of TFP came behind capital as the most important source of growth, TFP growth resulted in the sustainable, long-term growth of Thai agriculture. The long-term growth of agricultural productivity makes it possible for food exports to grow rapidly and keep Thailand as one of the world's largest exporters of food. Since investment in agricultural R&D is the major factor explaining productivity growth, the rate of return on investment in agricultural research is very high.

The impressive growth of the food industry is also mainly attributed to technology. Unlike in agriculture where research is mainly carried out by the public sector, it is the private sector that takes the lead role in food research in the food industry. Moreover, in recent years, a few large-scale agribusiness companies have begun to carry out their own research in agriculture. Some of the innovations and technologies that have been successfully developed are sold to farmers while others are freely distributed by the firms.

That the rate of return on agricultural research is very high (i.e., more than 30 percent to 40 percent) means that the government underinvests in R&D. In the past, the Thai government used to invest heavily both in agricultural research and in the training of researchers, particularly plant breeders. Recently, however, research intensity has declined drastically to a level (0.37 percent of agricultural GDP) that is lower than the research intensity of some

ASEAN countries. There are also many problems in the allocation of the research budget, which results in the inefficient use of said budget.

The rest of this chapter will briefly identify some important challenges—internal and external—facing Thai agriculture as well as some opportunities. Some policy implications will also be discussed.

Challenging issues

Thai agriculture is at a crossroads. It is facing several internal and external challenging issues. The internal constraints include labor shortage, increasing water scarcity, water and soil pollution caused by intensive agriculture, resource degradation, and increasing incidence of pest infestation and disease outbreaks. Labor shortage is one of the most serious problems not only because of the higher wage rate for hired labor (which can be partially mitigated by mechanization) but also because of the massive migration of young people out of agriculture (estimated at four million workers aged 15--34 years between 1991 and 2010). As a result, there is now a greater number of older farmers, with the average age of 52 years old and about 18 percent of whom are older than 60 years old. The problem is that as these elderly farmers retire, they are unlikely to be replaced by their sons and daughters who are now living in the cities. Those who wish to rent out their land will find that the legal regulations are biased in favor of the tenants (i.e., the rental contract has to be at least six years and if the landlord wants to sell his/her land, he/she has to give the tenant the right to buy before other potential buyers). If the law is not repealed, it is possible that a large number of lands will be left idle, affecting agricultural production.

The external challenges include climate change, widespread trade protection policies, and the increasing demand for safe food and foods that are produced and marketed in a socially responsible manner. Some studies predict that climate change will have serious impact on irrigated rice in the Central Plains within the next twenty to thirty years. (Rerkasem 2010; IFPRI 2008). It may, however, have a positive impact on some crops such as sugar cane while other crops, such as cassava, may not be affected (Rerkasem 2010).

Nevertheless, the future for Thai agriculture is still promising, given the increasing prices of food on the world market (IFPRI 2009; FAO 2009).[6] In addition, higher per capita income in the emerging economies of the world should result in increasing demand for high-value agricultural products in which Thailand has acquired comparative advantage.

Policy Implications

Thailand will be able to exploit such export opportunities only if it can tackle the constraints previously discussed. This requires changes in some key policies. As has already been mentioned, the agricultural tenant law has to be repealed so that it can provide balanced protection of rights to both the land owners and the tenants. The cumbersome legal process to evict tenants who refuse to move out after the contract has expired has to be streamlined. These constraints seriously affect the efficiency of the land-rental markets.

The second policy concerns the water demand-management policy. In response to increasing demand for water from the agricultural and nonagricultural sectors, the government has invested heavily in irrigation (especially in small and medium irrigation systems) in the last two decades. Despite this, the policy has not been effective in mitigating water-scarcity problems for several reasons such as the limited supply of surface water and the lack of investment coordination among a few dozen government agencies, among others (TDRI Report 2002). There has been a recent attempt to revise the demand management policy by drafting a new water law. The government, however, still controls property rights over water and still wants to impose a water-management system at the large river basin level. Still, water conflicts (most of which break out between the upstream and downstream farmers) arise at the small tributary of the river basin. Some studies found some success cases in water management organized at the local community level. The policy implication, therefore, is that a water management system can be effectively implemented if the local people are allowed to

[6] There are several reasons for the increase in world food prices (e.g., the pressure from biofuel policies in many developed countries; the slower growth of agricultural production due to the decline in public investment in agriculture and agricultural research; the increase in population and higher per capita income in the emerging countries). The World Bank (2008), however, argues that the demand for food in the emerging economies may increase only slowly in the future. Moreover, if new technologies for alternative energy can be commercially developed, there will less pressure on the future prices of commodities.

organize the system and if they are granted the right to manage water utilization at the small tributary of the river basin (Mingsarn 2011).

Finally, the most important policy would be the reform of agricultural research and extension policies. Without new technologies to cope with resource constraints and rapidly increasing production cost, Thai agricultural exports will quickly lose their competitiveness. Moreover, technologies will enable Thai farmers and agribusiness firms to move away from the production of low-value and labor-intensive agricultural products and to exploit the opportunity presented by increasing demand for high-value and safe food products. Higher-value products include health foods, organic foods, foods that are produced in an environment friendly and socially responsible manner as well as foods with therapeutic or medicinal value. At the top of the research agenda is the immediate need for the government to increase the research intensity for public research to 0.7 percent of agricultural GDP within the next few years and then to gradually increase it further to 1 percent in the coming decade. Public research should be financed by general revenues, a special levy on exports for exportable crops, and a research levy for import-substituting crops that are cash crops. The research levy will result in a steady research budget, thus allowing funding agencies to finance medium- and long-term R&D projects lasting at least five to eight years before the new technology can be fine-tuned and disseminated.

Another important policy change involves putting in place an objective mechanism for effective budget allocation. The current decision-making process on allocation is dominated by bureaucrats and politicians and needs to be more market-driven. The composition of the NRC has to be changed (e.g., reducing the number of senior bureaucrats and retired bureaucrats). After the NRC identifies the research objectives, the funding agencies should jointly commission a research study on the priority setting of the research budget using an approach similar to economic surplus. The decision process should also involve all the stakeholders in agricultural research and business.

The incentives for researchers also need to be overhauled. The promotion system and career path for researchers who are civil servants have to be different from that of other civil servants. The evaluation of the academic performance of university professors also needs to be changed so that it provides incentives for researchers to work on medium-term projects and to work as a team because agricultural R&D involves scientists from many disciplines. The government should also provide more scholarships for PhD students. Universities should be allocated more funds to finance the research projects of PhD students and postgraduate students who will have to work with their professors.

The Thai government has already provided generous income tax incentives for private firms that invest in R&D. However, the government should allow agribusiness firms to submit research proposals and to bid for theme research financed by public money. This will not only increase competition in research but will also enable researchers in agribusiness firms to work with public sector researchers. Of course, certain rules on intellectual property rights have to be established in a transparent and accountable manner.

Last but not least, the extension services provided by central government agencies need to be restructured. Even though the government has spent more on extension services than on research, farmers are not satisfied with the service. There are a number of success cases in the provision of extension service in many developing countries involving the decentralization of extension services to the local government and the participation of nongovernment organizations (NGOs) and university professors in extension services (World Bank 2008). The government should, therefore, begin to restructure extension services by carrying out several pilot projects and evaluating the effectiveness of new approaches.

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Tables and Figures

Table 2.1. Value Added Share and Annual Growth Rate of Agricultural Subsectors

Subsectors	1960-85	1985-96	1996-98	1998-2009	1960-2009
Agricultural (share of agricultural GDP)					
- Crops	65.49	64.86	64.27	64	66.41
- Livestock	10.62	10.68	10.74	10.69	9.06
- Fisheries	6.7	6.9	7.18	7.49	13.88
- Forestry	6.11	6.05	5.98	5.79	1.98
- Agricultural services	3.55	3.68	3.77	3.81	2.32
Agricultural (share of GDP)					
- Crops	14.54	13.9	13.32	12.88	7.96
- Livestock	2.36	2.29	2.23	2.15	1.09
- Fisheries	1.49	1.48	1.49	1.51	1.66
- Forestry	1.36	1.3	1.24	1.17	0.24
- Agricultural services	0.79	0.79	0.78	0.77	0.28
Growth rate of agricultural					
- Crops	3.98	2.63	-0.64	2.8	3.37
- Livestock	4.37	3.82	-3.26	3.1	3.8
- Fisheries	7.35	9.29	-1	3.54	5.38
- Forestry	0.62	-11.12	-6	-1.64	-3.38
- Agricultural services	4.4	-0.81	-8.54	-0.36	0.54
Food and beverages (share of GDP)	2.86	3.09	3.25	3.44	5.52
	1980-85	**1985-96**	**1996-98**	**1998-2009**	**1980-2009**
Food and beverages					
- Share of manufacturing GDP	13.78	14.62	15.08	15.61	17.72
- Growth of manufacturing GDP	6.75	10.84	0.49	3.83	6.67
	1970-85	**1985-96**	**1996-98**	**1998-2010**	**1970-2010**
Simple agricultural processing					
- Share of manufacturing GDP	8.05	7.92	7.76	7.50	2.45
- Growth of manufacturing GDP	5.09	6.97	-1.79	2.15	5.47
		1988-96	**1996-98**	**1998-2010**	**1988-2010**
Share of agricultural export		100	100	100	100
- Crops		92.0	92.6	95.6	94.8
- Livestock		9.1	11.9	12.3	11.7
- Fisheries		43.0	45.0	26.7	30.4
Share of food processing export		100	100	100	100
- Crops product		12.4	8.6	11.2	11.3
- Livestock product		1.6	3.6	2.6	2.5
- Fisheries product		32.2	33.9	35.7	35.0
- Beverage		1.7	2.3	3.2	2.9
Growth of agricultural export		508.3	10.0	10.7	8.2
- Crops		5.3	9.9	11.1	8.5
- Livestock		8.9	34.5	5.5	9.8
- Fisheries		15.0	17.1	0.0	4.7
Growth of food processing export		7.1	17.8	6.8	8.5
- Crops product		9.3	1.3	8.8	8.3
- Livestock product		40.4	46.7	5.7	16.3
- Fisheries product		8.9	31.3	4.8	9.0

- Beverage		21.8	2.4	12.7	14.5

***Source*:** Calculated from NESDB, National Income

Table 2.2. Growth Rates of Output Classified by Traded and Nontraded Products

Items	Growth (% p.a.)				
	1980-1985	**1985-1990**	**1990-1996**	**1996-1998**	**1998-2004**
Traded Crops	5.84	2.34	2.00	0.52	2.96
Import Competing Crops	2.95	10.17	4.77	-9.09	4.39
Nontraded Crops	2.37	5.46	3.59	-5.72	6.96
Traded Livestock Products					
- Hens	7.08	7.67	4.42	10.44	9.73
Import Competing Livestock Products	4.23	5.66	4.74	-18.27	6.61
Nontraded Livestock Products	0.34	6.58	0.18	-4.41	4.90
Traded Fishery					
- Marine Fish	4.26	8.70	7.93	-0.85	0.45
Nontraded Fishery					
- Freshwater Fish	0.36	2.23	10.64	-2.02	4.64

***Source*:** Calculated from NESDB, National Income

***Note*:** (1) Exportable crops include paddy, cassava, kapok, tobacco, sugar cane, maize, sorghum, mungbean, sesame, black pepper, pineapple, rubber, and orchids. (2) Import-competing crops are cotton, kenaf, jute, soybean, garlic, shallots, oil palm, cocoa, coffee and tea. (3) Nontraded crops consist of native tobacco, castor bean, groundnut, chili, bird pepper, vegetables, fruits (except pineapple), coconut, flowers (other than orchids), and other crops. (4) Traded livestock = import-competing livestock = dairy products and cattle. (5) Nontraded livestock = buffaloes, swine, ducks, chicken, and duck eggs.

Table 2.3 Share of Land Holding by Crop (%)

Crops	1993	1998	2003	2008
Paddy Rice	55.4	56.1	52.3	50.6
Field crop	21.3	18.8	19.1	19.7
Vegetable/flower and ornamental plant	0.9	1.4	1.2	1.2
Permanent crop	9.6	10.6	11.7	10.5
Para rubber	8.0	9.4	8.6	12.1
Total area of holding	100.0	100.0	100.0	100.0

Source: NSO, Agricultural Census and Inter Census

Table 2.4. Value Added of Food Subsectors and Performance Ratios in 2005

	Food	**Beverage**	**Rice Products**	**Sugar**	**Maize**	**Seafood**	**Coffee**	**Dairy**	**Meat**	**Fruits**
Share of food value added	100	27.0	11.7	8.6	7.9	6.0	6.0	4.5	7.9	4.0
- rank	-	1	2	3	4	6	7	7	5	8
Export share	100	4.7	8.4	17.8	2.5		7.4	8.4		14.5
- rank	-	6	4	2	8		10	10		3
Key performance ratio										
VA/Output	26.5	52.8	16.5	40.9	18.8	18.8	36.1	30.2	18.8	21.8
Export/Output	32.4	3.6	36.5	36.7	18.8	95.4	51.8	17.3	18.8	59.6
Wages/VA	26.7	12.2	36.8	25.3	33.2	31.0	30.8	25.7	33.2	30.1
Profit/VA	50.2	28.2	52.0	52.9	58.5	59.1	53.5	42.6	58.5	52.6
Imported inputs/Intermediate	17.5	25.2	7.0	6.3	1.6	33.2	18.0	16.5	1.6	14.4
Sources of growth 2000--2005										
- Private consumption (%)	54.7	52.1	26.4	-531.3	86.6	-14.8	87.9	87.9	68.6	63.8
- Export (%)	24.8	-2.6	39.2	-2,450	24.2	-121.6	16.5	16.5	34.2	43.3

***Source*:** Calculated from NESDB, *Input-Output Table*

***Note*:** Meat Product = Slaughtering + Canning and Preserving of Meat

Dairy Product = Dairy Product

Fruit and Vegetables = Canning and Preserving of Fruit and Vegetables

Fish and Seafood = Canning and Preserving of Fish and Seafood

Oil Product = Coconut and Palm Oil + Other Vegetables and Animal Oil

Rice and Flour Product = Rice Milling +Flour and Sagu Mild Products and Tapioca Milling + Grinding Corn + Flour and Other Grain Milling +Bakery and Other + Noodle and Similar Products

Sugar and Confectionery = Sugar Refineries +Confectionery and Snack + Monosodium Glutamate

Coffee = Coffee and Cocoa and Tea Processing +Other Food Products

Fish Meal and Animal Feed = Fish Meal and Animal Feed

Beverage = Ice + Distilling and Blending of Spirits +Breweries +Soft Drinks and Carbonated Water

Tobacco = Tobacco Processing + Tobacco Products

Table 2.5 Pattern of Food Export by Products (billion baht)

	1988	1993	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
1. Agricultural products	97.78	96.06	186.28	161.18	171.88	181.64	193.68	246.8	318.25	309.72	384.5	402.5	518.85	419.19	530.25
(Share)	12.1%	10.2%	8.3%	7.3%	6.2%	6.3%	6.6%	7.4%	8.2%	7.0%	7.8%	7.6%	8.9%	8.1%	8.6%
1.1 Rice	34.68	32.96	86.8	73.81	65.56	70.1	70	75.73	108.29	92.92	97.54	119.22	203.22	172.21	168.19
1.1.1 White rice		23.36	65.72	48.23	42.78	38.1	27.02	25.62	44.77	29.51	30.62	41.4	71.41	34.42	45.84
1.1.2 Jasmine rice						2.08	15.17	24.42	26.24	26.19	30.94	34.78	46.53	55.13	53.09
1.1.3 Other rice				25.59	22.77	29.92	27.82	25.69	37.28	37.21	35.98	43.04	85.28	82.66	69.26
1.2 Maize	3.81	0.68	0.62	0.28	0.11	2.22	1.18	1.5	5.62	1.1	2.6	3.54	7.2	8.21	4.52
1.3 Tapioca and products	21.8	21.74	22.08	23	20.28	25.57	22.69	27.11	34.59	34.02	42.97	48.55	47.76	51.6	68.59
1.3.1 Cassava pellet		17	10.87	11.81	7.61	8.97	4.13	5.1	6.39	0.84	1.39	7.2	8.68	1.46	0.78
1.3.2 Cassava sliced		0.11	0.55	0.6	0.09	2.67	4.08	5.35	8.64	11.94	15.78	12.11	7.19	19	25.21
1.3.3 Cassava flour		4.53	5.2	4.82	6.17	6.3	6.44	7.51	8.29	9.47	13.68	14.01	15.01	16.66	24.59
1.4 Fresh and frozen fruits	0.76	1.76	3.99	5.51	8.99	8.4	8.96	9.1	9.79	11.82	12.2	13.2	13.58	17.96	17.23
1.4.1 Longans		0.41	0.17	1.19	2.13	1.97	1.99	1.68	2.19	2.17	2.14	2.43	2.61	3.63	3.51
1.4.2 Durian		0.55	2.61	2.72	2.25	2.64	2.32	2	2.22	2.65	3.19	2.57	3.13	4.11	3.69
1.5 Fresh and frozen vegetables	0.38	1.7	3.17	3.27	3.65	4.58	4.96	5.42	7.04	7.39	7.16	6.87	6.89	6.7	6.58
1.6 Rubber	27.19	29.18	55.41	43.94	60.71	58.71	74.6	115.8	137.47	148.68	205.37	194.34	223.63	146.19	249.26
1.6.1 Rubber smoked sheets		20.29	31.62	24.69	29.56	25.68	33.74	49.83	53.12	52.86	72.65	68.82	78.01	46.24	78.98
1.6.2 Block rubber		4.61	14.49	12.37	21.53	21.01	25.88	41.65	53.12	62.65	82.84	6.27	3.05	1.41	2.08
1.6.3 Rubber concentrated latex		3.97	8.94	6.61	9.36	11.66	13.8	22.61	28.65	30.39	46.3	43.67	46.16	40.62	59.41
1.7 Oil seeds and oleaginous fruits			0.49	0.61	0.33	0.39	0.38	0.47	2.45	0.77	1.59	0.71	0.45	0.52	0.44
1.7.1 Palm nuts and kernels					0.01	0.04	0.03	0.03	0.03	0.02	0.02	0.04	0.09	0.11	0.15
1.7.2 Other oil seeds					0.33	0.35	0.35	0.44	2.41	0.75	1.58	0.68	0.36	0.41	0.29
2. Fishery products	20.83	55.8	90.05	80.65	92.77	91.4	71.15	73.61	72.04	78.4	77.47	84.08	86.72	85	91.5
(Share)	2.6%	5.9%	4.0%	3.6%	3.4%	3.2%	2.4%	2.2%	1.9%	1.8%	1.6%	1.6%	1.5%	1.6%	1.5%
2.1 Fresh, chilled, and cooked shrimps	9.97	38.62	58.81	48.7	60.2	55.13	34.51	36.05	32.69	37.89	37.98	43.08	43.12	46.42	53.33

2.2 Fresh, chilled fish	4.54	9.01	16.19	16.31	16.59	18.61	18.91	19.32	19.01	21.54	20.98	22.38	26.6	23.33	22.8
3. Livestock	5.92	10.18	28.1	24.81	27.29	39.49	40.6	44.63	24.36	29.97	31.64	35.95	56.67	55.27	57.98
(Share)	0.7%	1.1%	1.2%	1.1%	1.0%	1.4%	1.4%	1.3%	0.6%	0.7%	0.6%	0.7%	1.0%	1.1%	0.9%
3.1 Fresh,chilled poultry cuts	4.9	8.89	16.64	15.26	15.69	23.93	22.96	24.77	1.75	0.54	0.6	1.05	1.34	1.58	1.88
3.2 Prepared poultry			8.66	5.94	8.75	11.55	13.15	15.7	20.85	27.34	28.84	31.98	50.28	47.26	50.35
4. Agro-industrial products	95.18	83.07	202.6	204.6	187.7	213.49	218.94	247.59	255.84	280.21	299.6	327.3	385.77	384.3	419.32
(Share)	11.8%	8.8%	9.0%	9.2%	6.8%	7.4%	7.5%	7.4%	6.6%	6.3%	6.1%	6.2%	6.6%	7.4%	6.8%
4.1 Preserved and canned seafood	20.94	30.04	76.45	75.22	82.84	89.38	86.5	88.79	90.71	100.29	109.28	109.02	128.92	126.69	130.09
4.2 Preserved and canned fruits	6.64	13.13	15.45	21.76	18.35	21.22	24.59	29.52	31.37	34.53	37.97	38.32	44.79	41.76	44.93
4.3 Preserved and canned vegetables		3.36	6.35	5.87	6.28	6.82	6.91	7.62	8.44	9.03	10.86	9.99	9.67	9.81	9.81
4.4 Cane sugar and molasses	10.23	12.74	28.05	21.68	27.03	33.28	32.04	40.36	34.12	30.7	29.37	45.06	49.34	63.02	70.29
Total Agricultural export	219.71	245.1	507.02	471.24	479.64	526.02	524.36	612.62	670.49	698.3	793.21	849.83	1,048.00	943.76	1,099.00
Total Export	**807.14**	**940.86**	**2,248.09**	**2,214.25**	**2,768.06**	**2,884.70**	**2,923.94**	**3,325.63**	**3,874.82**	**4,439.31**	**4,938.51**	**5,302.12**	**5,851.37**	**5,194.59**	**6,176.42**

Source: Ministry of Commerce

Note: Annual growth rate are

1) Agricultural products = 12%
2) Fishery products = 4%
3) Livestock = 11%
4) Agro-industrial products = 10%
5) Total Export = 13%

Table 2.6. Number of Factories by Food Subsectors.

Types	1997		2002		2007		2009	
	Number	*%*	**Number**	*%*	**Number**	*%*	**Number**	*%*
Basic agro industry	***48,936***		***46,774***		***43,998***		***43,348***	
tea and tobacco preservation	280	*0.5*	209	*0.4*	83	*0.2*	82	*0.2*
other agriculture produce	878	*1.6*	1,117	*2.1*	1,401	*2.8*	1,493	*3.0*
plant seeds or plant bulbs	47,778	*85.7*	45,448	*84.5*	42,514	*83.5*	41,773	*82.8*
food	***6,437***		***6,616***		***6,503***		***6,631***	
animals other than aquatic animals	619	*1.1*	646	*1.2*	942	*1.8*	989	*2.0*
milk and dairy products	102	*0.2*	194	*0.4*	174	*0.3*	182	*0.4*
aquatic animals	549	*1.0*	569	*1.1*	668	*1.3*	666	*1.3*
oil from plants or animals or animal fats	297	*0.5*	315	*0.6*	299	*0.6*	334	*0.7*
vegetables, plant and fruits	587	*1.1*	627	*1.2*	615	*1.2*	622	*1.2*
food from flour	1,643	*2.9*	1,642	*3.1*	1,258	*2.5*	1,248	*2.5*
related to sugar	192	*0.3*	192	*0.4*	130	*0.3*	123	*0.2*
tea, coffee, cocoa, chocolate or sweets	556	*1.0*	498	*0.9*	492	*1.0*	495	*1.0*
food ingredients	469	*0.8*	479	*0.9*	452	*0.9*	455	*0.9*
ice making	1,423	*2.6*	1,454	*2.7*	1,473	*2.9*	1,517	*3.0*
beverage	***375***		***402***		***444***		***463***	
liquor	80	*0.1*	97	*0.2*	104	*0.2*	118	*0.2*
nonalcohol	295	*0.5*	305	*0.6*	340	*0.7*	345	*0.7*
Total	**55,748**	*100.0*	**53,792**	*100.0*	**50,945**	*100.0*	**50,442**	*100.0*

Source: Department of Industrial Works, Ministry of Industry

Table 2.7. Number of New Food Factories by Employment Size

Year	Small	Medium	Large
1980	91	7	2
1981	91	6	3
1982	93	3	4
1983	91	8	1
1984	91	6	3
1985	90	6	4
1986	91	5	4
1987	92	5	3
1988	95	3	2
1989	87	8	5
1990	86	8	6
1991	83	9	9
1992	87	9	4
1993	85	10	5
1994	85	9	6
1995	89	7	4
1996	84	11	5
1997	90	7	3
1998	93	5	2
1999	93	6	1
2000	95	4	1
2001	92	6	2
2002	92	6	2
2003	91	6	3
2004	89	8	3
2005	90	8	2
2006	89	8	3

***Source*:** Department of Industrial Works

***Note*:** Small = less than 50 workers; Medium= 50-300 workers; Large = more than 300 workers

Table 2.8. Domestic Resource Cost of the Agricultural and Food Industries, 1997

(1) Export-oriented industries		(2) Import-substituted industries	
IO	**DRC**	**IO**	**DRC**
Wood products	0.58	Coffee and tea	2.83
Flour	0.66	Leather tanning	2.44
Furniture	0.7	Confectionery	1.94
Leather products	0.74	Tobacco	1.91
Rubber tire	0.75	Liquor distilling	1.6
Monosodium glutamate	0.77	Dairy products	1.24
Other rubber products	0.77	Saw milling	1.17
Other food products	0.82	Paper pulp	1.06
Animal feeds	0.82	Fertilizers and pesticides	1.05
Canned and preserved seafood	0.82	Vegetables and animal oil	0.9
Canned fruits and vegetables	0.82		
Cassava starch	0.83		
Rice milling	0.83		
Jute products	0.84		
Crepe rubber	0.84		
Slaughtering	0.85		
Sugar	1.02		

***Source*:** TDRI (1998).

Table 2.9. Decomposition of Sources of Growth in the Food Subsectors

	C (%)	**X (%)**	**X/output (%)**
Food		55.0	25.0
Beverages	52.0	-2.6	4.7
Rice product	26.0	39.0	8.4
Sugar	-531.0	-2,450.0	18.0
Meat	87.0	24.0	2.5
Dairy	88.0	17.0	8.4
Fruits and vegetables	64.0	43.0	15.0

***Source*:** NESDB, Input Output Table 2005

Table 3.1-a. Growth Accounting in Agricultural Subsectors

	Labor	Land	Capital	TFP
Agricultural	18.79	6.13	54.73	20.35
Crop	7.6	7.63	63.95	20.82
Livestock	78.35	-0.38	4.53	17.49

***Source*:** Waleerat (2009).

Table 3.1-b. Growth Accounting for Growth in the Agricultural Subsectors

	GDP growth	Labor adjusted for quality and working hours	Land	Capital	TFP
a) All sectors					
1981--1985	5.45	1.51	0.07	2.35	1.52
1985--1996	8.78	1.61	0.02	4.88	2.27
1996--1998	-1.99	0.63	0.01	3.3	-5.94
1998--2003	2.18	0.69	0.01	0.66	0.81
1981--2003	6.07	1.47	0.03	3.28	1.29
% of growth	100	24.24	0.46	54.00	21.30
b) Agriculture					
1981--1985	4.26	0.40	0.36	0.84	2.65
1985--1996	3.54	-0.43	0.12	2.62	1.24
1996--1998	0.57	-0.32	0.07	3.04	-2.22
1998--2003	3.43	-1.33	0.12	1.45	3.20
1981--2003	3.43	-0.28	0.16	2.06	1.50
% of growth	100	-8.09	4.64	59.90	43.55
c) Crops					
1981--1985	5.26	0.22	0.47	2.46	2.11
1985--1996	2.96	-0.79	0.18	0.91	2.66
1996--1998	2.30	-0.75	0.18	1.97	0.90
1998--2003	4.20	-2.43	0.17	0.99	5.47
1981--2003	3.57	-0.70	0.23	1.35	2.68
% of growth	100	-19.64	6.52	37.86	75.27
d) Livestock					
1981--1985	1.82	3.06	0.16	3.55	-4.95
1985--1996	4.14	1.36	0	0.33	2.45
1996--1998	-0.89	-0.02	-0.46	-6.75	6.34
1998--2003	4.10	5.85	0	-2.28	0.53
1981--2003	3.59	2.65	-0.02	-0.28	1.24
% of growth	100	73.73	-0.42	-7.89	34.59
e) Fisheries					
1981--1985	4.74	6.17	0.03	2.36	-3.82
1985--1996	7.97	2.44	0.02	4.22	1.30
1996--1998	-1.43	1.64	0.02	6.16	-9.25
1998--2003	1.24	0.78	0.03	4.82	-4.38
1981--2003	5.36	1.99	0.02	3.96	-0.61
% of growth	100	37.03	0.42	73.9	-11.35

***Source*:** Nipon and Chaiyasit (2005).

Table 3.2. TFP Elasticity vis-a-vis Research Expenditure

Type of research	Agricultural	Crop	Livestock
Government	0.05	0.15	0.12-0.17
CGIAR	0.12	0.10	n.a.
Private	n.a.	0.15	0.25-0.32

***Source*:** Waleerat (2009).

Table 3.3. Rates of Return on Investment in Agricultural Research

	Percentage	Source
Agricultural	42--45.0	Setboonsrang and Evenson (1991)
Agricultural	44.95	Pochanakul (1992)
Crop	17--29.5	Waleerat (2009)
Livestock	104--144	Waleerat (2009)
Rice (Chainart)	200	Orachos (2009)
Rice (RD. 6 Blast Resistance)	47--57	Watcharin (2009)
Rice	BC ratio 16	(2005)
Nutrient management in maize (4 site-specific)	BC ratio 19.4	Suwanna and Somporn (2010)

Table 3.4. Source of Growth of the Food Industry

Industry	Technology					Trade	Taste	Investment	General macro	Total impact
	Primary factors (saving)	Intermediate input usage for production	Intermediate input usage for capital creation	Labor saving	Total					
Agriculture	4.8	–0.6	–0.6	–1.9	1.7	1.3	1.1	0.6	0.5	5.3
Food	5.0	–0.3	–0.5	–2.0	2.2	1.2	–0.7	0.8	0.5	4.0
Textiles	5.4	0.5	–0.5	–2.1	3.2	1.1	–0.6	0.9	0.5	5.1
Jewelry	3.7	4.2	–0.4	1.4	8.9	–0.5	1.1	0.6	0.3	10.4
Electronics	3.3	10.9	–0.3	1.3	15.2	1.4	0	0.8	0.3	17.6
Vehicles	4.2	1.7	2.6	1.5	10.0	4.0	0.5	1.7	0.4	16.7
Services	4.9	0.1	–1.0	–2.0	2.0	0.8	–0.7	0.4	0.7	3.3
Others	4.6	–1.3	–0.6	–1.9	0.9	0.6	–0.2	0.8	0.5	2.5

***Source*:** Chedtha Intaravitak (2010).

Table 3.5. Agricultural Technology

Impact	Technology	Product/Type	Researcher
I. Yield Improvement			
Breeding		RD. rice, etc.	Government
		Hybrid rice	Private (CP), Government
		Tapioca	Government, Kasetsart University, Thai Tapioca Development Institute
		Para rubber	Government
		Sugar cane	Government, Private
		Maize (Suwan 1-2)	Government
		Maize (hybrid)	Private
		Baby corn	Private
		Vegetables (kale, cauliflower, morning glory)	Private
Breeding and Raise		Tilapia nilotica	Government
		Sea bass	Government
		Shrimp (Vannamei)	Private
Selection / Breeding / Artificial insemination		Swine (land race)	Government, Kasetsart University
		Swine (European)	Private
		Beef cattle	Government, Private
		Dairy cattle	Government, Private
II. Value added			
Breeding		Rice (Pathumthani)	Government
		Rice (size 7 mm./ cooked quality)	Government
		Tilapia (Red, Ruby)	Private
		Fruit (Shogun orange, mango Mahachanok)	Farmer
		Swine (Kurobuta or Berkshire)	Private
		Chicken (native)	Government
		Beef (Ponyangkham brand)	Farmer
III. Health / Safety			
Breeding	Healthy food	Rice (Sinlek, Sangyod, Vitamin A rice)	Farmer
Process	Food safety/ healthy	Organic rice	Farmer Private
		Organic	Private, Farmer
		Egg (iodine)	Government
		Chicken (closed system)	Private
		Shrimp (closed system)	Private (trials)

Impact	Technology	Product/Type	Researcher
IV. Environment: Resistance to Droughts, Floods, and Pests			
Breeding	Pest resistance	Rice RD.6, Chainat1 (Blast resistance)	Government
		Maize (Suwan 1-2) Antimildew	Government
	Drought resistance	Rice (Khao Dawk Mali 105) drought resistance	NSTDA
	Flood resistance	Rice (Hom Cholasit) Flood resistance	NSTDA
	Thermo tolerance	Swine, cattle	Private, Government
IPM	Pest resistance	Parasite of pink mealybug in cassava	Thai Tapioca Development Institute
V. Reduce production costs			
Reduce costs	Housing	Swine, chicken: evaporative housing	Private
	Feed cost	Swine, cattle, chicken	Kasetsart University, Private
Harvest	Labor cost	Combine harvest (rice)	Private
		Combine harvest (sugar cane)	Private
		Combine harvest (tapioca)/ Knife (sugar cane)	Private
		Elevator (tapioca, sugar cane)	Private
Tillage	Labor cost	Parachute	Farmer
	Seed cost	Plough up and over rice stubble	Farmer

***Source*:** Nipon et al. (2010).

Table 3.6. Yield of Selected Crops (kg per rai)

	Rice	Maize	Cassava	Sugar cane	Rubber	Sorghum	Mungbean	Kenaf	Cotton	Oil Palm	Soybeans	Pineapple
1970	306	291	2,446	6,904	36	183	149	145	139		137	2,449
1971	300	361	2,250	7,640	39	258	156	145	141		151	2,276
1972	270	211	2,366	6,851	40	283	144	145	129		138	1,879
1973	285	326	2,080	8,396	43	252	131	173	157		136	2,606
1974	268	323	2,080	8,254	43	198	145	152	148		134	2,981
1975	275	349	2,180	7,541	40	188	118	151	153		154	3,361
1976	281	333	2,364	8,146	43	166	90	182	174		179	4,510
1977	247	223	2,237	8,366	46	118	76	153	172	659	101	3,886
1978	279	322	2,246	5,349	50	197	98	169	174	618	157	3,275
1979	267	300	2,100	6,445	56	169	95	156	190	506	150	4,593
1980	289	335	2,281	4,698	48	153	93	198	203	474	127	4,521
1981	296	352	2,235	6,781	51	156	93	175	182	540	165	3,762
1982	281	286	2,302	7,830	58	154	93	159	171	897	146	3,324
1983	312	337	2,220	6,696	59	197	95	147	188	910	176	2,495
1984	319	372	2,276	6,618	73	204	107	151	196	1,027	197	3,202
1985	320	399	2,087	7,318	79	209	94	170	239	1,382	203	3,160
1986	306	353	1,969	6,997	88	174	95	162	227	1,328	198	3,542
1987	305	254	2,217	7,256	98	173	92	159	217	1,268	149	3,751
1988	322	408	2,258	7,422	106	191	112	198	270	1,462	206	3,930
1989	320	393	2,394	8,870	120	197	111	191	2,441	1,674	210	3,775
1990	278	341	2,165	7,824	129	195	108	196	210	1,778	199	3,809
1991	342	411	2,114	8,309	136	203	110	204	207	1,563	200	3,773
1992	329	435	2,183	8,282	154	214	109	211	205	1,487	209	3,846
1993	311	398	2,220	6,430	161	190	108	220	203	1,884	197	3,969
1994	348	449	2,165	7,063	172	207	113	227	219	1,831	194	3,697

1995	348	498	2,004	8,594	176	219	107	234	222	2,016	205	3,615
1996	350	523	2,205	9,233	180	241	109	230	223	2,024	212	3,756
1997	367	439	2,287	8,932	182	231	111	227	222	1,900	218	3,888
1998	367	513	2,329	7,370	177	238	119	248	217	1,739	219	3,144
1999	375	555	2,293	8,777	179	259	124	256	214	2,236	220	3,825
2000	418	587	2,574	9,466	249	257	129	261	221	2,325	232	3,683
2001	443	597	2,805	9,042	268	270	129	268	213	2,699	236	3,618
2002	464	594	2,731	9,496	271	286	127	270	200	2,434	238	3,501
2003	464	616	3,087	10,429	286	295	123	259	227	2,725	246	3,733
2004	457	617	3,244	9,269	291	261	121	238	215	2,682	238	3,777
2005	474	611	2,749	7,434	282	298	117	240	189	2,469	250	3,557
2006	467	630	3,375	7,899	282	251	124	259	204	2,827	250	4,280
2007	481	629	3,668	10,194	274	281	128	287	206	2,399	255	3,702
2008	474	652	3,401	11,157	278	268	118	325	233	3,214	256	3,915
2009	460	668	3,628	11,094	266		120			2,560	254	3,344

***Source*: OAE**

Table 3.7. Profitability of Crops Produced under Contract Farming System

Table 3.7-a. Farmers in Chiang Mai, 1994/95

Net revenue (baht/rai/month), contract farmers, 1995/96	**Profit (baht/rai/month) of alternative crops, independent farmers, 1994/95**			
Cotton 875	Cotton 358	Maize 548	Major rice 253	Soybeans 348
Japonica Rice 400	-	-	Major rice 253	Soybeans 348
Green Soybeans 3,500	-	-	Major rice 253	Soybeans 348
Potatoes 4,333	Potatoes 1,084	-	Major rice 253	Soybeans 348
Tomatoes 3,333	Tomatoes 2,880	-	Major rice 253	Soybeans 348

Table 3.7-b. Farmers in Sakaew Province, 2003

Net Income (baht/rai/crop), contract farmers, 2003	**Profit (baht/rai/crop) of crops produced by independent farmers**			
Asparagus 49,916	Tapioca 1,243	Maize 958	Rice 691	-

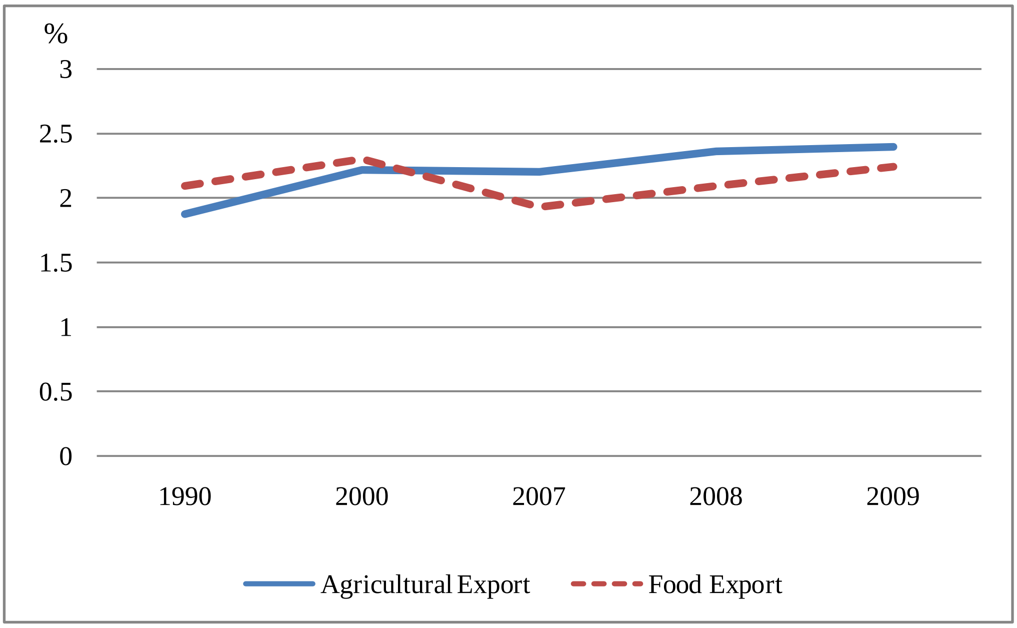
Source: (A) TDRI (1996, 6); (B) Paichayon Uathavikul (2004)

Table 3.8 Technology Upgrading in the Food Industry

Technology	Chicken	Fishery	Swine/dory	Rice	Sugar	Vegetables	Corn
1. Hardware							
- Breeding	hybrid	-	heat-tolerant	hybrid	HYV	seeds	hybrid seeds
- Reproduction		shrimp	AI				
- cultivation							
- Peed	improved	improved	improved				
- Housing	- evaporative - closed system	- closed system	evaporative			- hydroponic farm	
- factory/farm	- sealing up	- sealing up	scaling up		scaling up		
- mechanization	/	-	/	/	/	-	-
2. Software-management							
- GAP, GMP	/	/	/	organic	/	organic	- feed factory
- QCC/HACCP	/	/	/	-	-	/	-
- biosafety / traceability	/	/	/	-	-	/	-
- raw materials	contract & owned farm - skilled workers	- trust & owned farm	- scaling-up collecting station	-	CCS	/ (canned pineapple)	-
- logistics handling		- major implement			- handling station	major improvement	
- procurement/ standards	/	/	/	/	/	/	-
by supermarket	(brands)	(brands)	(brands)	-	-	(brands)	
- product development	- ready-to-eat	- ready-to-eat	- new production	organic	-	organic	-
- package	/	patsy	/	- small package		/	-
3. Market strategy							
- Brands		- buying brand	-				
- alliance partner	/	/	-	-	/	-	-
abroad	(China)	(china)			(Australia)		

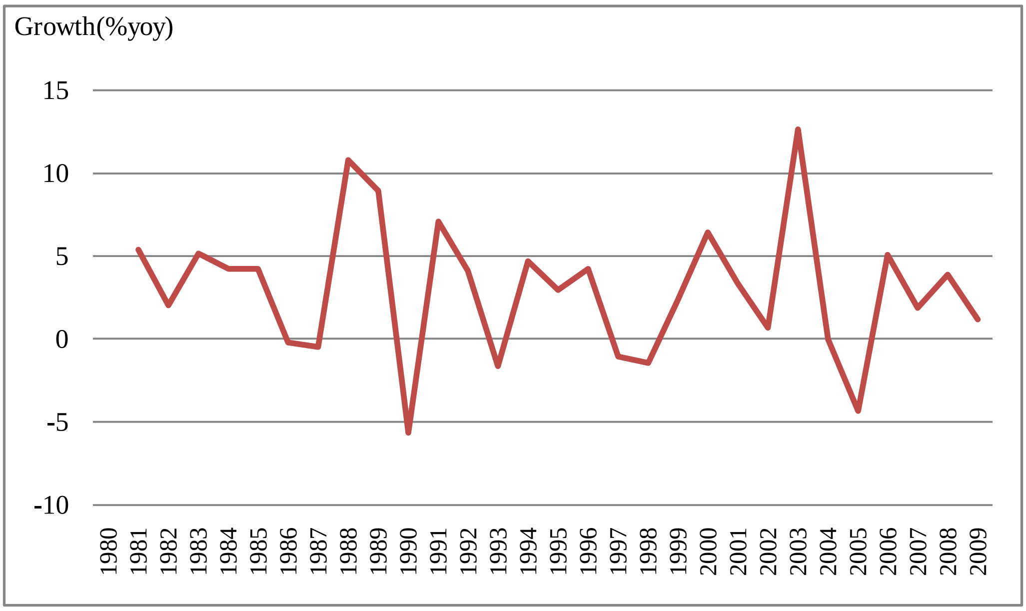
***Sources*:** Achanun (2006); Patarapong (2010); Bhanupong (2007); Poapongsakorn et al. (2010).

Figure 1.1. Market share in the world



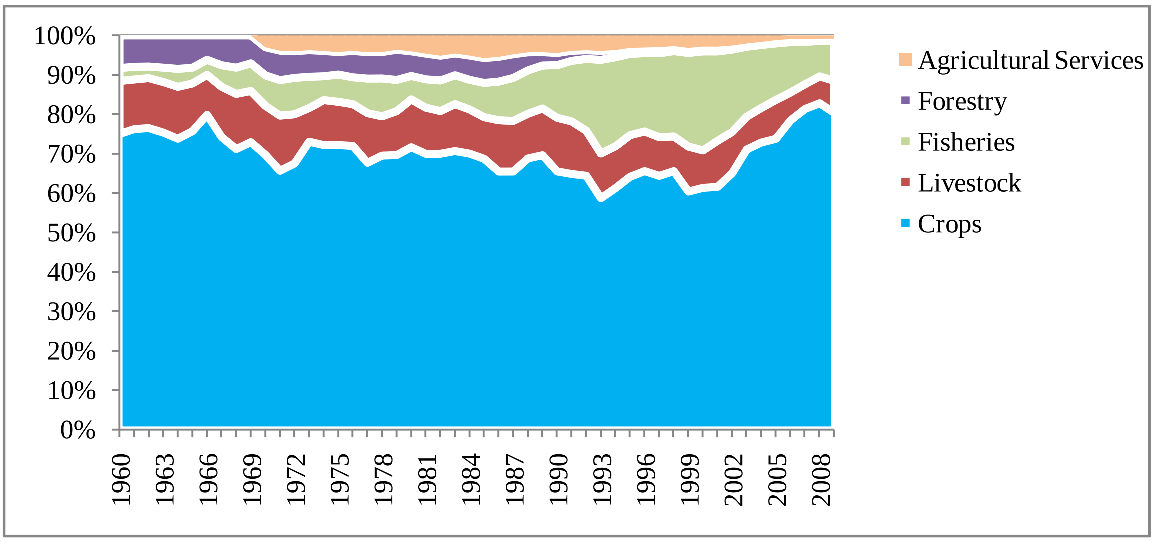
Source: WTO (2010).

Figure 2.1. Annual growth rate in agricultural GDP



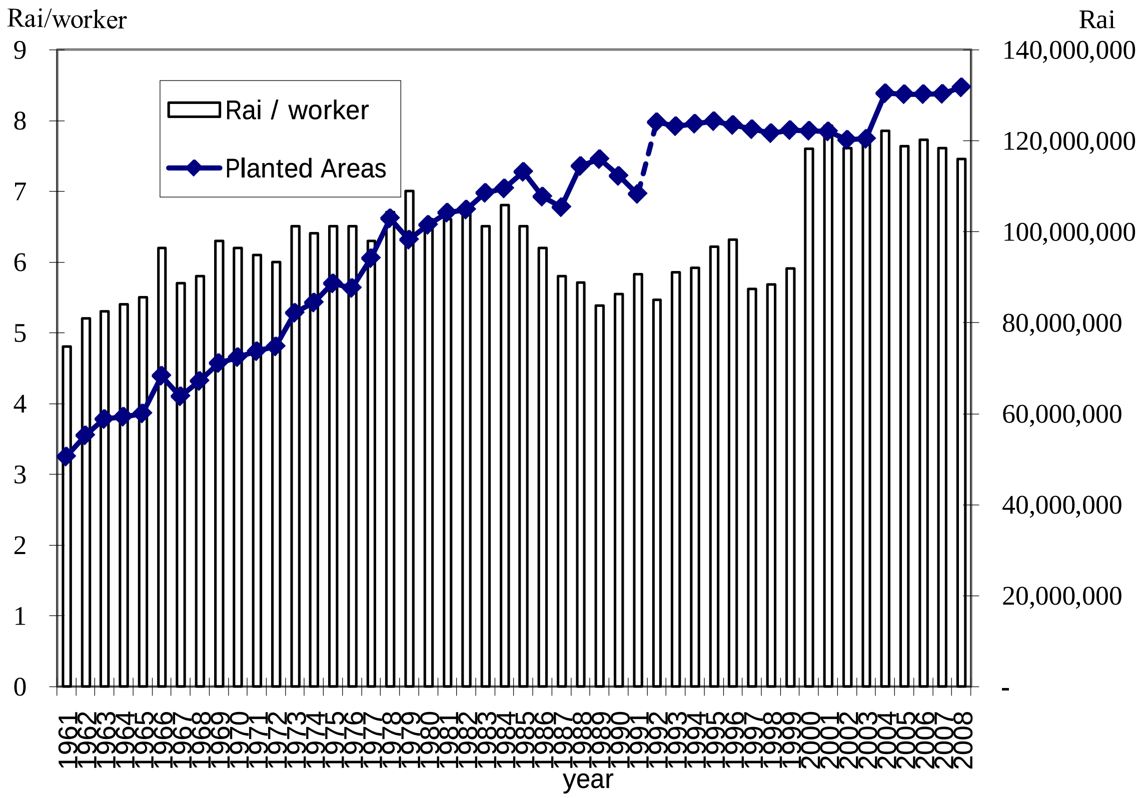
Source: Calculated from NESDB, National Income

Figure 2.2. Share of agricultural subsectors



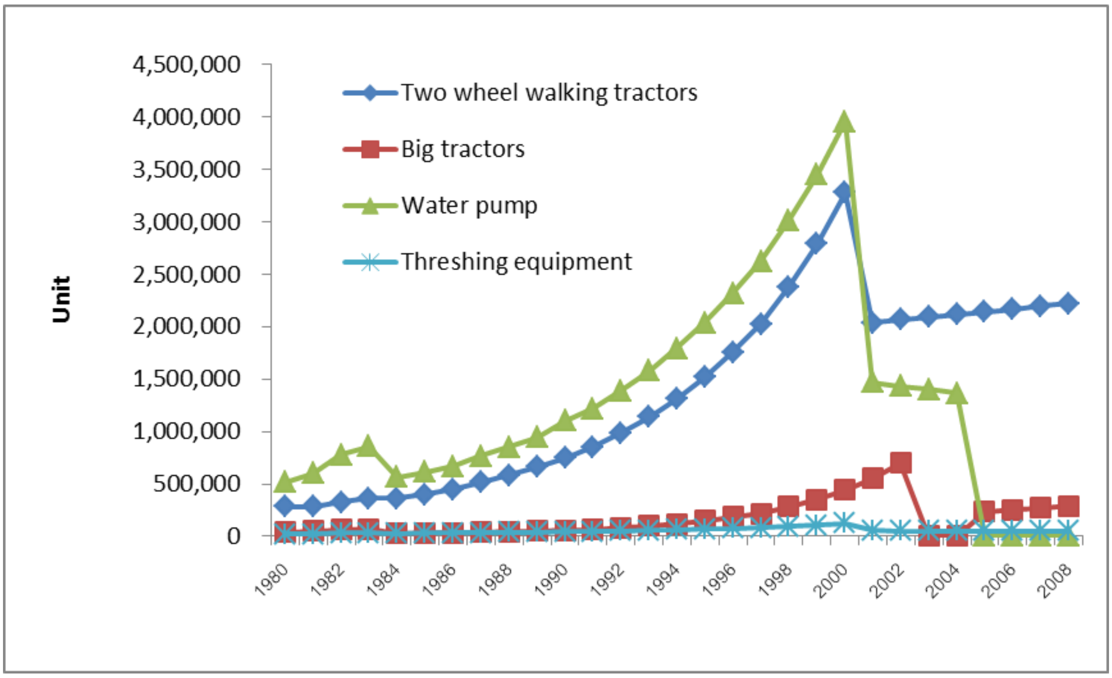
Source: Calculated from NESDB, National Income

Figure 2.3. Planted areas and area per worker



Sources: Office of Agricultural Economics; National Statistical Office Labor Force Survey

Figure 2.4. Investments in agricultural equipment and machinery



Source: Office of Agricultural Economics, Ministry of Agriculture & Cooperatives

: FAO Statistics Division 2011

Note : Two-wheel walking tractors 1980-2002, calculated from OAE

Big tractors 1980—1999, calculated from OAE

Water pump and threshing equipment 1980—2004, calculated from OAE

Two-wheel walking tractors 2003—2008, estimated by FAO

Big tractors 2000—2008, estimated by FAO

Water pump and threshing equipment 2005—2008, estimated by FAO

Table 4.1. Public Research and Extension Budget by Agency and Research Intensity

Year	DOAE	Agricultural research department					Other agricultural research department					Total (Ex. DOAE)		Research Intensity %
		DOA	RD	DLD	DOF	Subtotal	NSTDA	TRF	NRCT	ARDA	Subtotal	Nominal	at 1988 price	
1961	n.a.	26.2	21.6	21.8	8.6	78.3	n.a.	n.a.	n.a.	n.a.	n.a.	78.3		
1962	n.a.	40.3	32.1	34.0	23.0	129.4	n.a.	n.a.	n.a.	n.a.	n.a.	129.4		
1963	n.a.	43.3	36.1	40.6	28.7	148.7	n.a.	n.a.	n.a.	n.a.	n.a.	148.7		
1964	n.a.	49.9	44.0	40.9	37.9	172.7	n.a.	n.a.	n.a.	n.a.	n.a.	172.7		
1965	n.a.	56.3	50.3	45.5	30.6	182.7	n.a.	n.a.	n.a.	n.a.	n.a.	182.7	608.3	
1966	n.a.	77.2	83.6	60.5	42.9	264.2	n.a.	n.a.	n.a.	n.a.	n.a.	264.2	812.4	
1967	n.a.	102.0	81.3	79.2	55.9	318.5	n.a.	n.a.	n.a.	n.a.	n.a.	318.5	996.2	
1968	n.a.	116.1	95.8	82.9	60.5	355.3	n.a.	n.a.	n.a.	n.a.	n.a.	355.3	1,114.1	
1969	n.a.	92.1	52.2	86.8	71.0	302.0	n.a.	n.a.	n.a.	n.a.	n.a.	302.0	916.2	
1970	95.3	104.3	52.3	88.8	60.8	306.1	n.a.	n.a.	n.a.	n.a.	n.a.	306.1	977.7	
1971	124.0	106.4	52.4	87.4	58.3	304.5	n.a.	n.a.	n.a.	n.a.	n.a.	304.5	980.3	0.39
1972	123.0	107.7	53.8	91.0	56.9	309.3	n.a.	n.a.	n.a.	n.a.	n.a.	309.3	936.5	0.31
1973	143.6	173.8	n.a.	118.4	68.5	360.8	n.a.	n.a.	n.a.	n.a.	n.a.	360.8	921.9	0.24
1974	157.1	189.4	n.a.	123.6	82.9	395.9	n.a.	n.a.	n.a.	n.a.	n.a.	395.9	840.9	0.20
1975	231.8	271.2	n.a.	177.0	137.7	586.0	n.a.	n.a.	n.a.	n.a.	n.a.	586.0	1,202.7	0.27
1976	278.8	318.1	n.a.	210.5	177.5	706.1	n.a.	n.a.	n.a.	n.a.	n.a.	706.1	1,386.7	0.29
1977	402.3	342.9	n.a.	264.7	179.3	786.9	n.a.	n.a.	n.a.	n.a.	n.a.	786.9	1,457.8	0.29
1978	480.6	352.2	n.a.	286.2	190.2	828.5	n.a.	n.a.	n.a.	n.a.	n.a.	828.5	1,399.3	0.26
1979	535.7	378.2	n.a.	294.2	212.6	885.0	n.a.	n.a.	n.a.	n.a.	n.a.	885.0	1,375.7	0.25
1980	743.9	432.5	n.a.	360.2	243.2	1,035.9	n.a.	n.a.	n.a.	n.a.	n.a.	1,035.9	1,428.8	0.24
1981	917.5	515.4	n.a.	438.6	300.5	1,254.4	n.a.	n.a.	n.a.	n.a.	n.a.	1,254.4	1,596.5	0.27
1982	1,020.5	583.4	n.a.	501.1	371.1	1,455.6	n.a.	n.a.	n.a.	n.a.	n.a.	1,455.6	1,763.3	0.35
1983	1,215.9	719.8	n.a.	615.7	532.9	1,868.4	n.a.	n.a.	n.a.	n.a.	n.a.	1,868.4	2,183.8	0.41
1984	1,340.8	776.5	n.a.	685.7	585.8	2,048.0	n.a.	n.a.	n.a.	n.a.	n.a.	2,048.0	2,359.4	0.49
1985	1,627.1	797.3	n.a.	784.1	658.2	2,239.7	n.a.	n.a.	n.a.	n.a.	n.a.	2,239.7	2,525.3	0.59
1986	1,530.4	845.8	n.a.	814.2	719.8	2,379.8	n.a.	n.a.	n.a.	n.a.	n.a.	2,379.8	2,639.9	0.59
1987	1,355.9	849.7	n.a.	837.4	671.9	2,359.1	n.a.	n.a.	n.a.	n.a.	n.a.	2,359.1	2,498.8	0.54

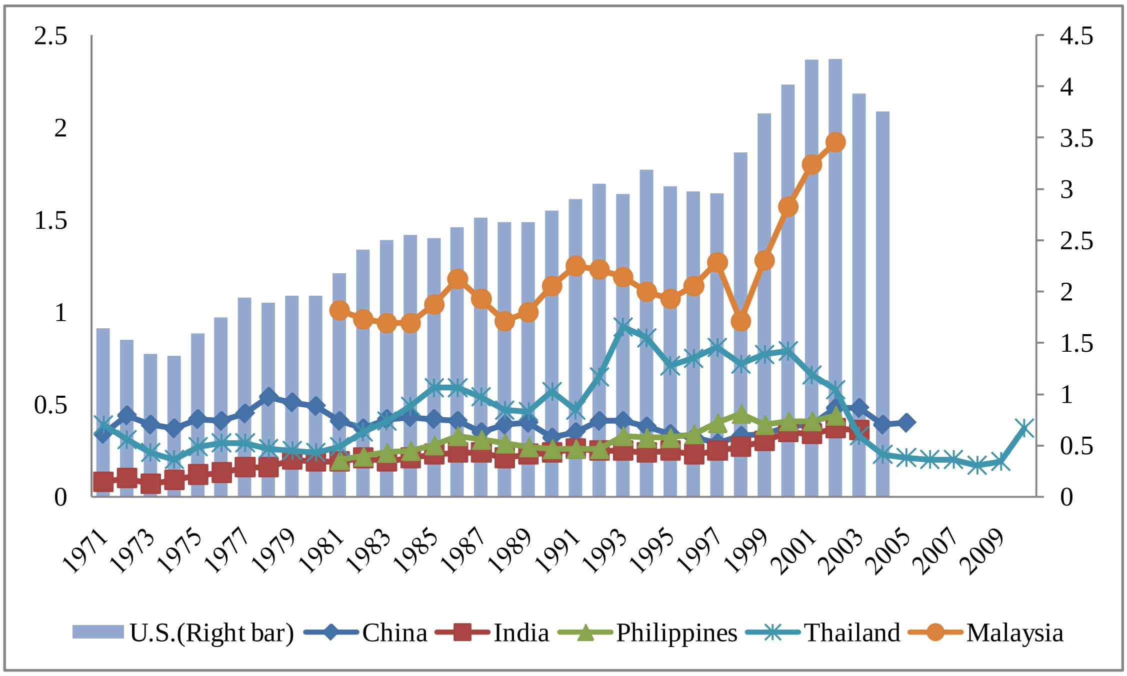
Year	DOAE	Agricultural research department					Other agricultural research department					Total (Ex. DOAE)		Research Intensity %
		DOA	RD	DLD	DOF	Subtotal	NSTDA	TRF	NRCT	ARDA	Subtotal	Nominal	at 1988 price	
1988	1,391.8	979.7	n.a.	1,065.3	735.4	2,780.3	n.a.	n.a.	n.a.	n.a.	n.a.	2,780.3	2,780.3	0.47
1989	1,494.8	1,049.7	n.a.	1,070.6	828.5	2,948.7	n.a.	n.a.	n.a.	n.a.	n.a.	2,948.7	2,778.6	0.46
1990	1,848.4	1,246.4	n.a.	1,415.9	1,486.3	4,148.5	n.a.	n.a.	n.a.	n.a.	n.a.	4,148.5	3,696.1	0.57
1991	2,526.2	1,564.2	n.a.	1,959.9	1,946.0	5,470.1	n.a.	n.a.	n.a.	n.a.	n.a.	5,470.1	4,608.7	0.47
1992	3,042.3	1,768.4	n.a.	1,985.2	2,478.2	6,231.8	n.a.	n.a.	n.a.	n.a.	n.a.	6,231.8	5,024.8	0.65
1993	4,048.3	2,197.0	n.a.	2,735.3	2,717.1	7,649.4	n.a.	n.a.	n.a.	n.a.	n.a.	7,649.4	5,971.4	0.92
1994	4,683.3	2,468.7	n.a.	2,963.0	2,719.4	8,151.0	n.a.	n.a.	n.a.	n.a.	n.a.	8,151.0	6,048.0	0.86
1995	5,460.8	2,534.3	n.a.	3,357.5	3,091.3	8,983.1	n.a.	n.a.	n.a.	n.a.	n.a.	8,983.1	6,312.6	0.71
1996	6,407.5	3,105.4	n.a.	3,799.6	3,412.5	10,317.5	n.a.	n.a.	n.a.	n.a.	n.a.	10,317.5	6,970.8	0.75
1997	6,756.4	3,301.6	n.a.	3,698.6	3,872.6	10,872.8	n.a.	n.a.	n.a.	n.a.	n.a.	10,872.8	7,059.1	0.81
1998	5,306.7	3,051.5	n.a.	3,164.7	3,315.6	9,531.8	n.a.	n.a.	n.a.	n.a.	n.a.	9,531.8	5,665.1	0.58
1999	5,380.1	3,165.1	n.a.	2,861.1	3,368.4	9,394.6	n.a.	n.a.	n.a.	n.a.	n.a.	9,394.6	5,818.5	0.65
2000	5,682.2	3,237.7	n.a.	2,848.9	3,120.3	9,206.9	n.a.	n.a.	n.a.	n.a.	n.a.	9,206.9	5,626.6	0.65
2001	5,591.1	3,190.7	n.a.	2,832.3	3,088.5	9,111.5	n.a.	n.a.	n.a.	n.a.	n.a.	9,111.5	5,455.4	0.60
2002	5,452.5	3,092.9	n.a.	2,583.4	3,302.4	8,978.6	n.a.	n.a.	n.a.	n.a.	n.a.	8,978.6	5,332.2	0.52
2003	4,962.9	2,867.0	n.a.	2,826.6	2,443.4	8,137.0	n.a.	n.a.	n.a.	n.a.	n.a.	8,137.0	4,769.1	0.39
2004	4,602.7	2,971.4	n.a.	3,052.7	2,496.6	8,520.6	n.a.	n.a.	n.a.	n.a.	n.a.	8,520.6	4,842.6	0.35
2005	4,339.6	2,838.7	n.a.	3,011.3	2,664.4	8,514.4	n.a.	n.a.	n.a.	n.a.	n.a.	8,514.4	4,631.2	0.31
2006	4,144.7	3,215.6	n.a.	4,012.6	2,699.2	9,927.3	n.a.	102.9	n.a.	n.a.	102.9	10,030.2	5,183.0	0.39
2007	4,186.1	2,946.3	815.4	6,445.5	2,872.9	13,080.0	n.a.	270.0	n.a.	n.a.	270.0	13,350.0	6,661.9	0.45
2008	4,338.7	2,969.7	1,050.4	4,264.0	2,804.3	11,088.4	n.a.	115.7	n.a.	n.a.	115.7	11,204.1	5,384.3	0.33
2009	4,756.6	3,308.5	1,413.6	4,705.2	3,081.8	12,509.1	635.0	364.0	125.4	102.8	1,227.2	13,736.3	6,601.2	0.37

Table 4.2. Agricultural Research Expenditure by Crops, 2007/10

Product	Output value		No. of Project	Budget		Budget/Project (Million baht)	Intensity (%)
	Million baht	%		Million baht	%		
Pulp and paper	715,823	41.9	52	12.3	0.6	0.24	0.002
Rice	364,031	21.3	588	740.4	34.3	1.26	0.20
Natural rubber	165,661	9.7	273	241.7	11.2	0.89	0.15
Chicken	76,499	4.5	51	28.6	1.3	0.56	0.04
Sugarcane	62,916	3.7	106	111.1	5.2	1.05	0.18
Cassava	62,324	3.7	101	99.3	4.6	0.98	0.16
Shrimp	53,842	3.2	178	125.5	5.8	0.71	0.23
Pig	49,369	2.9	110	120.4	5.6	1.09	0.24
Beef	27,144	1.6	144	204.2	9.5	1.42	0.75
Maize	25,321	1.5	85	37.1	1.7	0.44	0.15
Pineapple	24,544	1.4	36	24.9	1.2	0.69	0.10
Dairy cattle	18,523	1.1	138	70.3	3.3	0.51	0.38
Chili	18,106	1.1	88	73.5	3.4	0.84	0.41
Durian	12,824	0.8	29	22.9	1.1	0.79	0.18
Palm oil	9,783	0.6	106	137.3	6.4	1.30	1.40
Garlic	7,535	0.4	4	1.1	0.1	0.28	0.01
Longan	7,276	0.4	54	30.0	1.4	0.56	0.41
Orchid	5,897	0.3	59	76.2	3.5	1.29	1.29
Total	1,707,418	100.0	2,202	2,157.0	100.0	0.98	0.13

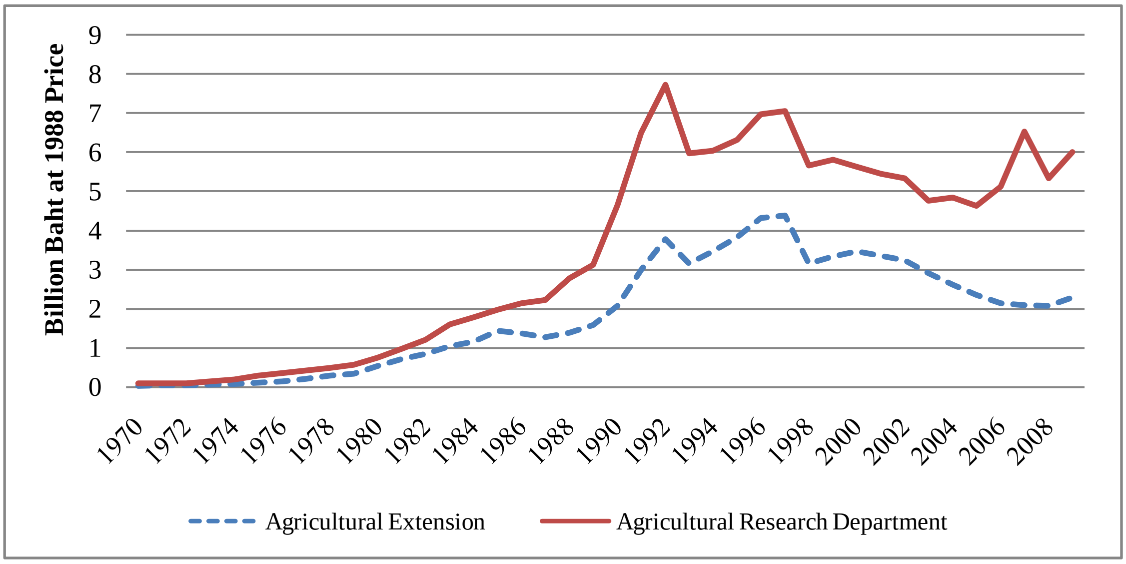
***Source*:** Pongtep et al. (2010).

Figure 4.1. Agricultural research intensity in selected countries



Source: Waleerat (2009) and ASTI database.

Figure 4.2. DOAE's extension and research budgets for four research departments in MOAC (at 1988 price)



***Source*:** Bureau of the Budget

Figure 4.3-a. Number of Thai researchers by fields of research

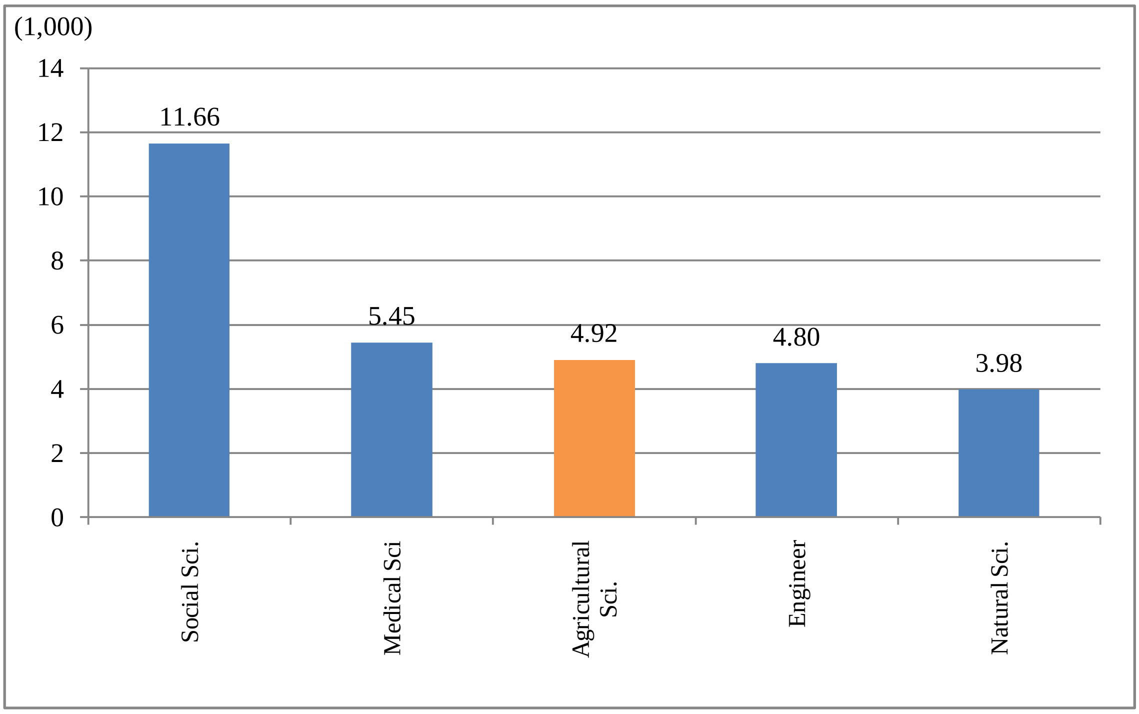
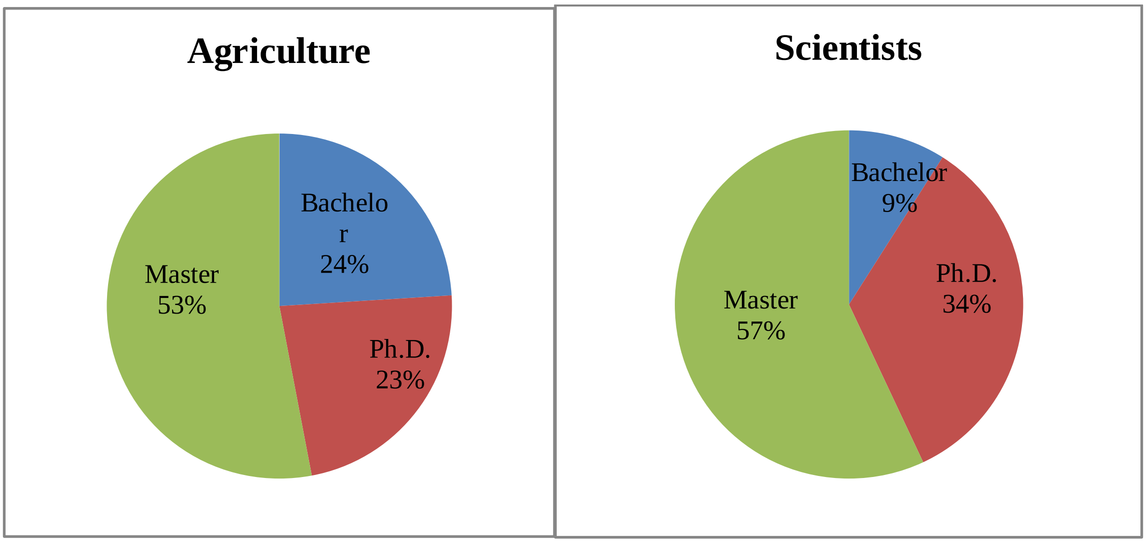
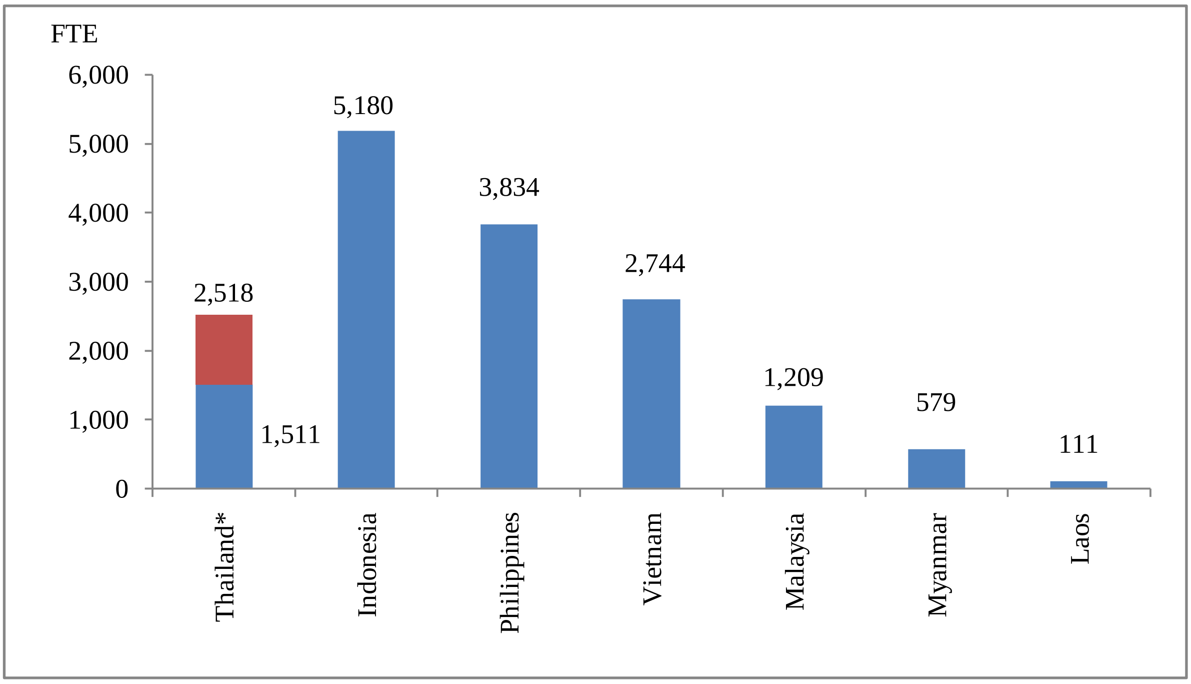


Figure 4.3-b. Educational qualifications of agricultural researchers and natural scientists



Source: Survey of research expenditure and research personnel 2008, National Research Council

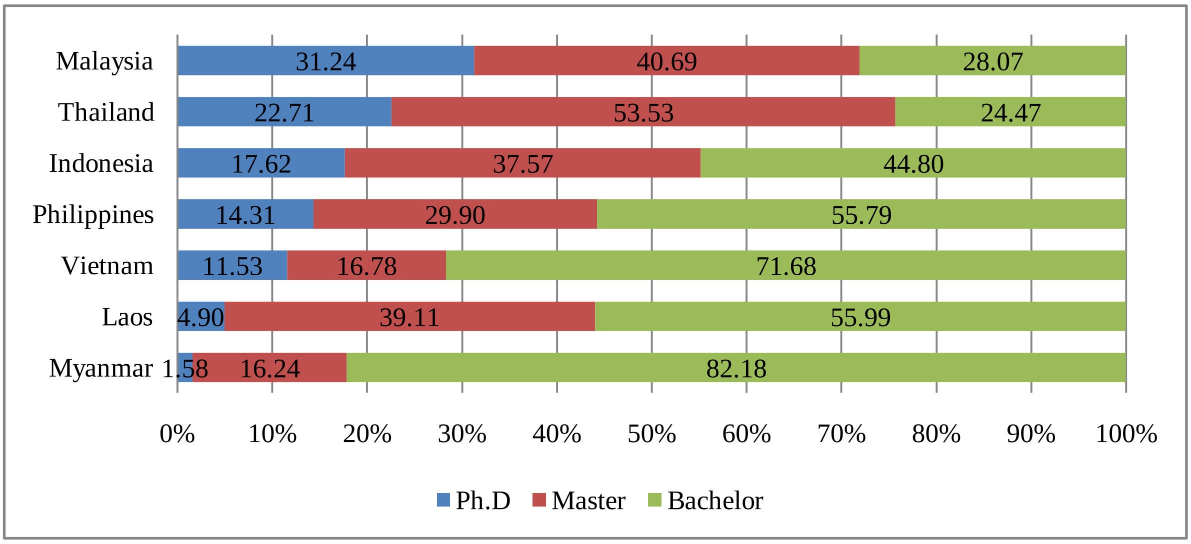
Figure 4.4-a. Number of agricultural researchers in ASEAN countries



Source: Office of the National Research Council of Thailand and Reitzer et al. (2009).

Note: *Thailand FTE calculated from 30 percent and 50 percent of number of researchers.

Figure 4.4-b. Educational qualification of agricultural researchers



Source: Office of the National Research Council of Thailand and Reitzer et al. (2009).

Chapter 10

Agricultural Development and Rural Transformation: The Case of Vietnam

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CHAPTER 10

Agricultural Development and Rural Transformation: The Case of Vietnam[1]

Nguyen Anh Duong and Vo Tri Thanh

Central Institute for Economic Management

1. Introduction

Vietnam embarked on agricultural and rural reforms even before the beginning of the Doi Moi (Renovation) in 1986. Prior to the 1980s, the country basically followed a centrally planned economy with key characteristics of, among others: (1) state or collective ownership of all production means, including those in agriculture; (2) government-administered supply of physical inputs and outputs; and (3) absence of factor markets, highly regulated goods, and services markets.[2] Poor incentives and restricted information flow then led to heavy distortion of resource allocation (Vo and Nguyen 2006). While ensuring the contribution of output to the State, the cooperatives failed to meet half of members' demand.[3] Facing an economic crisis and severe shortage of food, Vietnam then had to carry out reforms in the early 1980s but only at the micro level. Among the reform measures were agricultural reforms, including "illicit contracting" and the introduction of a contract system in January 1981.

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[1] Paper prepared for the ERIA Project on *"Agricultural Development, Trade, and Regional Cooperation in an Integrating and Industrializing East Asia."* The views and opinions expressed in this paper are solely of the authors and may not necessarily reflect those of the ERIA or the Central Institute for Economic Management. The authors benefited a great deal from the suggestions and comments of Dr. Ponciano S. Intal and of the participants at the two ERIA workshops under this Project. All the remaining errors belong to the authors.

[2] For further references, see Vo and Nguyen 2006, Dinh et al. 2009, and Vo 2009.

[3] See Ministry of Agriculture and Rural Development (MARD 2004) for further details.

Yet these reforms merely followed a "bottom-up" approach.[4] Gradual reforms towards marketization of agricultural products in the 1980s brought about some success, with significant growth in output. Simultaneously, Vietnam saw the development of a two-tier price system in the context of goods scarcity that aggravated inflationary pressures (Pham 2006). Accordingly, output in general and agricultural products in particular moved away from the fixed-price central planning channels to the free market for trading at higher prices. Following drastic and successive attempts to equalize planned and market prices, the latter surged above the new official prices. Therefore, the attempts failed to produce the desired outcomes in terms of price control and resource allocation.

The year 1986 marked a major breakthrough in economic reforms as Vietnam publicly rejected the rationale behind the central planning model and declared its intention to transform itself into some kind of mixed-market economy. Since then, various market-oriented reforms have been undertaken, all aimed at stabilizing and opening the economy and enhancing freedom of choice for all economic units. Among the measures implemented were agricultural reforms where (1) households replaced cooperatives as the basic decision-making unit in production; (2) farm families received security of tenure; (3) domestic trade barriers were removed; and (4) a more open economy was created.

Following the passage of Resolution 10 NQ/TW in April 1988, various new policies on agriculture have been implemented, thereby empowering farmers to manage main production materials and their products and to take the initiative in implementing production proceedings. This autonomy induced them to exert greater effort in, and bind themselves more closely with, agricultural production. Fundamentally, therefore, production relations changed as management was transferred from cooperatives and production teams to farm households in line with the change in the distribution of output. Households can now take over the management of land and main production materials and are directly involved in product distribution. Moreover, Vietnam has abandoned the food-procurement-at-the-lowest-price strategy and has started applying the market-price mechanism. Consequently, farmers now have even greater incentive to engage in agricultural production, and outputs have risen even though investment in agriculture contracted in real terms.

In recent years, the emphasis on agricultural and rural development has been even greater as Vietnam recognized the importance of such development in accelerating the pace of poverty

[4] For instance, till 1984, the State still retained monopoly over essential products (MARD 2004).

reduction. The incorporation of agricultural and rural development into the measures set out in the country's Comprehensive Poverty Reduction and Growth Strategy reflects such emphasis. Also, in line with the Socio-Economic Development Strategy for 2001—2010, Vietnam sought to accelerate the industrialization and modernization of agriculture and rural areas by establishing an extensive market for agricultural commodities, applying scientific and technological advances in agricultural production, and relying to a larger extent on improving labor productivity and product competitiveness. At the same time, the government increased investment in agricultural and rural infrastructure while encouraging investment in the processing of agricultural products.

Together with agricultural reforms, Vietnam's proactive efforts at international economic integration enhanced the opportunities for agricultural development. Apart from numerous bilateral trade agreements (BTAs), the country joined the Association of Southeast Asian Nations (ASEAN) and the associated ASEAN Free Trade Area (AFTA) in 1995 before joining the Asia Pacific Economic Cooperation (APEC) forum in 1998. The economic integration process was accelerated after 2000 with the forging of the country's first and most comprehensive BTA with the United States and various multilateral free trade agreements (FTAs) within the ASEAN framework (e.g., ASEAN-China FTA, ASEAN-Korea FTA, ASEAN-Australia-New Zealand FTA, ASEAN-Japan Comprehensive Economic Partnership, and ASEAN-India FTA). Accordingly, market access has been significantly expanded for Vietnam's agricultural products.

To further modernize agriculture and simultaneously to develop rural areas, the Central Committee of the Communist Party of Vietnam (CPV) issued Resolution No. 26-NQ/TW (hereinafter referred to as Resolution 26) in 2008. This resolution reaffirms the important roles of agriculture, farmers, and rural areas in Vietnam's socioeconomic development process. The resolution also emphasizes that issues related to their development must be addressed simultaneously rather than separately. On that basis, the government recently issued Resolution No. 24/2008/NQ-CP dated October 28, 2010, with an action plan to implement Resolution 26. Specifically, the action plan aims to: (1) build a modern and large-scale agricultural sector characterized by high productivity, quality, efficiency, and competitiveness; (2) develop infrastructure and human resources for rural areas; and (3) improve the material and physical life of people in the rural areas, particularly those beset by difficulties, and facilitate their participation in, and benefits from, the industrialization and modernization process.

While conforming with the Socio-Economic Development Strategy for 2001—2010, the resolutions mentioned above incorporate new substances that prove important in the context of the global financial crisis of 2007—2008 and the domestic economic downturn in 2009. On the one hand, the crisis triggered economic recession in Vietnam's major trade partners, thereby decreasing the demand for the country's agricultural exports. This, in turn, affected the livelihood of farmers who supplied agricultural exports or who supplied agricultural inputs to other export enterprises. On the other hand, the decrease in import demand from trade partners also led to the contraction of production activities in the country's industrial zones and export processing zones. Many of the laid-off workers then had to return to work in agriculture. In this respect, agriculture played a role in ensuring social stability during the economic downturn. Reviewing the roles of agriculture and rural areas in Vietnam thus becomes even more important, particularly in the context of Vietnam's industrialization process, to help alleviate the weakness of the sector and to ensure that economic growth is inclusive for rural households as well.

This paper attempts to looks into the extent and sustainability of agricultural development and determine if it is accompanied by rural transformation in Vietnam. In doing so, the paper narrows its scope of analysis to changes in output and export of agricultural products, value-added content, employment, and income—both over time and relative to gross domestic product (GDP). The paper also investigates the patterns of agricultural output at a more disaggregated level to extract evidence of agricultural and rural diversification in Vietnam. Due to the lack of sufficiently detailed data, this paper focuses mainly on the period starting 2000, though earlier available data can be employed. On that basis, the paper discusses some impediments to the further diversification of agriculture and rural areas and makes several policy recommendations as to how such a process can be accelerated.

Apart from the introduction, the remainder of the paper is structured as follows. Section II provides an overview of the performance of Vietnam's agricultural sector. Section III then elaborates on different aspects of agricultural and rural transformation in Vietnam. Finally, Section IV concludes the paper with some policy recommendations for agricultural development in general and rural diversification in particular.

2. An overview of Vietnam's agricultural performance

This section attempts to analyze Vietnam's agricultural performance, with emphasis on the period starting 2000 to date. The section narrows its focus to the agriculture-forestry-fishery sectors. Several aspects under investigation include growth rates and shares of these sectors in Vietnam's GDP and trade and the value-added content of some subsectors. In addition, the section discusses the changes in agricultural employment and labor productivity before decomposing agricultural growth to identify the sources of agricultural growth in 1990—2007.

Production pattern of agriculture-forestry-fishery

Table 1 shows the growth patterns of the agriculture-forestry-fishery sectors over the period 2001—2010. Among the three sectors, the fishery sector has always exhibited the highest growth rate. Its average growth rate over the period 2000—2010 was almost 7.6 percent per annum while the growth rates of agriculture and forestry reached only about 3 percent per annum and 1.5 percent per annum, respectively. However, the growth rate of the fishery sector tended to decrease over time, from over 11.5 percent in 2001 to just under 4.3 percent in 2009 and then to 4.4 percent in 2010. The growth rate of the agriculture sector fluctuated between 2 percent and 3.9 percent in the period 2001—2008, went further down to 1.3 percent in 2009 before recovering to 2.4 percent in 2010. Meanwhile, the forestry sector appeared to grow more rapidly, by nearly 3.5 percent in 2009 and 3.9 percent in 2010 relative to just under 0.5 percent in 2001. Overall, as agriculture attained the highest share among the three sectors (Table 2), the agriculture-forestry-fishery sectors as a whole experienced continuous growth but the growth rate varied markedly in the range of 3 percent to 4.2 percent in 2001—2008 and dropped to only 1.8 percent in 2009. Except for the forestry sector, agriculture and fishery experienced slower growth in 2009 due to a contraction in key export markets and a decline in international prices. In 2010, the agriculture-forestry-fishery sectors started to grow faster (at 2.8 percent), driven by a recovery in the growth of all subsectors.

Table 1. Growth Rates of the Agriculture, Forestry, and Fishery Sectors Relative to GDP, 2001—2010* (in %)

No.		*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*Average*
	Overall	**6.89**	**7.08**	**7.34**	**7.79**	**8.44**	**8.23**	**8.46**	**6.18**	**5.32**	**6.78**	**7.25**
	Agriculture-Forestry-Fishery	2.98	4.17	3.62	4.36	4.02	3.69	3.76	4.07	1.83	2.78	3.52
1	*Agriculture*	*2.05*	*4.13*	*3.19*	*3.92*	*3.16*	*3.13*	*2.72*	*3.93*	*1.32*	*2.43*	*3.00*
2	*Forestry*	*0.48*	*0.46*	*0.82*	*0.82*	*0.95*	*1.36*	*1.39*	*1.35*	*3.47*	*3.91*	*1.49*
3	*Fishery*	*11.51*	*5.67*	*7.69*	*8.53*	*10.66*	*7.77*	*10.57*	*5.44*	*4.28*	*4.38*	*7.62*
	Industry-Construction	10.39	9.48	10.48	10.22	10.69	10.38	10.22	6.11	5.52	7.7	9.10
	Services	6.10	6.54	6.45	7.26	8.48	8.29	8.85	7.18	6.63	7.52	7.33

***Source*:** Authors' calculation from data from the General Statistics Office (GSO).

***Note*:** * Based on values at comparable prices (1994 prices)

Table 2. Contributions of the Agriculture, Forestry, and Fishery Sectors to GDP, 2000—2009* (in %)

No.		**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**
	Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
	Agriculture-Forestry-Fishery	**24.53**	**23.24**	**23.03**	**22.54**	**21.81**	**20.97**	**20.40**	**20.34**	**22.10**	**20.66**	**20.58**
1	*Agriculture*	*19.82*	*18.26*	*18.02*	*17.53*	*16.99*	*16.17*	*15.66*	*15.58*	*17.41*	*16.14*	*16.11*
2	*Forestry*	*1.34*	*1.27*	*1.21*	*1.08*	*0.97*	*0.87*	*0.81*	*0.72*	*0.73*	*0.77*	*0.73*
3	*Fishery*	*3.38*	*3.72*	*3.80*	*3.93*	*3.84*	*3.93*	*3.93*	*4.03*	*3.95*	*3.75*	*3.74*
	Industry-Construction	**36.73**	**38.13**	**38.49**	**39.47**	**40.21**	**41.02**	**41.54**	**41.48**	**39.73**	**40.24**	**41.09**
	Services	**38.73**	**38.63**	**38.48**	**37.99**	**37.98**	**38.01**	**38.06**	**38.18**	**38.17**	**39.10**	**38.33**

***Source*:** Authors' calculation from GSO data.

***Note*:** * Based on values at current prices

Table 2 shows the shares of the agriculture-forestry-fishery sectors in Vietnam's GDP during the period 2000—2010. The growth patterns indicate that the share of the fishery sector in GDP went up steadily from 3.4 percent in 2000 to 4 percent in 2007 before decreasing to 3.8 percent in 2009 and then to 3.7 percent in 2010. The forestry sector's contribution to GDP fell almost continuously from over 1.3 percent to over 0.7 percent in the period 2000—2010. The share of the agriculture sector went down from 19.8 percent in 2000 to 15.6 percent in 2007 and then rose steadily to over 17.4 percent in 2008 before dropping again to 16.1 percent in 2010. Altogether, the share of the agriculture-forestry-fishery sectors contracted from over 24.5 percent to 20.3 percent in 2007, jumped to 22.1 percent in 2008, and then slid back down to 20.7 percent in 2009. This decline was not due to the contraction of the agriculture-forestry-fishery sectors in absolute terms. It could be attributed instead to the more rapid growth of the industry-construction and services sectors in Vietnam (Table 1). Table 3 presents the growth rates of some cropping subcategories from 1995—2009. The growth rate of food fluctuated before reaching 7.6 percent in 2008; its growth rate in 1995 was 3.6 percent. Meanwhile, the growth rate of fruit trees varied with even larger amplitude, starting with 3 percent in 1995 and ending with 6.7 percent in 2008. Meanwhile, the growth rates of vegetables and beans and industrial crops exhibited a distinct downward trend in 1995—2008, from 26.3 percent to 4 percent for vegetables and beans and from 18 percent to 7 percent for industrial crops. Most of the subcategories, except for fruit trees, experienced reduced growth rates in the years 2001—2009 compared to 1994—2000. For all the subcategories, however, the growth rate became significantly smaller in 2009 as a consequence of the global financial crisis and economic recession. The growth rates of food and industrial crops even failed to reach 1 percent during that year.

Table 3. Growth Rates of Some Cropping Subcategories* (in %)

	1995	*2000*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*Average 1994-2000*	*Average 2000-2009*
Overall	7.3	5.2	4.6	1.4	3.4	3.4	6.9	0.9	6.66	3.72
Food	3.6	4.6	4.2	0.4	0.5	1.6	7.6	0.1	5.21	2.91
Vegetables and	26.3	2.5	3.2	7.8	5.1	8.4	4.0	3.2	8.20	5.86
Industrial crops	18.0	9.4	5.9	-0.1	11.1	4.1	7.0	0.9	13.30	4.85
Fruit trees	3.0	-0.4	4.8	8	0.8	9.8	6.7	3.9	2.03	4.75

Source: Authors' calculation from GSO data.

Note: * Based on comparable prices with the base year being 1994.

On another aspect, the value-added content differed across the subsectors of agriculture-forestry-fishery (Table 4). Producers of other crops enjoyed the highest value-added content, which rose from over 80.9 percent in 1999 to almost 84.8 percent in 2005, before decreasing slightly to 83.9 percent in 2007. This is among the key reasons for farmers' attempts to produce crop outputs other than the "traditional" ones (e.g., paddy rice, raw rubber, coffee beans). Forestry products also had high value-added content, increasing almost continuously from 77.4 percent in 1999 to over 82.5 percent in 2007. Similarly, raw rubber and sugarcane also had significantly higher shares of value added relative to other subsectors, and such shares also increased over the period 1999—2007, from over 75.1 percent to nearly 79 percent for raw rubber and from 76.8 percent to nearly 78.1 percent for sugarcane. Meanwhile, fish farming suffered from a serious decrease in value-added content—a decrease of over 10.5 percentage points between 1999 and 2007. This decrease also happened to tea, cattle, and other livestock.

Table 4. Value-Added Content of Some Subsectors, 1999—2007 (in %)

		1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1	Paddy rice (all kinds)	67.55	68.20	68.87	69.60	70.21	70.79	71.53	70.86	71.67
2	Raw rubber	75.14	75.26	75.90	76.56	77.25	77.83	78.45	78.45	78.96
3	Coffee beans	67.10	66.58	67.19	67.78	68.64	68.64	69.74	69.59	70.17
4	Sugarcane	75.77	75.94	76.63	77.44	78.17	78.66	79.37	79.15	78.07
5	Tea	63.74	63.56	62.46	61.26	60.31	59.41	57.91	57.56	58.73
6	Other crops	80.91	80.73	81.53	82.53	83.23	84.13	84.83	84.12	83.89
7	Pig (all kinds)	46.34	46.51	46.01	46.55	47.13	46.51	47.12	46.56	46.33
8	Cattle (all kinds)	49.84	49.65	49.53	49.69	50.17	50.87	51.37	50.76	46.11

9	Poultry	63.95	64.08	64.28	64.78	65.23	65.46	65.71	64.93	64.69
10	Other livestock	57.92	58.06	57.83	56.96	56.35	55.86	55.75	55.09	54.55
11	Irrigation service	61.49	61.29	61.04	61.33	62.28	62.07	62.39	61.65	62.74
12	Other agricultural services	49.99	50.13	49.97	50.17	51.02	51.52	52.22	52.30	53.39
13	Forestry	77.40	77.28	78.44	79.18	80.37	81.67	82.97	82.62	82.52
14	Fishery	47.60	47.53	47.12	46.92	46.26	46.02	45.64	44.17	43.05
15	Fish farming	70.47	69.02	67.72	66.32	64.51	63.31	62.01	60.37	59.90

Source**:** Authors' calculation from GSO data.

Trade patterns of agriculture-forestry-fishery products

Table 5 illustrates the export growth and shares of agriculture-forestry-fishery products from 1997 to 2007.[5] Note that table 5 takes into account only the direct contribution of these sectors to export without considering their indirect contribution via providing inputs for other export sectors.[6] The key export products were raw rubber, coffee beans, other crops, and output from fishery and fish farming. Nonetheless, there were major changes in the relative sizes of these sectors. Specifically, coffee beans accounted for the largest share in 1997 while becoming the second-largest export subsector in 2007. This could be largely attributed to the negative growth of the subsector in nominal terms over the years 1997—2000. Similarly, raw rubber saw its share decrease continuously from over 2.4 percent in 1997 to 0.6 percent in 2007 due to negative growth in 1997—2000 and slow growth in 2000—2007 (relative to the whole sector). Conversely, other crops became the largest subsector in 2007 although the share (2.9 percent) contracted from that in 1997 (4.1 percent). The only notable expansion was in fish farming whose share in exports more than doubled from 0.8 percent to 2.3 percent in the period 1997—2007.

Observations can also be made of the export growth of the other subsectors in Table 5 . In the period 1997—2000, exports of raw rubber and coffee beans contracted while all other subsectors experienced positive and rapid growth. In subsequent years (i.e., from 2000 to

[5] Output of some sectors (e.g., irrigation and other agricultural services) are nontradable and are therefore excluded from this table.

[6] As an example, processed seafood and by-products alone already accounted for over 7.3 percent of Vietnam's exports in 2007.

2007), exports of all the subsectors expanded. Interestingly, export volumes of all the subsectors (except for forestry) expanded in 2000—2007 as reflected by the higher growth rates in export values compared to the corresponding export prices. In particular, exports of coffee beans and the outputs of fish farming went up mostly due to volume expansion rather than price increase.

Table 5. Export Growth Rates and Direct Contributions to Total Exports of Some Agriculture-Forestry-Fishery Products (in %)

No	*Sector*	**Share**			**Average growth***		**Average increase in export price**
		1997	*2000*	*2007*	*1997--2000*	*2000--2007*	*2000--2007*
	Total	100.00	100.00	100.00	21.60	20.15	
	Agriculture-forestry-fishery	16.45	10.88	9.32	5.94	17.53	
1	Raw rubber	2.42	0.92	0.62	-11.95	13.52	6.47
2	Coffee beans	6.32	2.50	2.31	-10.75	18.82	2.80
3	Other crops	4.12	4.54	2.90	25.62	12.67	5.97
4	Fishery	1.79	1.10	0.60	3.20	10.20	5.24
5	Fish farming	0.82	1.06	2.29	32.45	34.12	5.33
6	Other agriculture-forestry-fishery products	0.98	0.76	0.60	-	-	-

Source: Authors' calculation from GSO data.

Note: * Based on values at current prices.

To further investigate the allocation of agricultural outputs, appendix 1 lists some major user industries and the use they made of various agricultural outputs in 2007. As can be seen, the pattern of agricultural output allocation differs significantly across the subsectors of the agriculture-forestry-fishery industries. For instance, almost 38 percent of paddy rice was reserved as inventory while just over one-quarter was used for husking and flour production. Approximately 93 percent of husked rice and 65 percent of flour (the output of husking and flour production) was exported. In the same year, more than 97 percent of Vietnam's outputs in coffee beans and around 55 percent of perennial plants was exported. The volume of exports led to a drastic fall in inventory. Meanwhile, over 50 percent of the outputs of fishery nearly 28 percent of the output of fish farming were used for processed and preserved products and by-products. This contributed to the country's exports (84 percent of output) of processed and preserved fish products and by-products. Thus, the agriculture-forestry-fishery sectors actually made a larger contribution to exports than what is shown in Table 5. This also reflects the attempt to process agriculture-forestry-fishery products and to raise the value-added content before exporting them.

Table 6 shows the changes in the export shares and growth rates of processed agriculture-forestry-fishery products and will help the reader understand the contribution of the agriculture-forestry-fishery sectors to exports. Processed rice (3.1 percent), processed seafood (7.4 percent), and processed wood and wood products (3.6 percent) accounted for the largest shares in the exports of the agriculture-forestry-fishery sectors in 2007. Meanwhile, refined sugar, processed coffee, and processed tea were mainly for domestic consumption. In particular, the inability of sugar to emerge as an important export product reflects the failure of Vietnam's policies to develop the sugar chain. Overall, processed agricultural products added significant value to Vietnam's exports.

Table 6 also show the shift of agricultural exports away from unprocessed products towards processed ones.

Table 6. Export Growth Rates and Share in Total Exports of Some Processed Agriculture-Forestry-Fishery Products

Sector	*Share*			*Average growth* *		*Average increase in export price (2000-2007)*
	1997	*2000*	*2007*	*1997--2000*	*2000--2007*	
Total export	**100.00**	**100.00**	**100.00**	**21.60**	**20.15**	**-**
*Subtotal of some processed agricultural products***	*15.64*	*18.34*	*18.20*	*28.25*	*20.02*	-
Processed, preserved meat and by-products	0.42	0.19	0.11	-5.91	11.36	3.44
Processed vegetable, and animals oils and fats	0.19	0.38	0.52	54.10	25.63	3.47
Processed and preserved fruits and vegetables	0.58	0.19	0.42	-15.64	34.51	-0.75
Sugar, refined	0.01	0.25	0.05	295.29	-4.16	1.85
Coffee, processed	0.01	0.00	0.02	-2.73	50.08	2.30
Tea, processed	0.02	0.29	0.02	217.27	-17.28	1.28
Processed seafood and by-products	4.74	6.36	7.35	34.11	22.64	4.42
Rice, processed	6.38	6.89	3.10	24.73	7.17	6.93
Other food manufactures	0.71	0.55	1.09	11.57	32.63	3.27
Processed wood and wood products	1.91	2.12	3.60	25.88	29.60	3.56
Processed rubber and by products	0.25	0.15	0.67	2.30	48.90	4.61

***Source*:** Authors' calculation from GSO data.

***Note*:** * Based on values at current prices; **: Excluded from the listed products are the following: milk, butter, and other dairy products; cakes, jams, candy, cocoa, chocolate products; cigarettes and other tobacco products; paper pulp, paper products, and by-products; and animal feeds.

Table 7. Growth Rates and Share in Total Imports of Some Agriculture-Forestry-Fishery Products, 2000—2007 (in %)

No	**Sector**	**Share**			**Average growth***		**Average increase in import price**
		1997	*2000*	*2007*	*1997--2000*	*2000--2007*	*2000--2007*
	Total	**100.00**	**100.00**	**100.00**	**16.47**	**22.18**	
	Agriculture-forestry-fishery	6.32	1.45	1.89	-28.72	26.88	
1	Raw rubber	0.42	0.10	0.18	-26.94	32.45	0.55
2	Other crops	5.25	0.84	1.04	-36.77	25.90	4.98
3	Forestry	0.34	0.39	0.51	21.94	27.17	0.93
4	Other agriculture-forestry-fishery products	0.31	0.12	0.16	-	-	-

***Source*:** Authors' calculation from GSO data.

***Note*:** * Based on values at current prices.

Similar analysis can be undertaken with the imports of agriculture-forestry-fishery products (Table 7). As can be seen, the overall share of these products in Vietnam's total merchandise imports was rather small, decreasing from 6.3 percent to 1.5 percent in the period 1997—2000 and then slightly rising to almost 1.9 percent in 2007. Crops (other than tea, paddy rice, and rubber) accounted for the highest share of imports of agriculture-forestry-fishery products—5.3 percent in 1997 and 1.04 percent in 2007. This subcategory contributed mostly to the increase or decrease in the overall share of agriculture-forestry-fishery products in total imports over the period 1997—2007. Forestry products also made up nearly 0.4 percent of the total imports of agriculture-forestry-fishery products in 2000 and over 0.5 percent in 2007. With small import values, the subsectors of agriculture-forestry-fishery experienced drastic variations in growth rates (Table 7). Similar to the sectoral patterns of exports, import volumes also expanded for all agriculture-forestry-fishery products. More important, for all subsectors, the contribution of quantity to import growth was larger than that of price.

Employment and labor income in agriculture-forestry-fishery

The analysis of employment in the agriculture-forestry-fishery sector in both absolute and relative terms sheds further light on the development of the sector (Table 8). Thanks to the Government's proactive efforts at international economic integration and the implementation of market-oriented reforms starting 2000 (with particular measures to encourage the participation of private and foreign-invested sectors), Vietnam experienced a boom in economic activities, thereby creating more jobs.[7] With the boom in investment projects and enterprises involved in the industry-construction and services sectors, the employment structure exhibited further positive shift. Notably, the number of people employed in the agriculture-forestry-fishery sector decreased from 24.8 million in 1999 to 24.5 million in 2000 and then to over 23.6 million in 2008. Along with the increase in the total number of people employed, the share of the agriculture-forestry-fishery sector in total employment decreased from 68.9 percent in 1999 to around 65.1 percent in 2000 and then to almost 52.5 percent in 2008. Such a decrease was in line with the contraction of the agriculture-forestry-fishery sector relative to Vietnam's GDP (Table 2). Still, agriculture-forestry-fishery accounted for the largest share in total employment, exceeding that of industry-construction and services in total.

Table 8. Vietnam's Employment Structure by Economic Sector

	1999	**2000**	**2001**	**2003**	**2006**	**2007**	**2008**
Number of employees (thousand persons)							
Total	35,976	37,610	38,563	40,574	43,340	44,172	45,037
Agriculture-Forestry-Fishery	*24,792*	*24,481*	*24,470*	*24,443*	*23,927*	*23,919*	*23,625*
Industry-Construction	*4,300*	*4,929*	*5,555*	*6,671*	*8,336*	*8,825*	*9,386*
Services	*6,884*	*8,200*	*8,538*	*9,460*	*11,077*	*11,428*	*12,027*
Share (%)							
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture-Forestry-Fishery	*68.9*	*65.1*	*63.5*	*60.2*	*55.2*	*54.1*	*52.5*
Industry-Construction	*12.0*	*13.1*	*14.4*	*16.4*	*19.2*	*20.0*	*20.8*
Services	*19.1*	*21.8*	*22.1*	*23.3*	*25.6*	*25.9*	*26.7*
Growth rate (%)							

[7] For further details, see Vo and Nguyen (2010).

Total	2.11	4.54	2.53	2.70	1.91	1.92	1.96
Agriculture-Forestry-Fishery	*1.17*	*-1.26*	*-0.04*	*-0.05*	*-1.70*	*-0.04*	*-1.23*
Industry-Construction	*3.45*	*14.62*	*12.69*	*9.63*	*7.73*	*5.87*	*6.35*
Services	*4.74*	*19.12*	*4.13*	*5.49*	*6.03*	*3.17*	*5.24*

***Source*:** Extract from Dinh et al. 2009.

Note: Sector I: Agriculture - forestry - fishery; Sector II: Industry - Construction; Sector III: Services.

However, the shift in employment structure towards a smaller share of the agriculture-forestry-fishery sector in total employment was even faster than that in the economic structure (Table 2). This could be attributed to the significant increase in labor productivity in the agriculture-forestry-fishery sector, proxied by GDP (at current prices) per employee in the sector (Table 9). Specifically, GDP per employee in the agriculture-forestry-fishery sector more than tripled from VND 4.1 million in 1999 to over VND 13.8 million in 2008. This increase was larger than that at the national level by almost 3 times, from VND 11.1 million in 1999 to VND 32.8 million in 2008. Yet in absolute terms, GDP per employee in the agriculture-forestry-fishery sector was still significantly smaller than that in industry-construction and in services. As of 2008, the figure for the agriculture-forestry-fishery sector was slightly over one-fifth of that in industry-construction and just under 30 percent of that in services.

Table 9. GDP per Employee (in VND million/year)

	1999	*2000*	*2001*	*2003*	*2006*	*2007*	*2008*
At current prices							
Total	11.117	11.743	12.481	15.119	22.480	25.892	32.811
Agriculture-Forestry-Fishery	4.103	4.426	4.571	5.657	8.308	9.724	13.820
Industry-Construction	32.081	32.910	33.037	36.298	48.549	53.757	62.560
Services	23.282	20.863	21.775	24.634	33.472	38.215	46.899
At comparable prices (in 1994)							
Total	7.123	7.276	7.586	8.287	9.815	10.444	10.876
Agriculture-Forestry-Fishery	2.456	2.603	2.682	2.898	3.332	3.458	3.644
Industry-Construction	20.474	19.661	19.260	19.399	20.905	21.763	21.713
Services	15.592	13.785	14.046	14.378	15.473	16.325	16.626

***Source*:** Extract from Dinh et al. 2009.

Dinh et al. (2009) also estimated employment elasticity to growth. For the years 2000—2007, employment elasticity at the economy level was estimated at 0.38 (i.e., a 1 percent rise in GDP increased employment by 0.38 percent). Meanwhile, the estimated figures for the agriculture-forestry-fishery sector, the industry-construction sector, and the services sector were -0.11, 0.84, and 0.63, respectively. Thus, the growth of the agriculture-forestry-fishery sector led to the contraction of employment in the sector. Also, the higher elasticities in the industry-construction and services sectors arguably indicate the faster shift in the employment structure among the three sectors, specifically towards a smaller share for the agriculture-forestry-fishery sector and a larger share for the industry-construction and services sectors.

Another reason for the development of the agriculture-forestry-fishery sector was the growth in income for labor, which provides a source for value added in the subsectors (Table 10). As can be seen in table 10, the figures are significant for all the subsectors of the agriculture-forestry-fishery sector. Growth in income for labor was most rapid in fish farming, reaching over 20.7 percent per annum on average in 2000—2007. Incomes in fishery and tea followed, at an average of almost 12.6 percent and around 12.1 percent, respectively, per annum. Meanwhile, for paddy rice, income for labor grew at a modest pace of roughly 9.1 percent per annum, on average, in 2000—2007. Considering the smaller number of people employed in the agriculture-forestry-fishery sector, higher income for labor implies that each employee has been earning more on average. However, the share of income for labor went down for some subsectors, most rapidly in forestry (by nearly 2.6 percentage points) and most slowly in fish farming (almost 0.5 percentage point).

Table 10. Growth Rates of Income for Labor (in %)

		2000	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*	*Average*
1	Paddy rice (all kinds)	5.52	0.55	9.58	8.98	11.35	9.91	11.06	16.27	9.07
2	Raw rubber	6.41	5.97	12.05	11.12	11.66	9.84	13.54	16.61	10.85
3	Coffee beans	4.35	2.66	8.78	7.85	12.95	8.39	13.64	17.33	9.40
4	Sugarcane	2.45	1.14	9.56	8.48	11.11	8.29	10.83	14.77	8.24
5	Tea	4.83	2.53	16.52	6.85	20.64	15.79	11.36	19.67	12.09
6	Other crops	5.54	1.89	10.25	8.63	10.59	10.82	12.67	15.35	9.40
7	Pig (all kinds)	3.67	0.08	12.02	11.27	12.88	16.40	12.68	15.58	10.44
8	Cattle (all kinds)	4.32	3.49	8.69	9.49	9.09	9.32	17.83	5.43	8.38
9	Poultry	4.48	1.02	10.35	12.00	11.86	19.92	12.21	15.91	10.83
1	Other Livestock	3.18	0.23	11.65	11.71	11.24	28.66	10.17	14.64	11.16
1	Irrigation service	5.74	3.47	9.46	8.22	10.57	9.72	14.86	18.12	9.93
1 2	Other agricultural services	3.26	0.14	7.92	6.24	8.54	8.00	17.15	18.45	8.55

1	Forestry	3.14	2.94	8.68	16.74	16.88	4.66	9.86	10.43	9.04
1	Fishery	16.00	10.91	8.09	14.77	3.72	5.54	21.70	21.08	12.55
1	Fish - Farming	19.51	27.19	17.71	22.82	19.37	22.41	18.12	18.89	20.72

Source**:** Authors' calculation from GSO data.

Income for farmers and laborers in the agriculture-forestry-fishery sector is partly constrained by the presence of *thuong lai* (middlemen) who serve as intermediaries between enterprises and farmers. The thuong lai purchase rice from farmers and resell it to enterprises. They constitute a key feature of agricultural trade in Vietnam. For example, the thuong lai play an important role in agricultural trade in Dong Thap province where farmers harvest approximately a million tons of rice yearly. The Dong Thap Food Joint-Stock Company, the main rice buyer in the province, only manages to purchase roughly one-fifth of that volume because the remainder is collected by the thuong lai when they visit the farmers' houses to purchase rice. They then sell the total volume of rice collected to enterprises and exporters in Dong Thap and neighboring provinces.[8] The thuong lai are well-organized. Each large, intermediary group has a large number of boats (anywhere from 5 to 10) ready to carry purchased rice. They also have access to information about prices and crop harvests that can be updated on an hourly basis, thanks to a wide network that reaches every corner of hamlets and communes. With the current inadequacy of rural infrastructure, the presence of middlemen is necessary as they can better facilitate the collection of agricultural products from farmers than the enterprises themselves. The problem, however, is that farmers are largely "forced" to sell their output to middlemen at a less-than-satisfactory price. Meanwhile, they have almost no other choices as the enterprises cannot reach them in a timely and proper manner once they have output ready for sale. Given this situation, the farmers earn an income smaller than what they deserve if their produce had been bought at market prices.

Changes in total factor productivity in the agriculture-forestry-fishery sector

Nguyen and Goletti (2001) provide the first comprehensive analysis of the sources of agricultural growth in Vietnam during the period 1985—1999. As can be seen in Table 11. agricultural growth reached 3.9 percent per annum on average in 1985—1989 and increased further to 5.9 percent in 1990—1999. There were, however, different reasons for the pace of agricultural growth during these subperiods. Between 1985 and 1989, growth in total factor productivity (TFP) played an important role, accounting for more than one-half of agricultural

[8] For further discussion, see http://vietnambusiness.asia/the-middle-man-necessary-for-the-rice-economy/

growth. This was a result of farmers' attempts to increase agricultural production following the massive incentives offered by the government. In other words, institutional reforms in 1985—1989 enhanced TFP growth, which, in turn, spurred agricultural growth. Yet in the 1990s, the contribution of TFP contracted in both absolute and relative terms. Instead, agricultural growth in 1990—1999 was driven mainly by the expansion of production factors, such as fertilizers, tractors, and pumps.

Table 11. Sources of Agricultural Growth in Vietnam, 1985—1999 (in %)

	1985--1989	**1990--1999**
Output	3.91	5.91
Land	0.09	1.75
Labor	2.64	2.68
Fertilizer	6.04	12.39
Tractor	-9.41	20.71
Pump	-12.56	18.99
Work animal	4.77	0.94
TFP	2.16	0.32

***Source*:** Nguyen and Goletti 2001.

To better explain the growth of the agriculture-forestry-fishery sector as a whole, the paper decomposes such growth into different sources, namely: (1) change in employment of the sector; (2) change in fixed capital of the sector; and (3) change in TFP of the sector.[9] Detailed notes on the employed decomposition method can be found in appendix 2. Results of the decomposition for the period 1990—2007 are tabulated in Table 12.

Table 12. Sources of Growth for the Agriculture-Forestry-Fishery Sector (in %)

	Average			
	1990--1996	*1997--1999*	*2000--2003*	*2004--2007*
Growth rate of agriculture-forestry-fishery*	4.15	4.36	3.85	3.87
Growth rate of employment	1.78	1.27	-0.35	-0.54
Growth rate of capital	67.12	25.95	3.37	7.84
Growth rate of land	3.22	4.08	1.33	1.08
Growth rate of TFP	-9.47	-1.53	3.42	2.79

[9] Forestry and fishery are also important to rural development in Vietnam. Thus, this paper extends the calculations of TFP growth for the agriculture-forestry-fishery sector.

Percentage contribution of TFP to growth of agriculture-forestry-fishery	-228.21	-35.10	88.76	72.11

***Source*:** Authors' calculations from GSO data.

***Note*:** * At comparable prices to 1994.

From 1990 to 1996, the growth of the sector came mainly from increases in capital stock, agricultural land, and employees while the contribution of TFP growth was negative. Between 1997 and 1999, the absolute contribution of capital and employment fell while that of land increased. Yet TFP growth was still negative, albeit at a smaller magnitude than in 1990—1996. These variations are consistent with the findings of Nguyen and Goletti (2001) that the growth of the sector in 1990—1999 was driven mainly by the expansion of production factors (i.e., labor, capital, and land).[10] However, in relative terms, there was a positive shift as TFP contribution to growth gradually improved.

Starting 2000, the employment scale contracted, growth rate of capital seemed to accelerate while the growth rate of land decelerated. Notably, this period also corresponds to Vietnam's numerous efforts to deepen its international economic integration. This led to a greater investment in agriculture and even larger foreign direct investments (FDIs) in the nonagriculture sectors, which induced the labor structure's shift away from agriculture. Along with such changes, the positive contribution of TFP growth could be seen more clearly. From 2000 to 2003, TFP growth contributed almost 89 percent (or 3.4 percentage points) to the growth of the agriculture-forestry-fishery sector. During the period 2004—2007, the former still had the largest contribution to the latter sector although the share dropped to over 72 percent. This means that the growth of the agriculture-forestry-fishery sector in 2000—2007 was driven mainly by TFP growth. Essentially, the driver for agricultural growth in Vietnam changed from the expansion of production factors in 1990—1999 to productivity improvement in 2000—2007.

Overall, even with its goal of becoming a modern industrial economy, Vietnam has made significant progress in agricultural development. In the period under investigation (i.e., starting 2000), the agriculture-forestry-fishery sector has been growing yearly but at a slower pace than that of the economy as a whole. Accordingly, the sector has accounted for a smaller share of GDP. The growth pattern and value-added content is not uniform across the different subsectors of the agriculture-forestry-fishery sector. In addition, the sector made only limited

[10] For further references, see MARD (2004).

direct contribution to overall exports and imports while certain subsectors mainly provided inputs to other export-oriented sectors. Agricultural development also benefits rural workers.

The share of agriculture-forestry-fishery in total employment went down faster than its share in GDP, reflecting the improvement in labor productivity. Such improvement was also rewarded as workers in the sector made higher earnings, on average. However, the increase in farmers' income was partly constrained by the presence of middlemen. Over the period 1990—2007, the sources for agricultural growth changed from expansion of production factors (1990—1999) to productivity improvement (2000—2007), which gives hope for more sustainable growth of the agriculture-forestry-fishery sector in the future.

3. Agricultural Development and Rural Diversification in Vietnam

Together with the developments discussed above, Vietnam has also witnessed diversification in its products. Agriculture is still dominant in the agriculture-forestry-fishery sector (hereinafter referred to as the "extended agriculture sector") as a whole although its share has somewhat declined (Table 13). Specifically, the share of agriculture in the extended agriculture sector went down from almost 80.8 percent in 2000 to over 76.6 percent in 2007 before recovering to 78.1 percent in 2009 and then 78.3 percent in 2010. Meanwhile, the corresponding share of fishery rose from nearly 13.8 percent to almost 19.8 percent in the years 2000—2007 and then fluctuated before reaching 18.2 percent in 2010. Notably, the trend in diversification has not been towards the forestry sector since the share of this sector dropped from 5.5 percent in 2000 to 3.7 percent in 2009 and then to 3.6 percent in 2010 (although there was some minor increase in 2007—2009).

Table 13. Relative Share of Agriculture, Forestry, and Fishery in the Overall Value-Added of the Agriculture-Forestry-Fishery Sector

	2000	**2001**	**2002**	**200**	**2004**	**200**	**2006**	**2007**	**200**	**200**	**2010**
Agriculture (%)	80.7	78.5	78.2	77.7	77.92	77.1	76.7	76.6	78.7	78.	78.28
Forestry (%)	5.46	5.45	5.27	4.81	4.46	4.15	3.99	3.54	3.32	3.7	3.55
Fishery (%)	13.7	16.0	16.4	17.4	17.61	18.7	19.2	19.8	17.8	18.	18.17
Sum of squares	*0.6745*	*0.6455*	*0.6422*	*0.6372*	*0.6402*	*0.6317*	*0.6274*	*0.6277*	*0.6539*	*0.6444*	*0.6471*

***Source*:** Authors' calculation from GSO data.

The trend of diversification becomes more evident at the aggregate level if we compute for the sum of squares of the relative shares of the different subsectors of the extended agriculture sector. Theoretically, the larger figure reflects the larger concentration of the products as well as the smaller diversity of the products. As Table 13 shows, the figure decreased from 0.6745 in 2000 to 0.6274 in 2007. This change reflects the enhancement of product diversity in the extended agriculture sector from 2000—2007. During the period of domestic macroeconomic instability and economic downturn (2008—2010), however, the diversification process was slightly reversed. This was indicated by the rising sum of squares of the relative shares of the different subsectors—0.6444 in 2009 and 0.6471 in 2010.

Table 14. Shares and Growth Rates of the Agricultural Subsectors

	1995	*2000*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*
Share (%)								
Farming	80.41	81.04	80.08	78.69	78.21	78.04	78.04	77.06
Breeding	16.56	16.51	17.64	19.04	19.56	19.75	19.81	20.77
Services	3.03	2.45	2.28	2.27	2.24	2.22	2.14	2.17
Sum of squares	0.6749	0.6846	0.6730	0.6560	0.6504	0.6485	0.6488	0.6375
Growth rate (%)								
Farming	7.3	5.2	4.6	1.4	3.4	3.4	6.9	0.9
Breeding	4.8	6.7	2.3	11.4	6.9	4.6	7.3	7.1
Services	6.6	3.7	2.3	2.6	2.7	2.7	3.5	3.3

***Source*:** Authors' calculation from GSO data.

Table 14 lists the subsectors of agriculture with their corresponding shares and growth rates from 1995 to 2009. The growth rate of farming slid from 7.3 percent in 1995 to 6.9 percent in 2008 and then to 0.9 percent in 2009. Agricultural services also experienced slower growth—from 6.6 percent in 1995 to between 2.3 percent and 3.5 percent in 2004—2009. The growth rate of the breeding subsector peaked at 11.4 percent in 2005 after which it became more stable and settled at 7.1 percent in 2009. Consequently, the shares of the agricultural subsectors changed significantly. Specifically, the share of the farming subsector in agriculture increased from 80.4 percent in 1995 to 81 percent in 2000 before falling to 77.1 percent in 2009. The share of the services sector went down from 3 percent in 1995 to 2.1 percent in 2008 and recovered only slightly to 2.2 percent in 2009. The growth rate of the breeding subsector dropped only slightly from 16.6 percent in 1995 to 16.5 percent in 2000 before climbing to 20.8 percent in 2009.

These shifts in the structures of farming, breeding, and agricultural services partly show the greater diversity of these products and services. This trend towards diversification of agricultural products and services is further confirmed by the sum of squares of their shares (Table 14). Specifically, product diversity appeared to have been reduced in 1995—2000, with the sum of squares of shares increasing from 0.6746 to 0.6846. In the years 2000 to 2009, however, the figure reflected greater product diversity as it went down almost continuously from 0.6846 to 0.6375. However, with the decreasing share of agricultural services, diversification in agriculture seemed to progress only towards breeding.

Table 15. Shares in the Gross Output of Different Agricultural Subsectors, 1999—2007 (in %)

No	***Subsector***	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***	***2005***	***2006***	***2007***
1	Paddy rice (all kinds)	38.89	38.85	38.55	38.39	38.27	37.93	37.06	36.86	36.61
2	Raw rubber	1.75	1.77	1.86	1.91	1.98	2.01	1.95	1.96	1.97
3	Coffee beans	4.86	4.89	4.93	4.93	4.91	4.93	4.78	4.81	4.83
4	Sugarcane	2.22	2.17	2.18	2.18	2.17	2.13	2.07	2.03	2.04
5	Tea	0.57	0.58	0.61	0.65	0.71	0.77	0.78	0.80	0.81
6	Other crops	26.71	27.01	26.81	26.63	26.54	26.53	26.40	26.31	26.42
7	Pig (all kinds)	10.65	10.51	10.66	10.78	10.92	11.28	11.59	11.74	11.78
8	Cattle (all kinds)	0.84	0.84	0.88	0.88	0.87	0.85	0.82	0.87	0.87
9	Poultry	4.45	4.44	4.48	4.55	4.63	4.62	4.94	4.99	5.01
10	Other livestock	4.18	4.11	4.15	4.29	4.38	4.47	5.23	5.11	5.13
11	Irrigation service	0.99	1.01	1.05	1.04	1.02	1.02	1.00	1.03	1.03
12	Other agricultural services	3.88	3.83	3.85	3.77	3.61	3.47	3.39	3.47	3.49
	Sum of squares of shares	**0.2425**	**0.2434**	**0.2406**	**0.2387**	**0.2377**	**0.2359**	**0.2301**	**0.2286**	**0.2275**

***Source*:** Authors' calculation from GSO data

An investigation of Vietnam's agricultural outputs at a more disaggregated level also indicates progress in diversification (Table 15). Paddy rice continues to dominate agricultural production, but the share of this subsector went down steadily from 38.9 percent in 1999 to 36.6 percent in 2007. That of other crops followed although the share mainly fluctuated within the range of 26.3 percent and 27 percent. Over the period 1999—2007, a number of subsectors, including raw rubber, pigs (of all kinds), poultry, and other livestock, saw their shares rise. The shift in the structure of the different agricultural subsectors is not the only evidence of greater product diversity in agriculture. The larger diversity of agricultural products and services can also be portrayed by the sum of squares of their shares. From 1999 to 2007, the figure went down from 0.2425 to 0.2275, indicating that agricultural output became more dispersed within a larger range of products and services. That means there is hardly any evidence of agricultural product specialization over the period 1999—2007.

However, some progress towards regional specialization in agricultural products can be observed with sugarcane as a notable example. The shares of sugarcane in the national output of the Northern and Southern Central Coast rose from 22 percent to 37.3 percent and that of the Central Highlands from 5.7 percent to 11 percent over the period 1995—2009. In contrast, that of the Mekong River Delta fell from 50.4 percent to 30.9 percent.[11] The increasing share of the Northern and Southern Central Coast resulted from the government's measures to shift sugarcane production to some Central coastal provinces. Another example is coffee beans, although these are specialized products of the Central Highlands. For some other products, the pattern of regional specialization is less clear. For a key product like rice, progress towards regional specialization was limited. The share of the Mekong River Delta in total rice output went up only slightly from 51.4 percent in 1995 to 53.9 percent in 2005 before falling to 52.7 percent in 2009 while those of other regions fluctuated within relatively small ranges.

Table 16. Diversity of Income Sources for Rural Households, 1993—2008

	1993	***2002***	***2008***
Northern Uplands	4.43	4.97	4.64
Red River Delta	4.16	4.37	4.28
North Central Coast	3.57	4.65	4.36
South Central Coast	3.74	4.49	4.34
Central Highlands	3.41	5.21	4.16
South East	3.36	4.16	3.56
Mekong River Delta	4.31	4.91	3.85
Overall	**4.02**	**4.67**	**4.20**

***Source*:** Figures for 1993 and 2002 are from World Bank (2006); those for 2008 are from authors' calculations.

Note: To maintain consistency, the authors also use the classification of net income sources used by the World Bank (2006). Accordingly, there are eight sources of net income; namely cropping, livestock, fisheries, forestry, non-farm entrepreneurship, wage, transfer and other income.

[11] It should be noted that sugarcane output in the Mekong River Delta also went down from 5.4 million tons to 5 million tons in the same period.

On another aspect, the sources of income for rural households exhibited significant changes starting 1993 (

Table 16). The World Bank's (2006) analysis of the Vietnam Living Standard Survey in 1993 and the Vietnam Household Living Standard Survey in 2002 shows that rural households received income from more sources than previously thought. The average number of income sources for each rural household in 1993 was 4.02, further increasing to 4.67 in 2002. This increase could be largely attributed to a couple of factors. On the one hand, proactive international economic integration broadened access to export markets for Vietnam's agricultural products. On the other hand, Vietnam implemented measures to positively induce rural households to work and to promote rural transformation along with domestic economic reforms. The most rapid enhancement of income diversity was in the Central Highlands, with the figure rising from 3.41 in 1993 to 5.21 in 2002. Thus, in 2002, the Central Highlands had the highest number of income sources for households. Meanwhile, households in the Red River Delta experienced the smallest increase in income sources, with the average figure increasing to only 4.37 in 2002 from 4.16 in 1993.

From 2002 to 2008, however, income-generation activities for rural households seemed to become less diverse. Compared to the situation in 2002, each household, on average, received income from fewer sources (around 4.20) in 2008. The fall in the number of income sources for rural households was evident in all regions. In contrast to the progress they made between 1993 and 2002, the Mekong River Delta and the Central Highlands had the largest decrease in the number of income sources, by 1.06 and 1.05, respectively. Therefore, in 2008, the Northern Uplands had the largest diversity of income sources for rural households because it had a significantly smaller decrease in all regions. This may reflect some changes in rural transformation during the period 2002—2008, that is, rural households no longer relied on increasing participation in different economic activities for higher income. Instead, they started focusing on a smaller number of income sources, hoping that such specialization can improve their income better. The higher commercialization of agricultural products further confirmed this specialization.

In line with this development, the extent of agricultural commercialization was improved at the national level. However, such improvement proceeded at different paces for different agricultural subcategories (Table 17).

For crops, the proportion of output sold rose from only around two-fifths in 1993 to 54 percent in 1998 and then to 61 percent in 2002 before increasing to 69 percent in 2008. Commercialization was higher in 2008 even in the context of increasing output and the government's decision to control rice exports to ensure food security (due to a wrong forecast of rice output). For other agricultural outputs, commercialization also seemed to accelerate with the shares of sold outputs increasing from 48 percent in 1993 to 59 percent in 1998, to 70 percent in 2002, and then to almost 87 percent in 2008. The relatively smaller proportion of sold outputs for crops for all the surveyed years indicates the larger subsistence orientation of crops. Overall, the higher agricultural commercialization in the period 1993—2008 could be attributed to Vietnam's market-oriented reforms in general and attempts to encourage agricultural trade in particular.

Table 17. Proportion of Agricultural Outputs Sold to the Market (in %)

	1993		**1998**		**2002**		**2008**	
	Crops	*Other agricul-tural outputs*	*Crops*	*Other agricul-tural outputs*	*Crops*	*Other agricul-tural outputs*	*Crops*	*Other agricul-tural outputs*
Northern Uplands	22.00	36.00	33.00	44.00	34.00	52.00	39.36	73.05
Red River Delta	23.00	39.00	29.00	45.00	34.00	61.00	38.42	91.08
North Central Coast	22.00	37.00	30.00	44.00	38.00	63.00	50.79	82.94
South Central Coast	23.00	39.00	46.00	55.00	53.00	73.00	64.49	91.29
Central Highlands	78.00	77.00	78.00	78.00	74.00	74.00	76.61	72.71
South East	65.00	69.00	77.00	79.00	88.00	84.00	91.40	91.07
Mekong River Delta	56.00	59.00	74.00	74.00	84.00	85.00	86.69	93.50
Overall	**40.00**	**48.00**	**54.00**	**59.00**	**61.00**	**70.00**	**68.52**	**87.00**

***Sources*:** Figures for 2008 are from authors' calculations; figures for 1993, 1998, and 2002 are from the World Bank 2006.

At the regional level, agricultural commercialization was generally evident from 1993 to 2008 although it was not universal. Outputs of agricultural products other than crops were increasingly commercialized in all regions, except in the Central Highlands. The pace of commercialization became even faster in 2002—2008 when many products in this group (e.g., shrimp and catfish) were produced mainly for export. Similarly, except for the Central Highlands, all regions saw higher commercialization of crops in the years 1993—2008. Specifically, as of 2002, crop output was the most commercialized in the South East and the Mekong River Delta. Between 2002 and 2008, commercialization of crop output was promoted in all regions. The proportion of sold crop outputs rose most rapidly in the Northern Central Coast (by 12.8 percentage points) and most slowly in the Mekong River Delta (by around 2.7 percentage points). In absolute terms, as of 2008, the proportion of sold crop outputs for the Red River Delta and the Northern Uplands were the smallest, indicating that crop outputs were mainly for subsistence purposes in these regions.

Development and/or commercialization of agriculture, although not universal, contributed to poverty reduction in the rural areas. Table 18 depicts the development of general poverty rates by area and by geographical region. As can be seen, the poverty incidence in Vietnam went down in the urban and rural areas. In the rural areas, the poverty rate decreased steadily, from nearly 45 percent in 1998 to below 25 percent in 2004 and to roughly 19 percent in 2008. Over the period 1998—2008, the poverty rate in the rural areas fell by 26 percentage points, which was higher than the decrease in urban areas (6 percentage points). However, at all tabulated points in time, the poverty rate in the rural areas was higher than that in the urban areas. This shows the disadvantage of rural households in terms of participating in income-generation activities.

Table 18. Poverty Rate in Vietnam, 1998—2008 (in %)

	1998	**2002**	**2004**	**2006**	**2008**
Overall	37.4	28.9	19.5	16.0	14.5
By area					
Urban areas	9.0	6.6	3.6	3.9	3.3
Rural areas	44.9	35.6	25.0	20.4	18.7
By geographical region					
Red River Delta	30.7	21.5	11.8	8.9	8.0
Northern Uplands	64.5	47.9	38.3	32.3	31.6
Northern Central and Southern Central	42.5	35.7	25.9	22.3	18.4

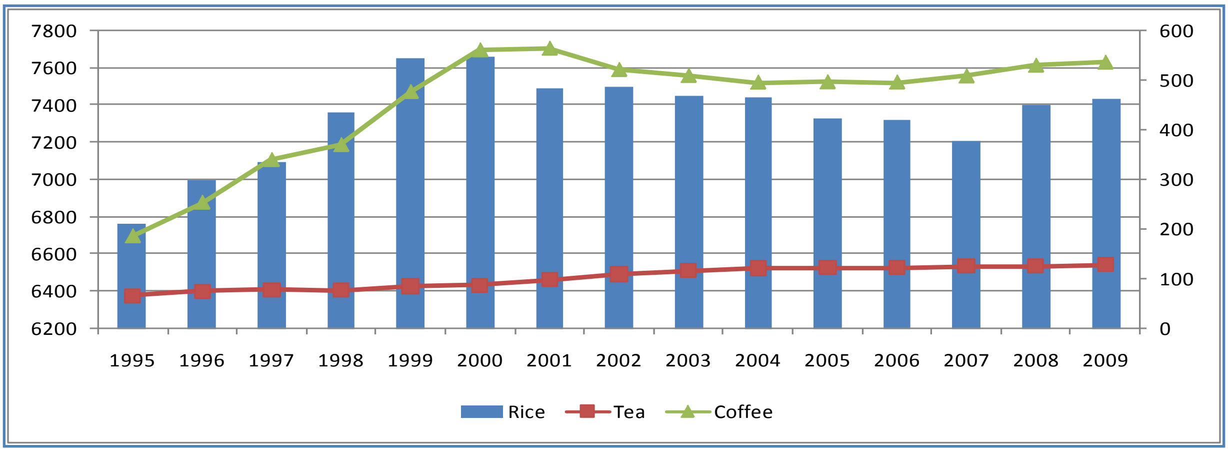
Coast					
Central Highland	52.4	51.8	33.1	28.6	24.1
South East	7.6	8.2	3.6	3.8	2.3
Mekong River Delta	36.9	23.4	15.9	10.3	12.3

***Source*:** GSO.

Poverty reduction has also been universal by geographical region, reflecting the efforts of the government and the people to improve the people's material life nationwide. However, the pace of improvement differs from one region to another. In 1998—2008, the decrease in poverty rate was fastest in the Northern Uplands (by around 33 percentage points) while being the slowest in the South East (by 5.3 percentage points). The limited extent of poverty reduction in the South East resulted largely from the fact that the poverty incidence in this region was already small in absolute terms (Table 18). Notably, general poverty rates of all other regions fell by at least 22.7 percentage points in the same period. Even so, the current poverty incidence remains considerably different across regions. As of 2008, poverty rates were the smallest in the South East and the Red River Delta and highest in the Northern Uplands. Comparing Table 16 and Table 18 provides an interesting observation for 2008—the three regions with the least diverse income sources (i.e., the Red River Delta, the South East, and the Mekong River) also have with smallest poverty incidence. This implies that diversifying income-generation activities can only help reduce poverty in rural households during the early stages, but such reduction can be sustainable in the long term only if the rural households acquire sufficient skills and competence to participate in specialized production.

The progress in agricultural commercialization was accompanied by an expansion in the scale of agricultural production. There was a huge surge in the production of commercial cash crops from 1995 to 2009. The land area planted to annual crops and perennial industrial crops (e.g., rice, tea, coffee) increased significantly (Figure 1). Between 1995 and 2000, the total area of cultivated land planted to these crops expanded steadily. Starting 2000, however, the trend changed. The total land area devoted to rice cultivation decreased from 7.7 million hectares to 7.2 million hectares in 2007 but later on increased to 7.4 million hectares in 2009. Meanwhile, the total land area planted to coffee contracted from 560,000 hectares in 2000 to just under 500,000 hectares in 2006. It bounced back to nearly 540,000 hectares in 2009. Only the areas planted to tea were expanded continuously, from 88,000 hectares in 2000 to 128,000 hectares in 2009. In general, the increase in agricultural output proceeded faster than the expansion of cultivated land. This further reaffirms the role of labor productivity in promoting agricultural growth and development during this period.

Figure 1. Total area of land planted to rice, tea, and coffee (in thousand ha)



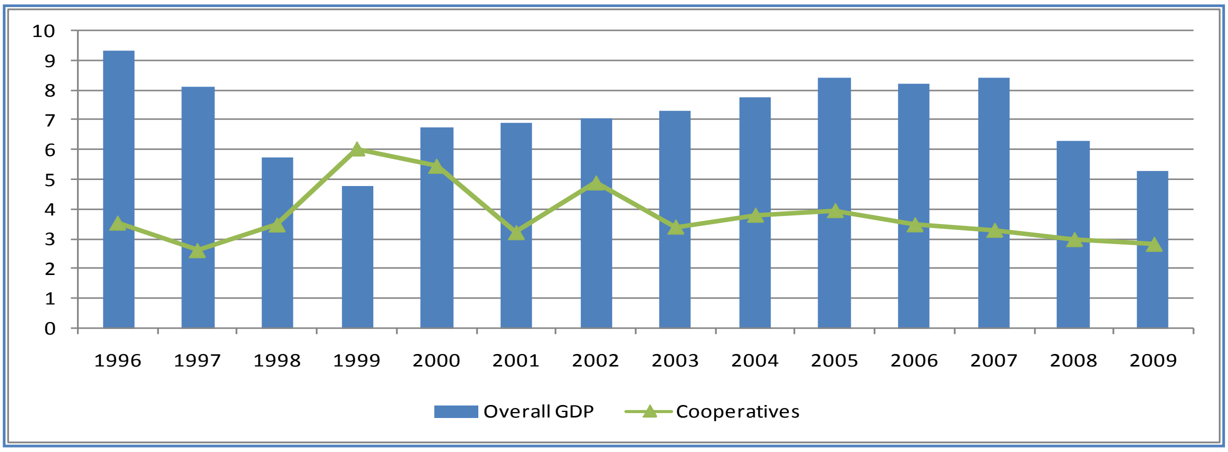
Source: GSO.

Underlying the expansion of agricultural production were measures to promote concentration of land and capital after the passage of Resolution No. 03/2000/NQ-CP in 2000. These measures included the allocation, lease, assignment, and accumulation of land over prescribed limits. Decree No. 04/2000/ND-CP passed in 2000 enhanced the stability of land-use tenure. In terms of land accumulation via family farms, the government prioritized two types of beneficiaries: (1) farming households with the necessary capital and production and management experience and who are willing to produce commercial crops and (2) landless households. The Ministry of Agriculture and Rural Development (MARD) has designated areas for large-scale production, such as areas to support the cultivation of rice for export, areas supplying materials for sugar-processing and fruit-processing plants, forested areas, and areas designated for aquaculture breeding purposes. Some provinces also set specific policy objectives to restructure agricultural production toward larger, commercial farms for short- and long-term industrial crops.

Vietnam also implemented policies to encourage the development of the "new cooperatives." The Cooperative Law, which took effect in 1997, emphasizes the role of cooperatives in providing members with supply and marketing services, coordinating production, and providing additional community activities. In the amended version passed in 2003, the

Cooperative Law stipulates the provision of economic-technical information and training for members.

Figure 2. Growth rates of the national economy and cooperatives, 1996—2009 (in %)



***Source*:** Authors' calculation based on GSO data.

Agricultural commercialization in Vietnam is still hampered by the very low level of mechanization. Rural households have little incentive to purchase or rent machinery due to low income and the availability of cheap labor. The situation somewhat improved in 2000—2009 (relative to 1990—1999) due to the comprehensive policies on preferential tax, credit, and investment that the government passed to support agriculture. For example, with Resolution No. 03/2000/NQ-CP, which was passed in 2000, Vietnam reduced the rental rate for land rented by large farms and strengthened the legal framework for measures supporting agricultural development, including master planning, investment, and credit policies for agricultural and rural development.[12] Even so, there was still insufficient progress in the mechanization of agriculture. By 2010, only 28 percent of rice harvests in the Mekong River Delta were mechanized due to the predominance of small landholdings, scattered plots, poor rural infrastructure, and farmers' insufficient access to credit (Cao 2010).[13]

Moreover, even with the various versions of the Cooperative Law, the economic contribution of agricultural cooperatives remains limited. There are currently 6,631 agricultural cooperatives, which represents 46 percent of all cooperatives in Vietnam. These agricultural cooperatives have 5.3 million members, which is equivalent to 70 percent of the membership of all cooperatives. In terms of the number of rural households covered by agricultural

[12] After Decree No. 41/2010/ND-CP of the government. This decree was later supported by circulars of the State Bank of Vietnam and the MARD.
[13] These problems actually existed even before 2000 (Marsh and MacAulay 2006).

cooperatives, the corresponding proportion is 44 percent. Despite the number of members and the proportion of households covered, cooperatives as a whole accounted for only a limited share in GDP, which decreased steadily from 10.1 percent in 1995 to 5.5 percent in 2009. The growth rate of cooperatives has generally been well below that of the overall growth rate of Vietnam's GDP (Figure 2). The limited contribution and growth rate could be attributed to the cooperatives themselves and the Cooperative Law (Nguyen 2010). Many cooperatives fail to organize their activities effectively, thereby generating little benefits for members. Others fail to engage the participation of the people and other economic entities. Consequently, the number of nonoperational cooperatives is rather large (about 3,040).

Vietnam's economy has been growing and has been characterized by increasing openness and integration into the regional and world economies. As such, Vietnam's opportunities for increased agricultural development remain enormous. In turn, this may stimulate further diversification of agriculture and the rural economy and, along with that, rural development. However, there remain various impediments to the diversification process. Within its limited scope, this paper focuses only on some of the major ones, which are as follows:

First, the current models and incentives for cooperatives are inadequate. The people still cannot properly grasp the very concept of cooperatives. The majority of them still think of cooperatives as an enterprise. This fallacy prevents members of cooperatives from fully acknowledging their rights and responsibilities as well as their role in the organization and management of all aspects of cooperatives, including handling of finance, assets, and distribution. There is also a lack of regulations enforcing transparency in accounting and the auditing of cooperatives. These factors, coupled with the limited range of input services provided by cooperatives, hinder their development and prevent them from becoming an effective support mechanism to the modern diversification of agriculture and the development of rural areas.

Second, investment in the agriculture-forestry-fishery sector is still relatively small, thereby preventing major breakthroughs in agricultural development and diversification. Even at current prices, investment for all subsectors of the agriculture-forestry-fishery sector rose by only 9.7 percent in the period 2000—2004 and by almost 93.3 percent in the period 2004—2009.[14] Such increases were far below those of total investment, which reached 92.4 percent in

[14] The growth rates are not annualized.

2000—2004 and 143.6 percent in 2004—2009. Consequently, the share of the agriculture-forestry-fishery sector in total investment contracted drastically from 14 percent in 2000 to 8 percent in 2004 and then to 6 percent in 2009. Excluding the effect of price increases, investment in the agriculture-forestry-fishery sector fell by 7.7 percent between 2000 and 2004 and increased by 74.2 percent in 2004—2009, that is, significantly more slowly than total investment, with growth rates of 64.5 percent in 2000—2004 and 96.1 percent in 2004—2009. Although investment in the agriculture-forestry-fishery sector grew faster in recent years, it still remained relatively small. Thus, diversification can happen only gradually. Moreover, limited investment prevents the purchase and use of machinery, ultimately constraining mechanization and large-scale agricultural production.

Third, together with the shift in economic structure, workers in the rural areas are shifting to the industry-construction and services sectors, which have been expanding more rapidly. However, the probability of getting employed in these sectors is not uniform for all rural workers. Those with better skills and qualifications can find jobs outside of agriculture with greater ease. As discussed in Section II, the shift in the labor structure away from the agriculture-forestry-fishery sector was slower than that which happened in the economic structure. This implies that most rural workers remain in the agriculture-forestry-fishery sector mainly due to their lack of skills relative to the requirement in the other sectors. This imposes more challenges for the rural areas and the agricultural sector as far as development is concerned.

4. Conclusions and policy recommendations

The paper affirms the progress Vietnam has made in terms of agricultural development. The extended agriculture sector exhibited continuous growth in 2001—2010. However, the sector's growth has been well below that of national GDP, thereby leading to its contraction relative to GDP. Also, the different subsectors of the agriculture-forestry-fishery sector had different growth rates, with the fishery subsector exhibiting the most rapid growth. The value-added content also differed markedly from one subsector to another, leading to different attempts to diversify agricultural production. Moreover, the direct contribution of agriculture-forestry-fishery products to exports and imports was rather limited and concentrated within a small range of products. Some of these are largely inputs to other export-oriented processing industries. Together with the shift in economic structure, the share of the agriculture-forestry-fishery sector in total employment also swiftly decreased. Evidence presented in the paper also shows that the sector's growth has been driven largely by productivity improvement, giving hope for more sustainable growth in the future.

Vietnam also witnessed the diversification of agriculture-forestry-fishery products. Agriculture in general and paddy rice in particular remain dominant, but their shares have somewhat declined with the expansion of other existing products and the emergence of new products. While crop specialization remains ambiguous, regional specialization for some agricultural products seems to be more evident. In the early years (i.e., from 1993—2002), rural households had more diverse sources of income, which helped reduce poverty. Starting 2008, these same rural households started specializing in a smaller range of income sources. Agricultural products were also increasingly commercialized, although crop outputs were less commercialized compared to other agricultural outputs. Vietnam recently emphasized the need to further develop agriculture and rural areas in line with measures passed by the government to support larger farms. However, major impediments to further agricultural and rural diversification remain, including inadequate models and incentives for cooperatives, relatively small investment in the agriculture-forestry-fishery sector, and the failure of the sector to attract and retain workers with skills and/or qualifications.

Despite these impediments, Vietnam has transformed itself from an aid-dependent economy plagued by serious food shortage and heavily distorted resource allocation into a significant exporter of a wide range of products, including unprocessed and processed agricultural goods. It should be noted that Vietnam's current stage of agricultural and rural development came years after the start of the Doi Moi. By way of an explanation, the agricultural and rural reforms were undertaken continuously as part of a comprehensive set of reforms, with a view to broadening the opportunities for economic entities and individuals and to enhancing their capacity to take advantage of such opportunities. In turn, the socioeconomic achievements in general and agricultural development in particular enhanced people's confidence in the reform process while helping to reveal the weaknesses that need to be addressed in such a process.

The context for further agricultural and rural development in Vietnam may change in the future. The recent global financial crisis failed to overshadow the issue of food security in the Asian region. The food crisis of 2008 caused panic in several Asian countries whose subsequent policies inappropriately influenced international markets. Even with the global financial crisis fading away, signs that food security is improving have yet to emerge. In fact, the issue has become more serious as the number of cultivation areas has stopped growing, even at the world level, and as productivity growth has slowed down over the past decades. To ensure food security, countries in the region need to make coordinated efforts in the following areas, among others: (1) refrain from imposing sudden restrictions on agricultural exports; (2) establish a stockpiling system for food at the domestic and regional level; (3) enlarge the production base of staple food for the long run; and (4) look into the impacts of price hikes of staple food on poverty (Kimura et al. 2009).

In this new development context, Vietnam needs several policies to promote agricultural development in line with agricultural and rural diversification. First, the country should further promote trade in agriculture-forestry-fishery products. On the one hand, this requires the establishment of a more relevant incentive structure to avoid unnecessary (and/or costly) distortion in such trade. On the other hand, it is of even greater importance to enhance the competitiveness of those products in terms of price and quality. This will help bring the products to market. In this respect, Vietnam's move to open rice trading to foreign enterprises starting 2011 (a fulfilment of one of its commitments as part of WTO accession), may actually be beneficial for the country's farmers and rice products.

Second, Vietnam should facilitate the establishment and development of rural value chains. This will further commercialize agricultural products and promote rural transformation. To do so, studies should first be undertaken to identify potential areas for setting up value chains and measures to raise the value-added content of final agricultural products. Moreover, existing value chains should also be strengthened. In either case, the value chains should be inclusive of rural households, particularly the poor ones. Only with such inclusiveness can rural inequality be reduced, thereby enhancing the sustainability of rural diversification. This should, however, be accompanied by the improved competence and even nonfarm entrepreneurship of rural households.

In addition, the development of rural value chains should rest to a large extent on building and/or strengthening the linkages between the agricultural and the nonagricultural sectors in the rural areas. Of special importance are measures to employ more modern technology (in processing, preserving, packaging, etc.) in the value chains, thereby increasing the commercial competitiveness (and value-added content) of agricultural products. Nevertheless, the development of rural value chains should also incorporate measures to address the prevailing issue of middlemen, so that producers of agricultural-forestry-fishery products can reap a more reasonable share of their final market value. Again, the presence of foreign enterprises in the rice market, while threatening local middlemen and rice-trading companies, may also benefit rice producers.

Third, Vietnam should improve human resources in rural areas to support agricultural and rural diversification. Rural farmers should be trained to adopt new technologies in agricultural production. With the current contraction in agricultural cultivation areas, this is the key direction for promoting higher agricultural productivity. Along with this process, the state and concerned agencies should disseminate information on market development and technologies related to processing, preserving, packaging agricultural products and equip farmers with the necessary skills to use that information. Together with developing rural value chains, measures should also be undertaken to improve farmers' capacity to participate in the different stages of the chains. As previously suggested, rural households should also be equipped with the necessary entrepreneurial skills, which may be crucial for more rapid and sustainable diversification of agriculture and the rural economy.

Finally, Vietnam should engage in regional and international cooperation on agriculture. Regional and international cooperation may facilitate the sharing of experience so that the country can take better advantage of opportunities and mitigate risks from agricultural markets. Also, as a key exporter of many agricultural products, including staple food, Vietnam's effective cooperation with other countries at the regional and international levels can help ensure stability in the international market. This helps reduce risks in terms of price and market access for the country's agricultural products, which may have significant implications for the livelihood of farmers in Vietnam. Likewise, more stable (price) signals in the international market can effectively induce more investment in agriculture, thereby broadening the chance for developing new agricultural products and thus agricultural diversification. Vietnam and other countries in region should also be engaged in long-term cooperation in the promotion of agricultural research and training. This helps lay the foundation for more sustainable development of agriculture and makes such development inclusive of farmers–the key actors in agriculture.

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Appendix 1: Major User Industries and Other Purposes for Agriculture Output

	Subsector	**Major user industries** *(figures in brackets denote percentages of output used)*	**Other purpose(s)**
1	Paddy rice (all kinds)	husking and flour production (25.90); annual crop (11.71); manufacturing animal, cattle, and fishery feed (9.59); other goods manufactures (7.52)	Change in inventory (37.76)
2	Sugarcane	other goods manufactures (87.02); annual crop (10.63)	
3	Other crops	annual crop (28.78); manufacturing animal, cattle and fishery feed (20.23); food service (5.49); processed and preserved fruits and vegetables (5.28); livestock (5.05)	Export (10.95)
4	Raw rubber	basic chemicals, fertilizer and nitrogen compound, plastic and primary synthetic rubber manufacture (9.27); by-product rubber manufacture (5.55)	Export (44.03); Change in inventory (35.26)
5	Coffee beans	perennial plant (54.61)	Export (97.31)
6	Tea, processed (all kinds)	other chemicals, man-made fibers manufacture (29.32); other goods manufactures (19.6); repair service and equipment and machinery maintenance, other processed industrial products manufacture (5.61)	Export (7.56)
7	Other perennial plants	manufacturing animal, cattle, and fishery feed (19.35); tobacco products (17.43); manufacturing drinks (8.00); husking and flour production (6.41)	Export (6.91)
8	Buffaloes, cows	livestock (57.61); processed, preserved meat and by-products (28.38); food service (17.55)	Export (9.81)
9	Pigs	processed, preserved meat and by-products (13.92); livestock (11.29)	Export (14.32); Change in inventory (15.19)
10	Poultry	food service (34.09); livestock (24.41)	

11	Other livestock and poultry, not elsewhere classified (n.e.c.)	livestock (7.53)	Change in inventory (26.12)
12	Agricultural services and other agricultural products	other agricultural activities and agricultural services (40.18); annual crop (33.73); manufacturing animal, cattle, and fishery feed (5.48)	
13	Round timber	Processed wood and by-wood products, bamboo (except except beds, cabinets, tables, chairs); straw products and entangle material (23.37); Manufactured beds, cabinets, tables, chairs (7.61)	Change in inventory (59.21)
14	Other forestry products; forestry service, planting tree	logging and other forest products (20.93); annual crop (6.52); forestry service, planting tree (5.50)	
15	Fishery	processed, preserved fishery and by-products (50.06); food service (5.65); fish farming (5.05)	
16	Fish farming	processed, preserved fishery and by-products (27.84); fish farming (7.47)	Export (37.09)

***Source*:** Authors' calculations from Vietnam's Supply-and-Use Table for 2007.

Appendix 2: Notes on calculations of TFP growth

This paper adopts the growth accounting method introduced by the Asian Productivity Organization (2001) to compute TFP growth in agriculture. The method rests on the modified version of the production function proposed by Solow (1957):

$Y_t = A_t f(K_t, L_t, N_t)$

of which, at time *t*, Y_t denotes total output, K_t represents capital stocks, and L_t and N_t are the area of agricultural land and number of workers, respectively. A_t measures the efficiency of joint utilization of production factors (i.e., productivity); therefore, total output may still vary in response to a change in A_t, even if scales of all other production factors remain constant. With this implication, A_t is called Total Factor Productivity (TFP).

According to the growth accounting framework, TFP growth is calculated as:

$$\%\Delta TFP = \%\Delta GDP_{agriculture} - (\alpha.\%\Delta K_{agriculture} + \beta.\%\Delta N_{agriculture} + \gamma.\%\Delta L_{agriculture})$$

of which*:* %Δ denotes the percentage change. α, β, and γ are the respective shares of capital, labor, and land for agriculture ($\alpha + \beta + \gamma = 1$). Accordingly, α and β are computed from the General Statistics Office (GSO) data on income for capital and workers and total value added in agriculture.

The computation of TFP growth for the agriculture-forestry-fishery sector, in this framework, requires the following data: (1) GDP of the sector at comparable prices (Y) to calculate GDP growth; (2) the value of fixed capital stock in the sector (at comparable prices) to calculate growth in capital stock; (3) the number of employees in the sector to calculate employment growth; and (4) income for capital and workers and value added of the agriculture-forestry-fishery sector.

The data on GDP, land, and employees for the agriculture-forestry-fishery sector are published by the GSO in its annual statistical yearbook. The data on capital stock/fixed assets are calculated by Dinh et al. (2009), but only at the economy level. Therefore, the authors computed the capital for agriculture based on following assumptions:

- All capital/fixed assets are homogeneous across sectors (agriculture and nonagriculture) and across types of ownership (public and private). This means that all components of fixed assets have the same marginal product and depreciation rate.
- Only private fixed capital (available for 1990—2007) is considered.
- The depreciation rate of fixed assets was 5.5 percent in 1995; for other years, the rates are based on actual depreciated amount calculated by the GSO.
- The share of private fixed capital in the agriculture-forestry-fishery sector (in total private fixed capital) is equivalent to the share of investment in the sector (in total investment) in the year. Due to the unavailability of data on investment in the sector, the shares of private fixed capital in the agriculture-forestry-fishery sector for 1990—1994 are set equal to that in 1995. However, investment in the sector only considers direct investments. Such figure excludes investment in education-training and infrastructure development as these cannot be disaggregated for the agriculture-forestry-fishery sector. As the investment in those areas rose significantly in recent years, its exclusion may lead to an overestimation of TFP growth.

Chapter 11

Household Implications of Production and Price Shocks in Indonesian Agriculture

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CHAPTER 11

Household Implications of Production and Price Shocks in Indonesian Agriculture*

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1. Introduction

The various economies of East Asia differ considerably in whether they are net importers or exporters of staple foodstuffs. Partly as a consequence, agricultural policies also differ widely. Generalizing broadly, major net exporters of food, such as Thailand, typically intervene only moderately in the markets for these commodities, but countries that are both net importers and substantial producers of food, such as Indonesia, have increasingly tended to intervene more heavily. In particular, they look for ways to promote "food security" by limiting food imports.[1] Critics of these policies interpret "food security" as code for politically driven protection of the import-competing agricultural sector. Whatever the motive for the protection, its existence has important economic consequences. When the agricultural sectors of these two groups of countries are affected by price or production shocks, the effects on the agricultural sectors themselves and the subsequent effects on rural

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[1] Importers that are not significant producers, such as Singapore and Hong Kong, view "food security" quite differently. For them, there is no possibility of producing all the food they require.

and urban households may be quite different because the policy environment in which the agricultural sector operates is so different.

As interpreted here, a price shock means an exogenous international price change like the international food price crisis of 2007—08. Obviously, such a shock can be positive or negative. A production shock means an exogenous positive or negative shock to domestic supply conditions. It may be a temporary negative shock, such as drought, floods, crop diseases, or pest outbreaks, but it can also be a more permanent positive shock such as a change in technology that shifts production functions or a permanent (positive or negative) change in climatic conditions.

This study focuses on Indonesia, a net importer of virtually all of its staple foods, including rice and sugar, but a net exporter of several nonstaple agricultural commodities, such as rubber and palm oil. The Indonesian government intervenes actively in pursuit of its goal of food security, which is overwhelmingly interpreted to mean avoiding imports of rice. Indonesia has been a major importer of rice for many decades, but it officially prohibited imports of rice in 2004.[2] This feature of its trade policy will clearly affect the way that production shocks on the one hand, and externally induced price shocks on the other hand impact rural and urban households in Indonesia, compared with what those impacts would be under free trade. This study attempts to clarify these differences.

The method of analysis used is a very simple general equilibrium model of the Indonesian economy to study the way these two kinds of shocks affect households under different agricultural trade policies. The model is indeed simple, but it is based on empirical Indonesian data. The research first simulates the effects of both production and price shocks under free trade, then under a binding restriction on food imports, and then compares the results. The reason for using a very simple model is to isolate the economic issues that are most important for the effects on households of agricultural price and production shocks. The paper begins by summarizing the case for a general equilibrium treatment. Then it

[2] The "ban" is only partially effective in the sense that some imports still enter the country, and imported rice can still be found in the Jakarta retail market. In effect, the "ban" is more like an import quota where the quantity of imports permitted is about one-tenth of the previous level. The permitted quantity of imports is apparently variable and has changed with market conditions. Exports of rice were already banned since at least the early 1990s to eliminate the possibility that a surge in international prices could produce a similar price surge within Indonesia.

presents a summary of the multihousehold general equilibrium model to be used followed by a description of the simulations performed. The study then discusses the implications of the findings.

2. A Simple General Equilibrium Framework

2.1 The case for a general equilibrium treatment

Suppose we are interested in the economic consequences on households of changes in international agricultural prices similar to what happened in 2007—08. The effect on the welfare of individual households involves both changes in household expenditures (operating through consumer goods prices) and changes in household incomes (operating through changes in factor returns). The effect on consumer goods prices is obvious. On the income side, factor returns will also be affected. In the case of a large increase in agricultural prices, the agricultural sector can be expected to respond to higher prices with increased output, increasing the demand for the factors of production that it uses. Returns to agricultural land will increase. Since agriculture is a large employer of labor, the equilibrium wage may rise throughout the economy, thereby influencing returns to fixed factors used elsewhere. These changes in factor returns will in turn affect the structure of household incomes, depending on the factor ownership characteristics of individual households.

Alternatively, consider the effect on agricultural production of shocks such as natural disasters or pest outbreaks on the one hand, or improvements to agricultural technology on the other. These shocks will affect households via changes in factor incomes and perhaps through changes in commodity prices as well.

Clearly, an analysis of the way large external price shocks or shocks to production conditions affect the structure of household welfare (and thus poverty) is inherently a general equilibrium problem. The objective of this study is to employ the *simplest* general equilibrium structure that is capable of capturing the essence of the phenomena under study. The model is called *Indonesia-Dua*. Most of its structural features are very conventional. Its distinctive feature is its disaggregated household structure, designed to facilitate analysis of the way exogenous shocks affect poverty and inequality. Despite its simplicity, the model is empirically based. On the production side, it draws upon the Indonesian *Social Accounting Matrix* and on the household side, it draws upon the Indonesian household income and expenditure survey called *Susenas*.

The advantage of working with a general equilibrium model with a disaggregated household sector is that it becomes possible to conduct controlled experiments that focus on the consequences on household incomes, expenditures, poverty, and inequality resulting from different economic shocks, taken one at a time.

2.2 Model structure

Consider a very simple two-sector economy in which agricultural commodities are net imports and nonagricultural commodities like manufactured goods are net exports. There is one factor of production—labor—which is mobile between the two industries and one specific factor used in each of the two industries. The agricultural factor can be called land and the nonagricultural factor, capital. There are 100 rural households of varying income levels, which derive their incomes primarily, but not exclusively, from ownership of factors used in agriculture. There are also 100 urban households whose incomes also vary and which derive their incomes primarily, but not exclusively, from factors used in the nonagricultural industry. The rural and urban households are each arranged by expenditure per person into 100 subcategories of equal population size.

The theoretical structure of *Indonesia-Dua* is conventional for static general equilibrium models and includes the following major components:

- Cobb-Douglas household consumption demand systems for each of the 200 households, for each of the two consumer goods
- The household supplies of each of the three factors of production are exogenously given
- A factor demand system, based on the assumption of constant elasticity of substitution (CES) production technology, which relates the demand for each primary factor to industry outputs and prices of the primary factors used in that industry. Factors of production may therefore be substituted for one another in ways that depend on factor prices and on the elasticities of substitution between the factors. Elasticities of

substitution in both industries are initially set at 0.5.

- Rates of import tariffs and excise taxes across commodities based on data from the Indonesian Ministry of Finance
- A set of macroeconomic identities ensuring that standard macroeconomic accounting conventions are observed
- A set of equations determining the incomes of the 200 households from their exogenous ownership of factors of production and their endogenously determined rates of return, reflecting data derived from the 2003 *Social Accounting Matrix*, the (endogenous) rates of return to these factors, and any net transfers from elsewhere in the system. This feature is fully integrated within the general equilibrium structure and enables the model to capture the way that changes in the economy affect households on the expenditure side (through changes in the prices of goods and services that they buy) and on the income side (through changes in the returns to factors of production that they own).
- The nominal exchange rate between the Indonesian currency (the rupiah) and the US dollar can be thought of as being exogenously fixed. The role of the exogenous nominal exchange rate within the model is to determine, along with international prices, the nominal domestic price level. Given that prices adjust flexibly to clear markets, a 1 percent increase in the rupiah/dollar exchange rate will result in a 1 percent increase in all nominal domestic prices, leaving all real variables unchanged.

The demand-and-supply equations for private-sector agents are derived from the solutions to these agents' microeconomic optimization problems (utility maximization for households and cost minimization for firms). All households and firms are assumed to be price-takers, with producers operating in competitive markets with zero-profit conditions, reflecting the assumption of constant returns to scale. Both agricultural and nonagricultural goods are traded internationally at exogenously given prices. The nominal exchange rate is exogenously fixed. Wage adjusts endogenously to clear the labor market.

The general equilibrium properties of this simple model can be understood with the aid of figure 1. The fixed total supply of labor is indicated by the horizontal axis. Labor can be allocated between the two sectors subject to this restriction on its total supply. Given the prices of the two goods, the marginal value product of labor in the agricultural and nonagricultural sectors corresponds to the demand for labor in these two sectors, respectively, as given by the schedules D_{LA} and D_{LN}.

When the demand for labor in agriculture is D^0_{LA}, the full employment equilibrium gives a wage of w^0 and an allocation of labor between the two sectors of L^0. If the demand for labor in agriculture shifts to the right, say to D^1_{LA} (as for example, with an increase in the price of the agricultural good or due to some particular forms of technical change, discussed further below), the equilibrium real wage increases to w^1, employment in agriculture increases to L^1 and employment in the nonagriculture sector declines. A larger increase in labor demand, say to D^2_{LA}, increases these effects, while a reduction in the demand for labor in agriculture, say to D^3_{LA}, reduces the real wage and shifts employment from agriculture to nonagriculture.

2.3 Social accounting matrix and equation set

Table 1 summarizes the social accounting matrix that describes the initial state of this economy, based on the Indonesian *Social Accounting Matrix* for 2003. Obviously, many simplifying assumptions were required to reduce the input-output structure for Indonesia to a two-sector framework without intermediate inputs. The expenditures, incomes, and sources of income of the 100 rural and 100 urban households are based on household survey data for Indonesia, derived from the 2006 *Susenas* survey. The full equation set for the model is provided in the appendix.

2.4 Factors of production

The mobility of factors of production is a critical feature of any general equilibrium system. "Mobility" here refers to mobility across economic activities (industries) rather than geographical mobility. The greater the degree of factor mobility, the greater is the economy's simulated capacity to respond to changes in the economic environment. Assumptions about the mobility of factors must be consistent with the length of run that the model is intended to represent.

Two types of factors are identified: those mobile between the two industries, called "labor," and those specific to the industry concerned within the period of adjustment implicit in the model. These specific factors are called “land” in agriculture and “capital” in nonagriculture, but it should be recognized that these are really just labels of convenience.

2.5 Households

Table 2 summarizes the characteristics of urban and rural households to the extent that they relate to poverty incidence. Mean consumption expenditures per capita differ widely between urban and rural households. In the simulations conducted below, poverty incidence is calculated for each of these two household categories. The poverty lines used for each category replicate the official levels of poverty incidence reported in the 2003 *Susenas* survey, using official poverty lines. These rates of poverty incidence are summarized in the final column of table 2. Significant numbers of poor people are found in both categories: 13.6 percent of the urban population and 20.2 percent of the rural population. These numbers, together with the urban/rural population shares, imply that 65 percent of all poor people within Indonesia reside in rural areas.

Figure 3 shows the cumulative distribution of expenditures for urban households (left panel) and rural households (right panel). The solid lines show these distributions as given by the data *ex ante*, that is, before any simulations are performed. The dashed lines, to be discussed later, show the estimated distributions *ex post*, or calculated from a particular simulation. The vertical intersection of the distribution with the poverty line indicates poverty incidence as a percentage of the population concerned.

2.6 Analyzing distributional impacts

Several approaches have been adopted in analyzing income distribution within a CGE context. The approach used in this study is the *integrated multihousehold method*, which consists of disaggregating households and arranging them by the size of expenditure or income per capita. If the categories are detailed enough, distributional impacts such as effects on poverty incidence or standard inequality indicators can be estimated with any desired level of accuracy. As the number of household categories is increased, greater accuracy can be achieved. For example, Warr (2008) used this approach in assessing the effects that the 2007—08 international food price crisis had on poverty incidence in Thailand.

Poverty incidence is calculated as follows. Let y_c be real expenditure per capita of a household of the c-th centile where c = 1, 2, …, 100. The initial (*ex ante*) level of poverty incidence is calculated using

$$P(y_c, y_P) = \max\{c \mid y_c < y_P\} + \frac{y_P - \max\{y_c \mid y_c < y_P\}}{\min\{y_c \mid y_c > y_P\} - \max\{y_c \mid y_c < y_P\}}$$

(1)

where y_P is the poverty line. The first term is simply the lowest centile of which expenditure per capita is closest to the poverty line. The second term is the linear approximation to where the poverty incidence lies between centiles c and c+1.

The change in poverty incidence after a policy shock (simulation) is calculated as

$$\Delta P = P(y_c^{**}, y_P) - P(y_c, y_P)\,.$$

(2)

The distribution y_c^{**} is calculated by first computing the distribution of *ex post* levels of real expenditures from

$$y_c^* = \left(1 + \frac{\hat{y}_c}{100}\right).y_c\,,$$

(3)

where $\hat{y}_c$ is the percentage change in real per capita expenditure of household of centile c produced from the simulation of the computable general equilibrium (CGE) model. The distribution y_c^* is then *re-sorted* to obtain the distribution y_c^{**}, such that $y_{c+1}^{**} \geq y_c^{**}$ for all c. This re-sorting is necessary to re-establish a well-behaved cumulative distribution because the ordering of households within the distribution y_c^* may have changed from the original distribution, y_c. It is therefore not necessarily the case that $y_{c+1}^* \geq y_c^*$ for all c.

Returning to figure 3, the dashed lines show the *ex post* distributions of real expenditures, calculated at base-period prices using household-specific consumer price deflators. Thus, their intersections with the poverty line indicate the estimated *ex post* level of poverty incidence. The difference between this and the *ex ante* levels is therefore the estimated change in poverty incidence resulting from the shocks concerned.

3. Simulations and Results: Agricultural Price Shocks

3.1 Model closure

Since the real expenditure of each household is to be used as the basis for the calculation of poverty incidence and inequality, the macroeconomic closure must be made compatible with both this measure and with the single-period horizon of the model. This is done by ensuring that the full economic effects of the shocks to be introduced are channeled into current-period household incomes and do not "leak" in other directions, with real-world intertemporal welfare implications not captured by the welfare measure. The choice of macroeconomic closure may thus be seen in part as a mechanism for minimizing inconsistencies between the use of a single-period model to analyze welfare results and the multiperiod reality that the model depicts.

To prevent these kinds of welfare leakages from occurring, the simulations are conducted with balanced trade (exogenous balance on current account). In addition, all government revenue raised from taxes is distributed to households in lump sum form in proportion to their incomes. This ensures that the potential effects of the shock being studied do not flow to foreigners through a current account surplus, or that increases in domestic consumption are not achieved at the expense of borrowing from abroad in the case of a current account deficit. In addition, the structural features of the model mean that there is no government spending, no investment, and no household saving. In macroeconomic terms, any change in GDP is matched by an identical change in household consumption expenditure. The effect of this closure is that the full effects of the shocks concerned on policy are channeled into household expenditures and not into effects that are not captured within the single-period focus of the model.

3.2 Shocks to the international price of the agricultural good

Table 2 summarizes the simulated effects of shocks to the international price of the agricultural good. The effects on rural and urban poverty incidence are summarized in figures 1 and 2. We analyze a range of price shocks ranging from a price reduction of 24 percent to a price increase of 24 percent. The simulated effects are described in table 2.

The distributional effects of the simulated shocks to prices can be clarified further by decomposing the change in real expenditure within each socioeconomic group as follows. As above, uppercase Roman letters like Z will denote levels of variables and lowercase Roman letters like z will denote their proportional change. Let the proportional change in the nominal income of household h be given by $y_h = \tilde{y}_h + p_h$, where $\tilde{y}_h$ is the proportional change in the household's real income and $p_h = \sum_{i=1}^{I} S_h^i p^i$ is the proportional change in a consumer price index (CPI) specific to household h, with $S_h^i = E_h^i / Y_h$ denoting that household's expenditure share on commodity i, E_h^i denoting its nominal expenditure on commodity i, and p^i denoting the proportional change in the consumer price of commodity *i*. The absolute change in this household's nominal income is now

$$dY_h = Y_h y_h = Y_h \tilde{y}_h + Y_h p_h. \tag{4}$$

Now, noting that the base levels of nominal and real expenditures are equal ($Y_h = \tilde{Y}_h$)[3], the change in the nominal income of the household is given by the change in its real income plus the change in its true cost of living, the latter an expenditure weighted sum of the changes in the consumer prices that household actually faces, where the expenditure weights pertain to that particular household:

$$dY_h = d\tilde{Y}_h + \sum_{i=1}^{I} E_h^i p^i. \tag{5}$$

[3] Real expenditures means expenditures measured at constant prices, defined here to mean base period prices. Thus, the levels of nominal and real expenditures in the base period are identical.

Disregarding any changes in transfer income or direct taxes for simplicity, the change in nominal income is equal to the change in factor income, Y_h^f. Thus

$$d\tilde{Y}_h = dY_h^f - \sum_{i=1}^{I} E_h^i p^i. \tag{6}$$

The change in the household's real income is decomposable into the change in its nominal factor income minus the change in its true cost of living. Clearly, the change in nominal factor income is itself directly decomposable into its factor components.

Tables 4 and 5 apply this decomposition to the results of the simulations described in table 3. The calculations refer to the particular household within the set of urban households (table 4) and rural households (table 5) with a base level of expenditures closest to the respective poverty line. If the real expenditure of that household increases, we expect poverty incidence within that socioeconomic category to decline and vice versa. The decomposition makes it possible to explain the reason for the estimated change in poverty. This feature of the analysis helps overcome the "black box" feature of so many general equilibrium studies.

3.3 Shocks to agricultural productivity

The effects of shocks to agricultural productivity are analyzed in a similar manner to the price shocks above. The meaning of the shocks can be seen from the equation set provided in the appendix. A factor-neutral deterioration in agricultural productivity is represented by the shock shown in the first column of table 6, a_A^L = a_A^K = -1. This shock *increases* the requirements of both labor and capital in producing one unit of output by 1 percent and is therefore a negative productivity shock. A factor-neutral improvement is given by the fourth column where a_A^L = a_A^K = 1 indicated a 1 percent *reduction* in the requirements of both labor and capital in producing one unit of output. Factor-biased technological change is covered in table 7. The first column, reporting the shock a_A^L = 1 depicts a 1 percent *reduction* (technological improvement) in the unit requirement of labor to produce one unit of output and so on.

Figure 2 illustrates the possibility of factor-biased technical change. An initial isoquant (combinations of labor and capital producing a particular level of output, $\overline{Q}$) is given by $f^0(L,K) = \overline{Q}$. Relative factor prices are given by the slope of the line *CC,* with a slope equal to $-(r/w)$, where r is the rate of return to capital and w is the wage, implying a cost-minimizing combination of factors producing output $\overline{Q}$, given by point A. Now consider the possibility of technical change that reduces the cost of producing output $\overline{Q}$ at these factor prices to $C'C'$. The new isoquant is given by $f^1(L,K) = \overline{Q}$ and the point of tangency between it and $C'C'$ is point B. Under factor-neutral technical change, point B will lie on the ray $(L/K)^0$, the same ratio of factor usage as point A. The definition of labor-saving technical change is that point B lies on a ray with a lower ratio of labor to capital than $(L/K)^0$, say $(L/K)^1$, with a combination of factors used equal to B^1. Capital-saving technical change has the opposite characteristic as shown in figure 3. The new isoquant ($f^2(L,K) = \overline{Q}$) produces a point of tangency along a ray with a ratio of labor to capital than $(L/K)^0$.

4. Results under Free Trade

4.1 Shocks to the international price of the agricultural good

Tables 3 to 5 summarize the results. We shall consider the effect of an exogenous decline in the international price of the agricultural good, holding the price of the nonagricultural good constant.[4] These effects of a lower agricultural price are shown in the left half of tables 3 to 5, and it is helpful to focus on the first column (a 24 percent reduction in the agricultural price). The effects of a price increase are the opposite of these and are shown on the right half of the same tables. The price decline reduces real wages by reducing the domestic price of the agricultural good and thereby reducing the demand for labor in agriculture, leaving the demand schedule for labor in nonagriculture unaffected. Despite this decline in the real wage, the decline in food prices makes a higher level of aggregate real consumption possible.

[4] The nonagricultural good may be considered the *numeraire*.

The effects on urban households on the border of the urban poverty line are summarized in table 4. Income from labor and land both decline (urban households derive some income from ownership of land) but the reduction in real wages increases the return to capital. Nevertheless, total income, measured in terms of the nonagricultural good (third row from the bottom), declines. However, the cost of living (second row from the bottom) declines even more. Real expenditure (final row), therefore, rises. For the poor rural household (table 5), these effects are qualitatively similar, although the decline in income from land (second row) is larger (because poor rural households derive more of their income from this source). The reduction in the cost of living is also larger because of the larger share of food in the budget of the rural poor than the urban poor. The rise in real income of both urban and rural households near the poverty line means that poverty incidence *falls* in both categories of households (table 3).

An increase in the agricultural price (right side of tables 3 to 5) reverses all of these effects, and poverty incidence *rises* in both categories of households. A crucial point is that under free trade, a change in the international price is transmitted to both domestic producer prices (leading to income side effects) and domestic consumer prices (leading to expenditure side effects).

4.2 Shocks to agricultural productivity

The effects of factor-neutral productivity shocks in agriculture, holding international prices constant, are summarized in tables 6, 8, and 9. Factor-neutral technical *progress*–reducing the unit requirement of both labor and land–is shown on the right side of table 6 where a_A^L = a_A^H > 0 and where H denotes land. To illustrate, we can focus on the case a_A^L = a_A^H= 4. This form of technical change reduces the unit cost of producing agricultural output at constant factor prices, raising the profitability of agricultural production, inducing an expansion of agricultural output with subsequent effects on factor prices. It is helpful to focus on the final column of table 6. Agricultural output increases, the real wage rises, along with the real return to land.

The effects on urban households on the border of the urban poverty line are summarized on the left side of table 8. Income from both labor and land increases, outweighing the reduction in the return to capital. Nominal income rises. The cost of living is unchanged because commodity prices are unchanged and real expenditure therefore rises. Urban poverty incidence falls (table 6). For rural households (table 9), the effects are again qualitatively similar, except that the effects on land income are higher than for urban households. Poverty incidence declines in both urban and rural areas. Productivity-reducing technical change (left side of table 6) produces the opposite of these effects, raising poverty incidence in both urban and rural areas.

Factor-biased technical change is analyzed in table 7. A reduction in the unit requirement of labor alone corresponds to labor-saving technical change. We can focus on the example of a_A^L = 4 given by the last column in table 7. Agricultural output increases and the real wage rises.[5] Land-saving technical change (e.g., a_A^H= 4) also induces an increase in agricultural output and real wage. The return per unit of land rises as a consequence of its higher productivity.[6] In the case of both labor-saving and land-saving technical change, poverty incidence declines in both rural and urban areas.

5. Results under Restricted Food Imports

As background to the simulations to be reported below, the effect of restricting imports of the agricultural good was simulated by exogenously reducing food imports by 90 percent. This solution was then used to produce a new database, summarized in table 10. This database was then used in all subsequent simulations, with the quantity of food imports exogenously fixed at this new, lower level. The import quota on food means that the domestic price of food is no longer determined by the international price but by domestic supply-and-demand conditions. As the international price varies, the quantity of food imported does not respond but the rent associated with the import quota is affected because it is determined by the difference between the domestic price and the international price. When the international price rises, the rent declines. In the simulations below, this rent is assumed to accrue to the richest one percent of urban households. In what follows, the focus is on the difference between the results obtained under free trade as discussed above and those arising with a

[5] We discuss below the role of the assumption that the elasticity of substitution is 0.5 in driving this result.

[6] The elasticity of substitution again plays an important role in this outcome.

fixed volume of food imports.

5.1 Shocks to the international price of the agricultural good

When the international price declines, the rent associated with the quota rises. Quota owners experience increased incomes, but the domestic price of food is not directly affected. There is a small effect arising from the small increase in the demand for food from the now-wealthier quota owners. This induces a small increase in agricultural output, which, in turn, induces a small increase in real wages. The result is a small reduction in urban and rural poverty. A price increase has the opposite result: a small, negative effect on the urban and rural poor, arising from a decline in agricultural income.

The restriction on food imports shields domestic markets from the effects of these international price changes. This, in turn, shields domestic poor households from almost all of the otherwise beneficial effects of an international price decline and the otherwise harmful effects of a price increase. In assessing these effects, it must be recalled that the imposition of the quota in itself imposes a substantial domestic price increase and negatively affects urban and rural poor households in much the same way that an international price increase does under free trade. Unlike the effects of temporary international price increases, however, the negative effects of the quota last as long as the quota remains in place.

5.2 Shocks to agricultural productivity

Tables 14 to 17 now summarize the effects of agricultural productivity shocks under a food import quota. Table 14 may be compared with table 6 above. Again, it is convenient to focus on the last column of table 14 ($a_A^L = a_A^H = 4$). Whereas agricultural output expands vigorously under free trade, the expansion is smaller under an import quota because the price of food is forced down. Output rises, imports remain the same, and the increased output must be consumed domestically. The increase in agricultural consumption (table 14, last column), therefore, far exceeds that under free trade (table 6, last column). This can occur only with a lower price of food. Under free trade, most of the increase in output is reflected in reduced imports. However, a comparison between tables 16 and table 8 shows that the final effect on the real expenditures of urban households is almost the same. Under free trade, there is a larger income effect but no cost-of-living effect from reduced food prices. Under the quota, there is almost no income effect but a substantial cost-of-living effect. Comparison between tables 17 and table 9 shows that the outcome for rural households is slightly more favorable under the quota than under free trade. The higher share of food in the consumption basket of rural households means that the decline in the price of food has greater value for them, on average, than for urban households.

An expansion of agricultural output occurs under both labor-saving and land-saving technical change, again forcing down the price of food. Nominal wages fall because of the decline in agricultural prices. However, this is outweighed by the decline in the CPI caused by declining food prices while real wages rise slightly. Returns to land rise under labor-saving technical change but fall under land-saving technical change. Under free trade, returns to land rise in all cases. The paradoxical effect of the existence of an import quota is that land owners lose from land-saving technical change because of the resulting decline in agricultural prices.

Overall, both the urban and rural poor benefit from technical progress in agriculture under free trade and under an import quota on food. The magnitude of the benefits is surprisingly similar under the two trade policy regimes. Under free trade, the benefits mainly take the form of increased incomes. Under restricted food imports, the benefits arise mainly from a lower price of staple foods.

6. Sensitivity of the Results to the Elasticity of Substitution

It has been known since Hicks that the elasticity of substitution can play an important role in determining the distributional effects of factor-biased technical change. For example, the lower is the elasticity of substitution, the greater is the likelihood that labor-saving technical change will lower the real wage. The preceding results were computed under the assumption that the elasticity of substitution in both industries is 0.5. Suppose this elasticity was 0.25 in agriculture. How would the results be affected? Tables 18 and 19 show the results.

The lower elasticity of substitution results in a smaller decline in the price of food under labor-saving technical change but a larger decline when the technical progress is land-saving. The decline in labor income that occurs under labor-saving technical change is accentuated by a low elasticity of substitution. Overall, both urban and rural households still gain from technical change under a lower elasticity of substitution, but the gain is smaller in the case of labor-saving technical change and larger in the case of land-saving technical change. Significantly, whether the technical change is labor-saving or land-saving and regardless of the trade policy regime, both urban and rural households benefit from productivity growth in agriculture, at least within the range of the elasticity assumptions considered in this study.

7. Conclusions

This paper used a simple general equilibrium framework to analyze the effects of agricultural price shocks and production shocks under two different policy environments. A restriction on food imports reduces welfare in a static sense and raises poverty incidence but it shields poor households from the effects of fluctuations in international agricultural prices. The effects of production shocks are also influenced by trade policies. When imports are restricted, production shocks affect poor households to a greater extent on the expenditure side (through the price of food rather than through income changes). The elasticity of substitution within agriculture has been found to affect the magnitude of these outcomes but not their signs. The results of this study show that the rural and urban poor benefit from technical progress in agriculture and lose from negative shocks, regardless of whether the shock is labor-saving or land-saving and regardless of the nature of the trade policy regime.

This study also found that whether the existing policy objective of "self-sufficiency" in staple foods is maintained or not, productivity-enhancing investments in agriculture have strong poverty-reducing effects. Unfortunately, Indonesia's public investment in agricultural research relative to total value-added in agricultural production (a measure known as research intensity) has declined alarmingly (by about two-thirds) over the past three decades since the late 1970s even though agricultural research in Indonesia has been found to enhance productivity growth with a high economic rate of return.[7] The trend of declining research intensity should therefore be reversed.

[7] Warr (2011) available from the author upon request.

Agricultural liberalization also enhances poverty reduction because it reduces the cost of staple foods, generating significant gains for poor households. Since 2004, Indonesia has adopted the opposite policy—tighter import controls on food, directed at achieving food self-sufficiency. It is a myth that poverty incidence is reduced by protecting the agricultural sector through import controls. Some poor farmers do indeed benefit from these import restrictions. However, many other small farmers are net purchasers of staple foods and they are harmed by import controls. Overall, the number of poor households within Indonesia that are net *sellers* of staple foods is greatly exceeded by the number of poor people who are net *purchasers*. This statement is true even within rural areas.

The policy recommendations consistent with these findings are that the interests of poor households within Indonesia, both rural and urban, are best served by gradual liberalization of import controls on staple foods, especially rice, combined with substantially increased levels of productivity-enhancing agricultural investments, particularly in research and development.

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Tables and Figures

Table 1. Social Accounting Matrix without Protection

			Industries		Commodities		Factors		HH	Govern-ment	ROW	
	Category		1	2	3	4	5	6	7	8	9	Total
Industries	Agriculture	1			342,077							342,077
	Nonagric.	2				1,665,920						1,665,920
Commodities	Agriculture	3							375,778			375,778
	Nonagric.	4							1,624,427		41,492	1,665,920
Factors	Labor	5	230,649	718,856								949,505
	Capital	6	111,429	947,063								1,058,492
Households		7					949,505	1,058,492		160	-7,951	2,000,205
Government	Taxes/Tariffs	8			160							160
Rest of the world (ROW)		9			33,541							33,541
	Total		342,077	1,665,920	375,778	1,665,920	949,505	1,058,492	2,000,205	160	33,541	

***Note*:** Data based on Indonesia input-output tables for 2005.

Table 2. Expenditure and Poverty Incidence, By Household Group, 2005

	% of total population in this group	**% of total households in this group**	**Mean per capita expenditure (Rp. /mo.)**	**% of population in this group in poverty**
Urban	45.54	44.68	732,023	13.6
Rural	54.46	55.32	413,576	20.2
Total	100	100	558,597	17.19

***Source*:** Authors' calculations from Indonesia's *Susenas* survey and related data sources.

Table 3. Agricultural Price Shocks under Free Trade: Simulation Results

	Variable	Unit	-24 %	-12 %	-8 %	-4 %	4 %	8 %	12 %	24 %
			Shock: Change to international price of agricultural good							
Output agric.	x_A	% Δ	-19.52	-8.75	-5.65	-2.74	2.58	5.01	7.31	13.53
Output non agric.	x_N	% Δ	3.49	1.69	1.11	0.55	-0.54	-1.07	-1.59	-3.09
Wage	w	% Δ	-9.00	-4.40	-2.91	-1.45	1.43	2.84	4.23	8.32
Rent on land	r_A	% Δ	-50.77	-26.74	-18.10	-9.18	9.43	19.09	28.97	59.83
Rent on capital	r_N	% Δ	7.11	3.40	2.24	1.10	-1.08	-2.13	-3.15	-6.09
CPI	*cpi*	% Δ	-5.02	-2.37	-1.55	-0.76	0.74	1.46	2.15	4.13
GDP	*gdp*	% Δ	-3.69	-1.94	-1.32	-0.67	0.69	1.39	2.11	4.35
Real GDP	*rgdp*	% Δ	0.035	-0.016	0.011	0.005	-0.005	-0.009	-0.014	-0.027
Real wage	*w-cpi*	% Δ	-3.98	-2.02	-1.36	-0.68	0.69	1.38	2.08	4.19
Total consumption	*cons*	% Δ	1.38	0.43	0.24	0.09	-0.05	-0.06	-0.04	0.23
Real consumption	*cons-cpi*	% Δ	6.40	2.80	1.79	0.86	-0.79	-1.52	-2.19	-3.90
Total exports	*e*	% Δ	282.54	142.81	95.52	47.91	-48.19	-96.65	-145.35	-292.85
Total imports	*m*	% Δ	493.76	215.42	137.79	66.22	-61.46	79.86	-176.14	-190.10
Price of Food	p_A	% Δ	-24.00	-12.00	-8.00	-4.00	4.00	8.00	12.00	24.00
Price of Non food	p_N	% Δ	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Abs.ch. agr. output	ΔX_A	Δ	-58,200	-28,104	-18,535	-9,171	8,989	17,807	26,463	51,542
Abs.ch. agr. cons'n	ΔQ_A	Δ	85,863	39,643	25,786	12,590	-12,033	-23,552	-34,596	-65,203
Abs.ch. agr.	ΔM_A	Δ	144,063	67,747	44,320	21,761	-21,022	-41,359	-61,059	-116,745
Δ Poverty rural	ΔP_R	Δ	-2.1652	-0.9259	-0.5559	-0.2508	0.1781	0.2962	0.3667	0.3804
Δ Poverty urban	ΔP_U	Δ	-0.8211	-0.1145	-0.0439	-0.0091	-0.0101	-0.0348	-0.0708	-0.2256
Δ Poverty total	ΔP	Δ	-1.5531	-0.5563	-0.3228	-0.1407	0.0924	0.2962	0.1674	0.1044
Δ Gini – rural	ΔG_R	Δ	-0.0029	-0.0015	-0.0010	-0.0005	0.0005	0.0011	0.0017	0.0034
Δ Gini – urban	ΔG_U	Δ	-0.0010	-0.0005	-0.0003	-0.0002	0.0001	0.0003	0.0005	0.0011
Δ Gini – total	ΔG	Δ	-0.0029	-0.0014	-0.0009	-0.0004	0.0004	0.0008	0.0013	0.0024

***Note*:** Units expressed as Δ are measured in billions of IDR, 2005 prices.

Table 4. Agricultural Price Shocks under Free Trade: Welfare Decomposition for Poor Urban Household

Price Shocks	**-24 %**	**-12 %**	**-8 %**	**-4 %**	**4 %**	**8 %**	**12 %**	**24 %**
Labor income	-344.6	-168.5	-111.5	-55.4	54.7	108.7	162.1	318.8
Land income	-211.0	-111.1	-75.2	-38.2	39.2	79.3	120.4	248.6
Capital income	315.0	150.8	99.1	48.9	-47.7	-94.2	-139.7	-269.9
Tax revenue	1.8	0.9	0.6	0.3	-0.3	-0.6	-0.9	-1.8
Transfer	0	0	0	0	0	0	0	0
Nominal total income	-290.9	-147.7	-99.0	-49.7	50.1	100.6	151.5	306.3
Cost of living	-355.8	-167.8	-109.9	-54.0	52.3	103.1	152.4	292.5
Real income = expend.	64.9	20.1	11.0	4.3	-2.2	-2.4	-0.8	13.8

***Note*:** Units expressed in billions of IDR, 2005 prices.

Table 5. Agricultural Price Shocks under Free Trade: Welfare Decomposition for Poor Rural Household

Price Shocks	**-24 %**	**-12 %**	**-8 %**	**-4 %**	**4 %**	**8 %**	**12 %**	**24 %**
Labor income	-283.2	-138.4	-91.6	-45.5	44.9	89.3	133.2	261.9
Land income	-286.1	-150.7	-102.0	-51.7	53.1	107.6	163.2	337.1
Capital income	286.8	137.3	90.3	44.5	-43.4	-85.8	-127.1	-245.8
Tax revenue	1.5	0.8	0.5	0.3	-0.3	-0.5	-0.8	-1.6
Transfer	0	0	0	0	0	0	0	0
Nominal total income	-281.3	-144.3	-97.0	-48.8	49.5	99.7	150.4	306.0
Cost of living	-409.8	-193.6	-126.8	-62.4	60.5	119.2	176.3	338.9
Real income = expend.	128.5	49.2	29.9	13.5	-10.9	-19.5	-25.8	-32.9

***Note*:** Units expressed in billions of IDR, 2005 prices.

Table 6. Factor-Neutral Agricultural Productivity Shocks under Free Trade: Simulation Results

	Shock: Change in agricultural productivity parameter							
	Variable	Unit	$a_A^L = a_A^H = -1$	$a_A^L = a_A^H = -2$	$a_A^L = a_A^H = -4$	$a_A^L = a_A^H = 1$	$a_A^L = a_A^H = 2$	$a_A^L = a_A^H = 4$
Output agric.	x_A	% Δ	-1.65	-3.26	-6.37	1.68	3.40	6.96
Output non agric.	x_N	% Δ	0.14	0.27	0.53	-0.14	-0.28	-0.56
Wage	w	% Δ	-0.36	-0.71	-1.39	0.36	0.73	1.49
Rent on land	r_A	% Δ	-2.30	-4.53	-8.83	2.36	4.78	9.83
Rent on capital	r_N	% Δ	0.27	0.54	1.06	-0.27	-0.55	-1.12
CPI	cpi	% Δ	0	0	0	0	0	0
GDP	gdp	% Δ	-0.17	-0.33	-0.64	0.17	0.35	0.71
Real GDP	$rgdp$	% Δ	-0.17	-0.33	-0.64	0.17	0.35	0.71
Real wage	$w\text{-}cpi$	% Δ	-0.36	-0.71	-1.39	0.36	0.73	1.49
Total consumption	$cons$	% Δ	-0.17	-0.33	-0.64	0.17	0.35	0.72
Real consumption	$cons\text{-}cpi$	% Δ	-0.17	-0.33	-0.64	0.17	0.35	0.72
Total exports	e	% Δ	11.89	23.52	46.07	-12.14	-24.55	-50.21
Total imports	m	% Δ	14.77	29.24	57.27	-15.09	-30.52	-62.40
Price of Food	p_A	% Δ	0	0	0	0	0	0
Price of Non food	p_N	% Δ	0	0	0	0	0	0
Abs.ch. agr. output	ΔX_A	Δ	-5,628	-11,135	-21,800	5,754	11,636	23,806
Abs.ch. agr. cons'n	ΔQ_A	Δ	-673	-1,329	-2,592	691	1,400	2,875
Abs.ch. agr. imports	ΔM_A	Δ	4,955	9,806	19,208	-5,063	-10,236	-20,931
Abs.ch. Poverty rural	ΔP_R	Δ	0.22289	0.43925	0.84286	-0.22896	-0.45587	-0.90499
Abs.ch. Poverty urban	ΔP_U	Δ	0.12889	0.25918	0.43954	-0.12755	-0.25386	-0.50303
Abs.ch. Poverty total	ΔP	Δ	0.18008	0.35725	0.65919	-0.18278	-0.36387	-0.72194
Abs.ch. Gini – rural	ΔG_R	Δ	0.00009	0.00018	0.00037	-0.00009	-0.00018	-0.00035
Abs.ch. Gini – urban	ΔG_U	Δ	0.00017	0.00034	0.00067	-0.00017	-0.00034	-0.00069
Abs.ch. Gini – total	ΔG	Δ	0.00017	0.00035	0.00069	-0.00018	-0.00035	-0.00071

***Note*:** Units expressed as Δ are measured in billions of IDR, 2005 prices.

Table 7. Factor-Biased Agricultural Productivity Shocks under Free Trade: Simulation Results

	Shock: Change in agricultural productivity parameter							
	Variable	Unit	$a_A^L = 1$	$a_A^L = 2$	$a_A^L = 4$	$a_A^H = 1$	$a_A^H = 2$	$a_A^H = 4$
Output agric.	x_A	% Δ	0.91	1.82	3.68	0.76	1.54	3.13
Output non agric.	x_N	% Δ	-0.05	-0.09	-0.19	-0.90	-0.18	-0.37
Wage	w	% Δ	0.12	0.25	0.49	0.24	0.48	0.97
Rent on land	r_A	% Δ	1.83	3.69	7.51	0.52	1.04	2.10
Rent on capital	r_N	% Δ	-0.09	-0.19	-0.37	-0.18	-0.36	-0.73
CPI	*cpi*	% Δ	0	0	0	0	0	0
GDP	*gdp*	% Δ	0.12	0.23	0.47	0.06	0.11	0.23
Real GDP	*rgdp*	% Δ	0.12	0.23	0.47	0.06	0.11	0.23
Real wage	*w-cpi*	% Δ	0.12	0.25	0.49	0.24	0.48	0.97
Total consumption	*cons*	% Δ	0.12	0.23	0.47	0.06	0.11	0.23
Real consumption	*cons-cpi*	% Δ	0.12	0.23	0.47	0.06	0.11	0.23
Total exports	*e*	% Δ	-6.39	-12.82	-25.84	-5.69	-11.48	-23.31
Total imports	*m*	% Δ	-7.94	-15.94	-32.12	-7.08	-14.26	-28.97
Price of Food	p_A	% Δ	0	0	0	0	0	0
Price of Non food	p_N	% Δ	0	0	0	0	0	0
Abs.ch. agr. output	ΔX_A	Δ	3,111	6,248	12,604	2,613	5,265	10,696
Abs.ch. agr. cons'n	ΔQ_A	Δ	448	902	1,830	239	481	977
Abs.ch. agr. imports	ΔM_A	Δ	-2,663	-5,346	-10,775	-2,374	-4,784	-9,718
Abs.ch. Poverty rural	ΔP_R	Δ	-0.13192	-0.26503	-0.54295	-0.09573	-0.19490	-0.37977
Abs.ch. Poverty urban	ΔP_U	Δ	-0.06337	-0.12677	-0.25381	-0.06452	-0.12840	-0.25426
Abs.ch. Poverty total	ΔP	Δ	-0.10070	-0.20206	-0.41128	-0.08152	-0.16462	-0.32261
Abs.ch. Gini – rural	ΔG_R	Δ	0.00006	0.00013	0.00028	-0.00015	-0.00031	-0.00063
Abs.ch. Gini – urban	ΔG_U	Δ	-0.00002	-0.00004	-0.00007	-0.00015	-0.00030	-0.00062
Abs.ch. Gini – total	ΔG	Δ	-0.00004	-0.00007	-0.00013	-0.00014	-0.00028	-0.00057

***Note*:** units expressed as Δ are measured in billions of IDR, 2005 prices.

Table 8. Agricultural Productivity Shocks under Free Trade: Welfare Decomposition for Poor Urban Household

	Factor-neutral						Factor-biased					
Productivity shock	$a_A^L = a_A^H$ = -1	$a_A^L = a_A^H$ = -2	$a_A^L = a_A^H$ = -4	$a_A^L = a_A^H$ = 1	$a_A^L = a_A^H$ = 2	$a_A^L = a_A^H$ = 4	a_A^L = 1	a_A^L = 2	a_A^L = 4	a_A^H= 1	a_A^H= 2	a_A^H= 4
Labor income	-13.6	-27.1	-53.2	13.9	28.0	56.9	4.8	9.5	18.8	9.0	18.2	37.1
Land income	-9.5	-18.8	-36.7	9.8	19.9	40.8	7.6	15.3	31.2	2.2	4.3	8.7
Capital income	12.0	23.8	47.0	-12.2	-24.5	-49.6	-4.2	-8.3	-16.5	-7.9	-16.0	-32.4
Tax revenue	0.1	0.1	0.3	-0.1	-0.2	-0.3	0.0	-0.1	-0.2	0.0	-0.1	-0.1
Transfer	0	0	0	0	0	0	0	0	0	0	0	0
Nominal total	-12.3	-24.4	-47.8	12.6	25.5	52.2	6.4	12.9	26.0	6.1	12.3	25.1
Cost of living	0	0	0	0	0	0	0	0	0	0	0	0
Real expenditure	-12.3	-24.4	-47.8	12.6	25.5	52.2	6.4	12.9	26.0	6.1	12.3	25.1

Note**:** Units expressed in billions of IDR, 2005 prices.

Table 9. Agricultural Productivity Shocks under Free Trade: Welfare Decomposition for Poor Rural Household

	Factor-neutral						Factor-biased					
Productivity shock	$a_A^L = a_A^H$ = -1	$a_A^L = a_A^H$ = -2	$a_A^L = a_A^H$ = -4	$a_A^L = a_A^H$ = 1	$a_A^L = a_A^H$ = 2	$a_A^L = a_A^H$ = 4	a_A^L = 1	a_A^L = 2	a_A^L = 4	a_A^H= 1	a_A^H= 2	a_A^H= 4
Labor income	-11.2	-22.2	-43.7	11.4	23.0	46.8	3.9	7.8	15.5	7.4	15.0	30.4
Land income	-12.9	-25.5	-49.8	13.3	26.9	55.4	10.3	20.8	42.3	2.9	5.9	11.8
Capital income	10.9	21.7	42.8	-11.1	-22.3	-45.2	-3.8	-7.6	-15.0	-7.2	-14.5	-29.5
Tax revenue	0.1	0.1	0.2	-0.1	-0.1	-0.3	0.0	-0.1	-0.1	0.0	-0.1	-0.1
Transfer	0	0	0	0	0	0	0	0	0	0	0	0
Nominal total	-12.2	-24.0	-47.0	12.4	25.2	51.6	7.1	14.3	29.0	5.2	10.6	21.5
Cost of living	0	0	0	0	0	0	0	0	0	0	0	0
Real expenditure	-12.2	-24.0	-47.0	12.4	25.2	51.6	7.1	14.3	29.0	5.2	10.6	21.5

Note**:** Units expressed in billions of IDR, 2005 prices.

Table 10. Updated Social Accounting Matrix with Protection

			Industries		Commodities		Factors		HH	Govern-ment	ROW	
	Category		1	2	3	4	5	6	7	8	9	Total
Industries	Agriculture	1			376,233							376,233
	Nonagric.	2				1,652,569						1,652,569
Commodities	Agriculture	3							379,953			379,953
	Nonagric.	4							1,641,113		11,459	1,652,572
Factors	Labor	5	249,033	720,622								969,655
	Capital	6	127,200	931,947								1,059,147
Households		7					969,657	1,059,148		213	-7,952	2,021,066
Government	Taxes/Tariffs	8			212							212
Rest of the world (ROW)		9			3,550							3,550
	Total		**376,233**	**1,652,569**	**379,995**	**1,652,569**	**969,657**	**1,059,148**	**2,021,066**	**213**	**3,507**	

Note**:** Data based on Indonesia input-output tables for 2005.

Table 11. Agricultural Price Shock under Restricted Food Imports: Simulation Results

			Shock: Change to international price of agricultural good							
	Variable	Unit	-24 %	-12 %	-8 %	-4 %	4 %	8 %	12 %	24 %
Output agric.	x_A	% Δ	0.0173	0.0087	0.0058	0.0029	-0.0029	-0.0058	-0.0087	-0.0174
Output non agric.	x_N	% Δ	-0.0039	-0.002	-0.0013	-0.0007	0.0007	0.0013	0.002	0.004
Wage	w	% Δ	0.0102	0.0051	0.0034	0.0017	-0.0017	-0.0034	-0.0051	-0.0102
Rent on land	r_A	% Δ	0.0626	0.0313	0.0209	0.0104	-0.0104	-0.0209	-0.0313	-0.0626
Rent on capital	r_N	% Δ	-0.0079	-0.004	-0.0026	-0.0013	0.0013	0.0026	0.004	0.0079
CPI	*cpi*	% Δ	0.0053	0.0026	0.0018	0.0009	-0.0009	-0.0018	-0.0026	-0.0053
GDP	*gdp*	% Δ	0.0447	0.0224	0.0149	0.0075	-0.0075	-0.0149	-0.0224	-0.0447
Real GDP	*rgdp*	% Δ	0	0	0	0	0	0	0	0
Real wage	*w-cpi*	% Δ	0.0049	0.0025	0.0016	0.0008	-0.0008	-0.0016	-0.0025	-0.0049
Total consumption	*cons*	% Δ	0.0396	0.0198	0.0132	0.0066	-0.0066	-0.0132	-0.0198	-0.0396
Real consumption	*cons-cpi*	% Δ	0.0343	0.0172	0.0114	0.0057	-0.0057	-0.0114	-0.0172	-0.0343
Total exports	*e*	% Δ	-6.991	-3.4955	-2.3303	-1.1652	1.1652	2.3303	3.4955	6.991
Total imports	*m*	% Δ	0	0	0	0	0	0	0	0
Price of Food	p_A	% Δ	0.0279	0.014	0.0093	0.0047	-0.0047	-0.0093	-0.014	-0.0279
Price of Non food	p_N	% Δ	0	0	0	0	0	0	0	0
Abs.ch. agr. output	ΔX_A	Δ	65.3	32.6	21.8	10.9	-10.9	-21.8	-32.6	-65.3
Abs.ch. agr. cons'n	ΔQ_A	Δ	65.3	32.6	21.8	10.9	-10.9	-21.8	-32.6	-65.3
Abs.ch. agr. imports	ΔM_A	Δ	0	0	0	0	0	0	0	0
Δ Poverty rural	ΔP_R	Δ	-0.03853	-0.01928	-0.01285	-0.00643	0.00643	0.01286	0.01930	0.03862
Δ Poverty urban	ΔP_U	Δ	-0.02418	-0.01209	-0.00807	-0.00403	0.00403	0.00807	0.01211	0.02422
Δ Poverty total	ΔP	Δ	-0.03200	-0.01601	-0.01067	-0.00534	0.00534	0.01068	0.01603	0.03206
Δ Gini – rural	ΔG_R	Δ	6E-06	3E-06	2E-06	1E-06	-1.1E-06	-2.1E-06	-3.1E-06	-6.1E-06
Δ Gini – urban	ΔG_U	Δ	2.3E-06	1.2E-06	8E-07	4E-07	-4E-07	-7E-07	-1.1E-06	-2.3E-06
Δ Gini – total	ΔG	Δ	4.7E-06	2.3E-06	1.6E-06	8E-07	-8E-07	-1.6E-06	-2.3E-06	-4.7E-06

***Note*:** units expressed as Δ are measured in billions of IDR, 2005 prices.

Table 12. Agricultural Price Shocks under Restricted Food Imports: Welfare Decomposition for Poor Urban Household

Price Shocks	**-24 %**	**-12 %**	**-8 %**	**-4 %**	**4 %**	**8 %**	**12 %**	**24 %**
Labor income	0.400	0.200	0.133	0.067	-0.067	-0.133	-0.200	-0.400
Land income	0.297	0.149	0.099	0.050	-0.050	-0.099	-0.149	-0.297
Capital income	-0.344	-0.172	-0.115	-0.057	0.057	0.115	0.172	0.345
Tax revenue	2.493	1.247	0.831	0.416	-0.416	-0.831	-1.247	-2.493
Transfer	0	0	0	0	0	0	0	0
Nominal total income	2.869	1.435	0.956	0.478	-0.478	-0.956	-1.435	-2.869
Cost of living	0.376	0.188	0.125	0.063	-0.063	-0.125	-0.188	-0.376
Real income = expend.	2.493	1.247	0.831	0.416	-0.416	-0.831	-1.247	-2.494

***Note*:** Units expressed in billions of IDR, 2005 prices.

Table 13. Agricultural Price Shocks under Restricted Food Imports: Welfare Decomposition for Poor Rural Household

Price Shocks	**-24 %**	**-12 %**	**-8 %**	**-4 %**	**4 %**	**8 %**	**12 %**	**24 %**
Labor income	0.329	0.164	0.110	0.055	-0.055	-0.110	-0.164	-0.329
Land income	0.403	0.202	0.134	0.067	-0.067	-0.134	-0.202	-0.403
Capital income	-0.314	-0.157	-0.105	-0.052	0.052	0.105	0.157	0.314
Tax revenue	2.170	1.085	0.723	0.362	-0.362	-0.723	-1.085	-2.170
Transfer	0	0	0	0	0	0	0	0
Nominal total income	2.543	1.272	0.848	0.424	-0.424	-0.848	-1.272	-2.543
Cost of living	0.435	0.217	0.145	0.072	-0.072	-0.145	-0.217	-0.435
Real income = expend.	2.109	1.054	0.703	0.351	-0.351	-0.703	-1.054	-2.109

Note**:** Units expressed in billions of IDR, 2005 prices.

Table 14. Factor-Neutral Agricultural Productivity Shocks under Restricted Food Imports: Simulation Results

	Shock: Change in agricultural productivity parameter							
	Variable	Unit	$a_A^L = a_A^H = -1$	$a_A^L = a_A^H = -2$	$a_A^L = a_A^H = -4$	$a_A^L = a_A^H = 1$	$a_A^L = a_A^H = 2$	$a_A^L = a_A^H = 4$
Output agric.	x_A	% Δ	-0.994	-1.968	-3.860	1.014	2.048	4.181
Output non agric.	x_N	% Δ	0.001	0.002	0.003	-0.001	-0.002	-0.003
Wage	w	% Δ	-0.002	-0.004	-0.008	0.002	0.004	0.008
Rent on land	r_A	% Δ	-0.013	-0.026	-0.051	0.013	0.026	0.051
Rent on capital	r_N	% Δ	0.002	0.003	0.006	-0.002	-0.003	-0.006
CPI	*cpi*	% Δ	0.186	0.371	0.736	-0.188	-0.377	-0.760
GDP	*gdp*	% Δ	0.001	0.002	0.003	-0.001	-0.002	-0.003
Real GDP	*rgdp*	% Δ	-0.184	-0.367	-0.724	0.187	0.375	0.760
Real wage	*w-cpi*	% Δ	0.015	0.029	0.059	-0.015	-0.029	-0.059
Total consumption	*cons*	% Δ	-0.994	-1.968	-3.860	1.014	2.048	4.181
Real consumption	*cons-cpi*	% Δ	0.001	0.002	0.003	-0.001	-0.002	-0.003
Total exports	*e*	% Δ	-0.002	-0.004	-0.008	0.002	0.004	0.008
Total imports	*m*	% Δ	0	0	0	0	0	0
Price of Food	p_A	% Δ	0.994	1.988	3.976	-0.994	-1.989	-3.978
Price of Non food	p_N	% Δ	0	0	0	0	0	0
Abs.ch. agr. output	ΔX_A	Δ	-3757	-7476	-14807	3795	7628	15415
Abs.ch. agr. cons'n	ΔQ_A	Δ	-3757	-7476	-14807	3795	7628	15415
Abs.ch. agr. imports	ΔM_A	Δ	0	0	0	0	0	0
Abs.ch. Poverty rural	ΔP_R	Δ	0.27100	0.52958	0.98679	-0.28139	-0.55635	-1.08807
Abs.ch. Poverty urban	ΔP_U	Δ	0.12612	0.25082	0.43302	-0.12757	-0.25663	-0.51935
Abs.ch. Poverty total	ΔP	Δ	0.20502	0.40263	0.73460	-0.21134	-0.41986	-0.82907
Abs.ch. Gini – rural	ΔG_R	Δ	0.00022	0.00044	0.00087	-0.00022	-0.00045	-0.00090
Abs.ch. Gini – urban	ΔG_U	Δ	0.00021	0.00042	0.00084	-0.00021	-0.00043	-0.00087
Abs.ch. Gini – total	ΔG	Δ	0.00028	0.00056	0.00111	-0.00028	-0.00057	-0.00115

***Note*:** Units expressed as Δ are measured in billions of IDR, 2005 prices.

Table 15. Factor-Biased Agricultural Productivity Shocks under Restricted Food Imports: Simulation Results

	Shock: Change in agricultural productivity parameter							
	Variable	Unit	$a_A^L = 1$	$a_A^L = 2$	$a_A^L = 4$	$a_A^H = 1$	$a_A^H = 2$	$a_A^H = 4$
Output agric.	x_A	% Δ	0.547	1.100	2.226	0.462	0.929	1.877
Output non agric.	x_N	% Δ	0.027	0.055	0.111	-0.028	-0.056	-0.113
Wage	w	% Δ	-0.070	-0.141	-0.286	0.072	0.145	0.292
Rent on land	r_A	% Δ	0.576	1.160	2.348	-0.562	-1.129	-2.278
Rent on capital	r_N	% Δ	0.054	0.109	0.221	-0.056	-0.112	-0.225
CPI	*cpi*	% Δ	-0.097	-0.194	-0.391	-0.090	-0.181	-0.364
GDP	*gdp*	% Δ	0.027	0.054	0.109	-0.027	-0.055	-0.110
Real GDP	*rgdp*	% Δ	0.123	0.248	0.499	0.063	0.126	0.253
Real wage	*w-cpi*	% Δ	0.027	0.053	0.105	0.162	0.326	0.656
Total consumption	*cons*	% Δ	0.124	0.249	0.502	0.063	0.127	0.255
Real consumption	*cons-cpi*	% Δ	0.221	0.443	0.892	0.154	0.308	0.619
Total exports	*e*	% Δ	-0.008	-0.015	-0.030	-0.007	-0.014	-0.028
Total imports	*m*	% Δ	0	0	0	0	0	0
Price of Food	p_A	% Δ	-0.515	-1.029	-2.060	-0.480	-0.961	-1.923
Price of Non food	p_N	% Δ	0	0	0	0	0	0
Abs.ch. agr. output	ΔX_A	Δ	2,052	4,117	8,287	1,735	3,479	6,995
Abs.ch. agr. cons'n	ΔQ_A	Δ	2,052	4,117	8,287	1,735	3,479	6,995
Abs.ch. agr. imports	ΔM_A	Δ	0	0	0	0	0	0
Abs.ch. Poverty rural	ΔP_R	Δ	-0.15752	-0.31777	-0.64946	-0.12324	-0.24765	-0.47596
Abs.ch. Poverty urban	ΔP_U	Δ	-0.06106	-0.12327	-0.25133	-0.06615	-0.13192	-0.26231
Abs.ch. Poverty total	ΔP	Δ	-0.11359	-0.22920	-0.46815	-0.09724	-0.19495	-0.37866
Abs.ch. Gini – rural	ΔG_R	Δ	5.3E-06	1.14E-05	2.59E-05	-0.00023	-0.00046	-0.00092
Abs.ch. Gini – urban	ΔG_U	Δ	-3.35E-05	-6.67E-05	-0.00013	-0.00018	-0.00036	-0.00073
Abs.ch. Gini – total	ΔG	Δ	-8.49E-05	-0.00017	-0.00034	-0.00020	-0.00040	-0.00080

Note: Units expressed as Δ are measured in billions of IDR, 2005 prices.

Table 16. Agricultural Productivity Shocks under Restricted Food Imports: Welfare Decomposition for Poor Urban Household

	Factor-neutral						Factor-biased					
Productivity shock	$a_A^L = a_A^H$ = -1	$a_A^L = a_A^H$ = -2	$a_A^L = a_A^H$ = -4	$a_A^L = a_A^H$ = 1	$a_A^L = a_A^H$ = 2	$a_A^L = a_A^H$ = 4	a_A^L = 1	a_A^L = 2	a_A^L = 4	a_A^H= 1	a_A^H= 2	a_A^H= 4
Labor income	-0.08	-0.16	-0.33	0.08	0.15	0.31	-2.74	-5.19	-10.52	2.82	5.32	10.73
Land income	-0.06	-0.12	-0.24	0.06	0.12	0.23	2.73	5.34	10.82	-2.67	-5.20	-10.49
Capital income	0.07	0.14	0.28	-0.07	-0.14	-0.27	2.36	4.62	9.37	-2.43	-4.73	-9.53
Tax revenue	0.11	0.22	0.44	-0.10	-0.21	-0.42	-0.06	-0.11	-0.22	-0.05	-0.10	-0.20
Transfer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nominal total income	0.03	0.07	0.13	-0.03	-0.07	-0.13	-0.25	-0.32	-0.64	0.22	0.25	0.51
Cost of living	13.30	26.48	52.44	-12.73	-25.59	-51.70	-6.94	-13.18	-26.51	-6.47	-12.29	-24.73
Real expenditure	-13.27	-26.41	-52.30	12.70	25.52	51.57	6.69	12.86	25.87	6.69	12.55	25.24

Note**:** Units expressed in billions of IDR, 2005 prices.

Table 17. Agricultural Productivity Shocks under Restricted Food Imports: Welfare Decomposition for Poor Rural Household

	Factor-neutral						Factor-biased					
Productivity shock	$a_A^L = a_A^H$ = -1	$a_A^L = a_A^H$ = -2	$a_A^L = a_A^H$ = -4	$a_A^L = a_A^H$ = 1	$a_A^L = a_A^H$ = 2	$a_A^L = a_A^H$ = 4	$a_A^L = 1$	$a_A^L = 2$	$a_A^L = 4$	$a_A^H = 1$	$a_A^H = 2$	$a_A^H = 4$
Labor income	-0.07	-0.13	-0.27	0.07	0.13	0.25	-2.25	-4.54	-9.19	2.32	4.65	9.37
Land income	-0.08	-0.16	-0.31	0.08	0.16	0.38	3.71	7.46	15.10	-3.62	-7.26	-14.65
Capital income	0.06	0.13	0.24	-0.06	-0.13	-0.28	2.15	4.33	8.78	-2.21	-4.44	-8.94
Tax revenue	0.10	0.19	0.38	-0.10	-0.19	-0.39	-0.05	-0.10	-0.20	-0.05	-0.09	-0.18
Transfer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nominal total income	0.02	0.04	0.08	-0.02	-0.04	-0.09	0.63	1.26	2.56	-0.64	-1.29	-2.60
Cost of living	15.39	30.63	56.14	-15.55	-31.25	-59.26	-8.03	-16.10	-32.39	-7.49	-15.02	-30.20
Real expenditure	-15.37	-30.59	-56.07	15.53	31.21	59.18	8.65	17.36	34.95	6.84	13.72	27.59

***Note*:** Units expressed in billions of IDR, 2005 prices.

Table 18. Factor-Biased Agricultural Productivity Shocks under Restricted Food Imports (σ= 0.25): Simulation Results

	Shock: Change in agricultural productivity parameter							
	Variable	Unit	$a_A^L = 1$	$a_A^L = 2$	$a_A^L = 4$	$a_A^H = 1$	$a_A^H = 2$	$a_A^H = 4$
Output agric.	x_A	% Δ	0.399	0.799	1.601	0.607	1.219	2.458
Output non agric.	x_N	% Δ	0.060	0.122	0.246	-0.061	-0.122	-0.246
Wage	w	% Δ	-0.156	-0.314	-0.636	0.157	0.316	0.637
Rent on land	r_A	% Δ	1.260	2.533	5.125	-1.241	-2.492	-5.027
Rent on capital	r_N	% Δ	0.121	0.243	0.493	-0.122	-0.244	-0.491
CPI	*cpi*	% Δ	-0.064	-0.128	-0.254	-0.123	-0.246	-0.492
GDP	*gdp*	% Δ	0.059	0.119	0.241	-0.060	-0.120	-0.241
Real GDP	*rgdp*	% Δ	0.123	0.247	0.496	0.063	0.125	0.250
Real wage	*w-cpi*	% Δ	-0.092	-0.186	-0.382	0.280	0.562	1.129
Total consumption	*cons*	% Δ	0.124	0.248	0.498	0.063	0.126	0.251
Real consumption	*cons-cpi*	% Δ	0.188	0.376	0.752	0.186	0.371	0.743
Total exports	*e*	% Δ	-0.005	-0.010	-0.020	-0.010	-0.019	-0.038
Total imports	*m*	% Δ	0	0	0	0	0	0
Price of Food	p_A	% Δ	-0.340	-0.678	-1.345	-0.651	-1.299	-2.588
Price of Nonfood	p_N	% Δ	0	0	0	0	0	0
Abs.ch. agr. output	ΔX_A	Δ	1,498	2,994	5,982	2,275	4,555	9,126
Abs.ch. agr. cons'n	ΔQ_A	Δ	1,498	2,994	5,982	2,275	4,555	9,126
Abs.ch. agr. imports	ΔM_A	Δ	0	0	0	0	0	0
Abs.ch. Poverty rural	ΔP_R	Δ	-0.12295	-0.24651	-0.52612	-0.15801	-0.30907	-0.57098
Abs.ch. Poverty urban	ΔP_U	Δ	-0.03257	-0.06580	-0.13438	-0.09335	-0.18464	-0.36120
Abs.ch. Poverty total	ΔP	Δ	-0.08179	-0.16422	-0.34772	-0.12856	-0.25240	-0.47545
Abs.ch. Gini – rural	ΔG_R	Δ	0.00019	0.00038	0.00077	-0.00041	-0.00082	-0.00166
Abs.ch. Gini – urban	ΔG_U	Δ	9.66E-05	0.00020	0.00040	-0.00031	-0.00062	-0.00124
Abs.ch. Gini – total	ΔG	Δ	3.93E-05	8.05E-05	0.00017	-0.00032	-0.00064	-0.00129

***Note*:** Units expressed as Δ are measured in billions of IDR, 2005 prices.

Table 19. Factor-Biased Agricultural Productivity Shocks under Restricted Food Imports (σ= 0.25): Welfare Decomposition for Poor Urban and Rural Households

	Urban household						Rural household					
Productivity shock	$a_A^L = 1$	$a_A^L = 2$	$a_A^L = 4$	$a_A^H = 1$	$a_A^H = 2$	$a_A^H = 4$	$a_A^L = 1$	$a_A^L = 2$	$a_A^L = 4$	$a_A^H = 1$	$a_A^H = 2$	$a_A^H = 4$
Labor income	-6.11	-12.29	-23.40	5.79	11.63	23.44	-5.02	-10.10	-20.44	5.06	10.16	20.48
Land income	5.97	12.02	23.61	-5.72	-11.48	-23.16	8.10	16.30	32.97	-7.98	-16.03	-32.33
Capital income	5.27	10.61	20.88	-5.15	-10.33	-20.80	4.80	9.66	19.57	-4.83	-9.69	-19.50
Tax revenue	-0.04	-0.07	-0.14	-0.07	-0.14	-0.27	-0.03	-0.07	-0.13	-0.06	-0.12	-0.25
Transfer	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nominal total income	-0.53	-1.06	-1.29	0.29	0.58	1.19	1.40	2.81	5.70	-1.41	-2.82	-5.68
Cost of living	-4.58	-9.14	-17.25	-8.32	-16.65	-33.40	-5.30	-10.58	-21.08	-10.16	-20.34	-40.77
Real expenditure	4.05	8.09	15.96	8.61	17.24	34.59	6.70	13.39	26.78	8.75	17.52	35.09

***Note*:** Units expressed in billions of IDR, 2005 prices.

Figure 1. General equilibrium effect of technical change

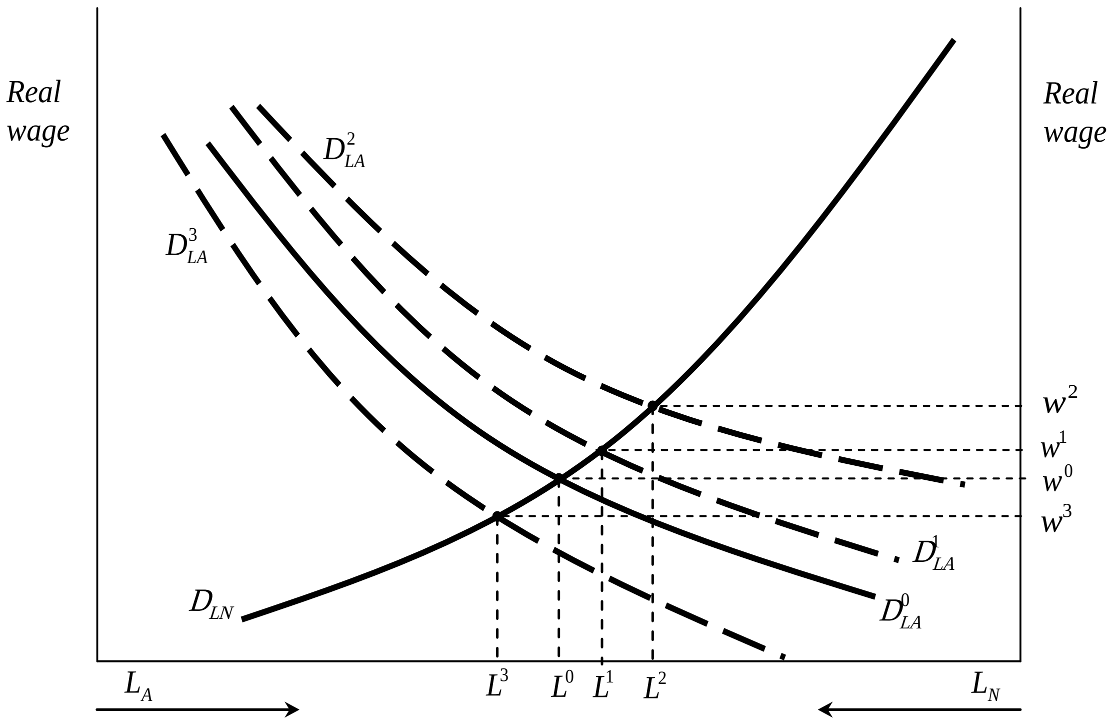


Figure 2. Labor-saving technical change

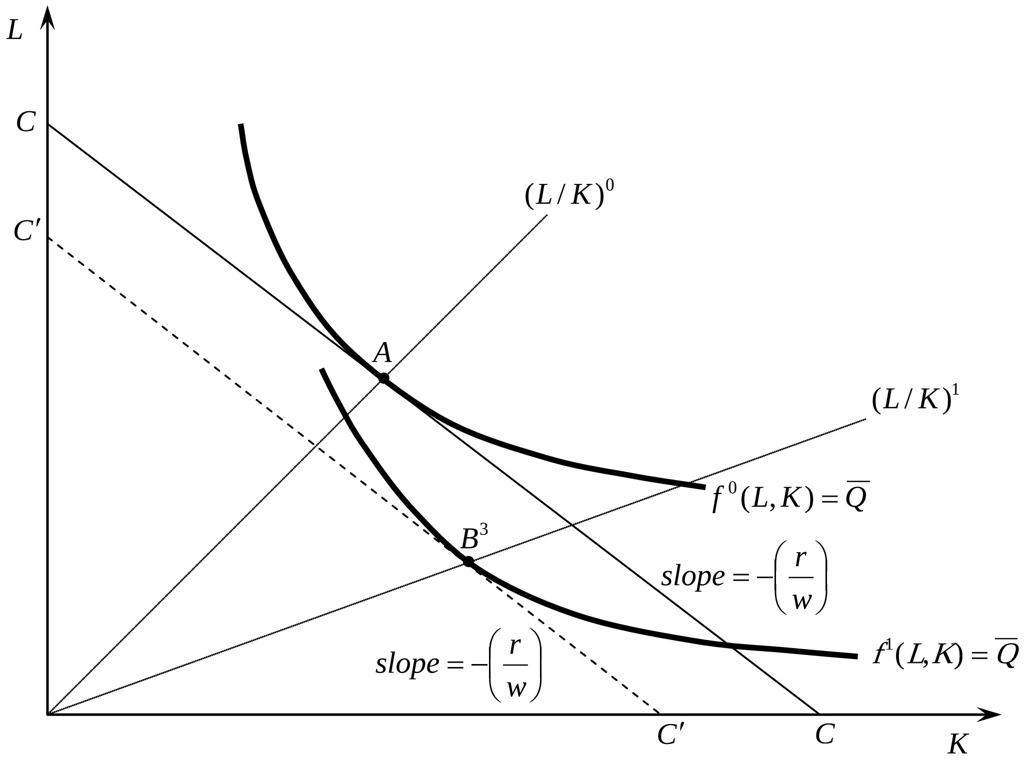


Figure 3. Calculation of poverty incidence for urban households (left panel) and rural households (right panel): -24% price shock

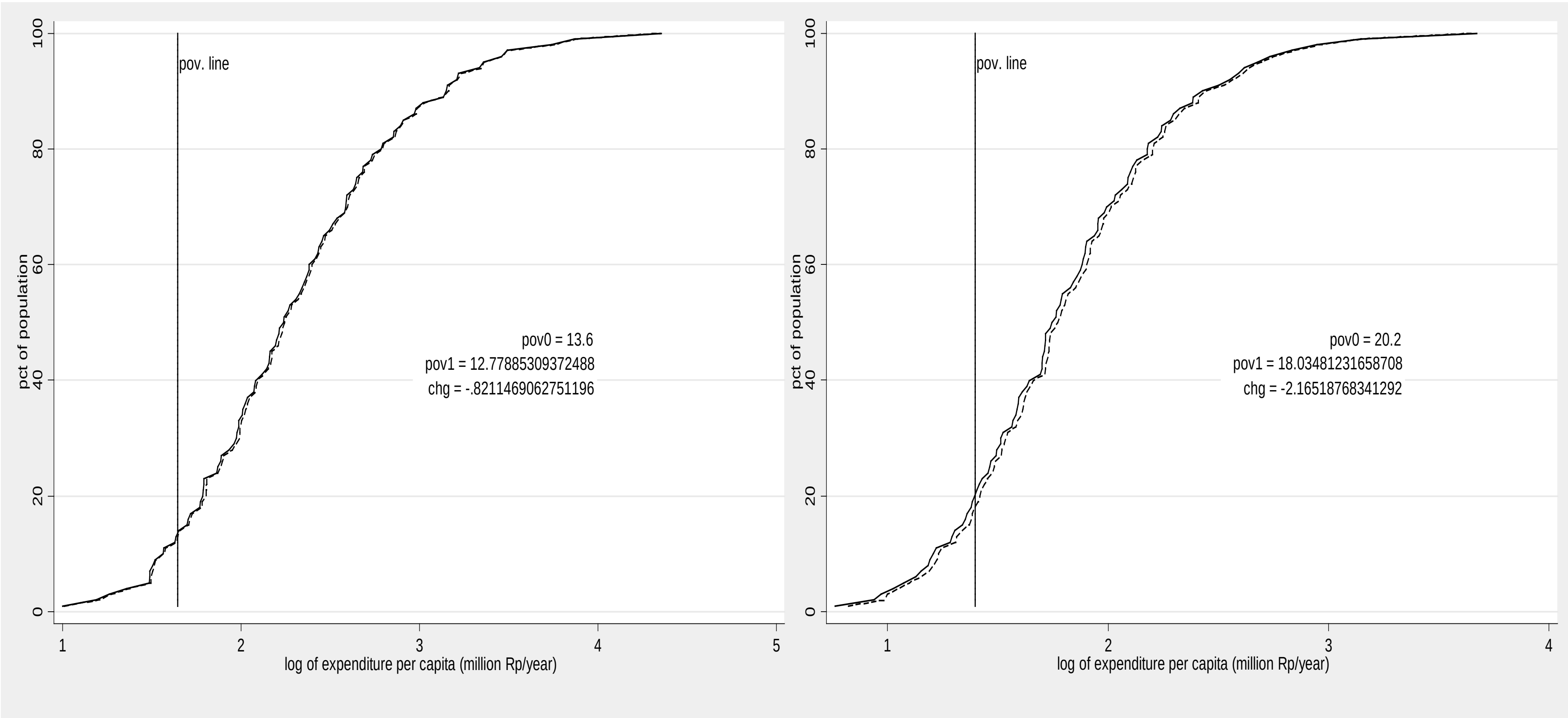


Figure 4. Price shocks and real expenditure: rural household on border of poverty line

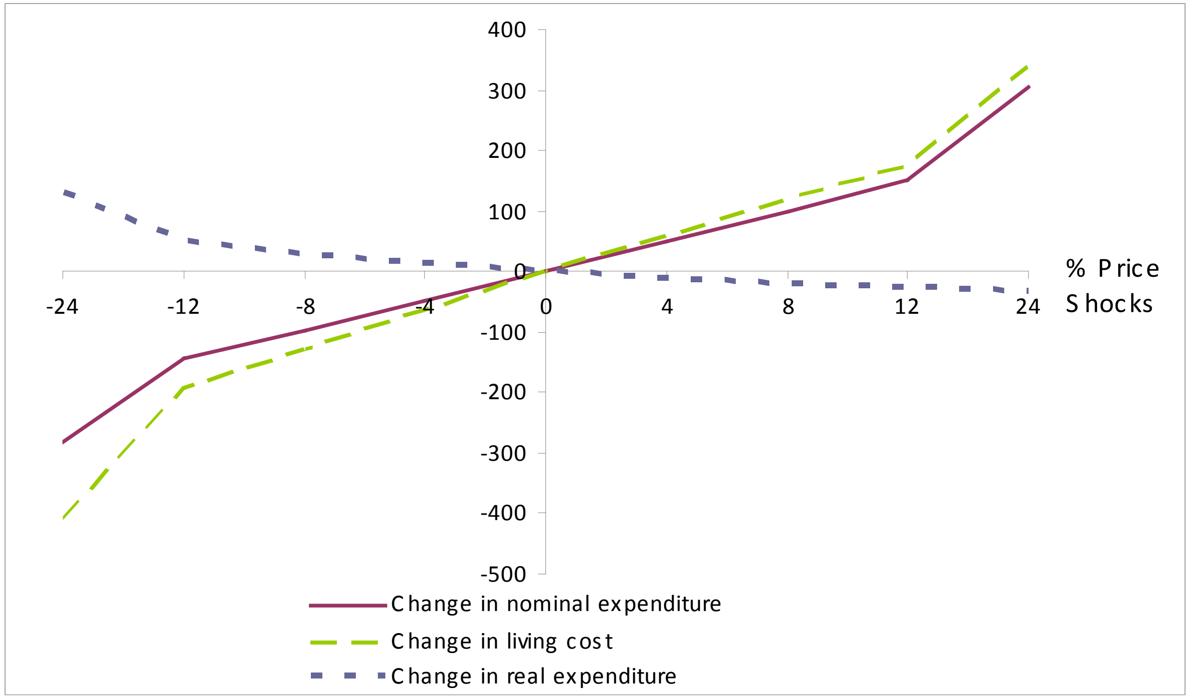
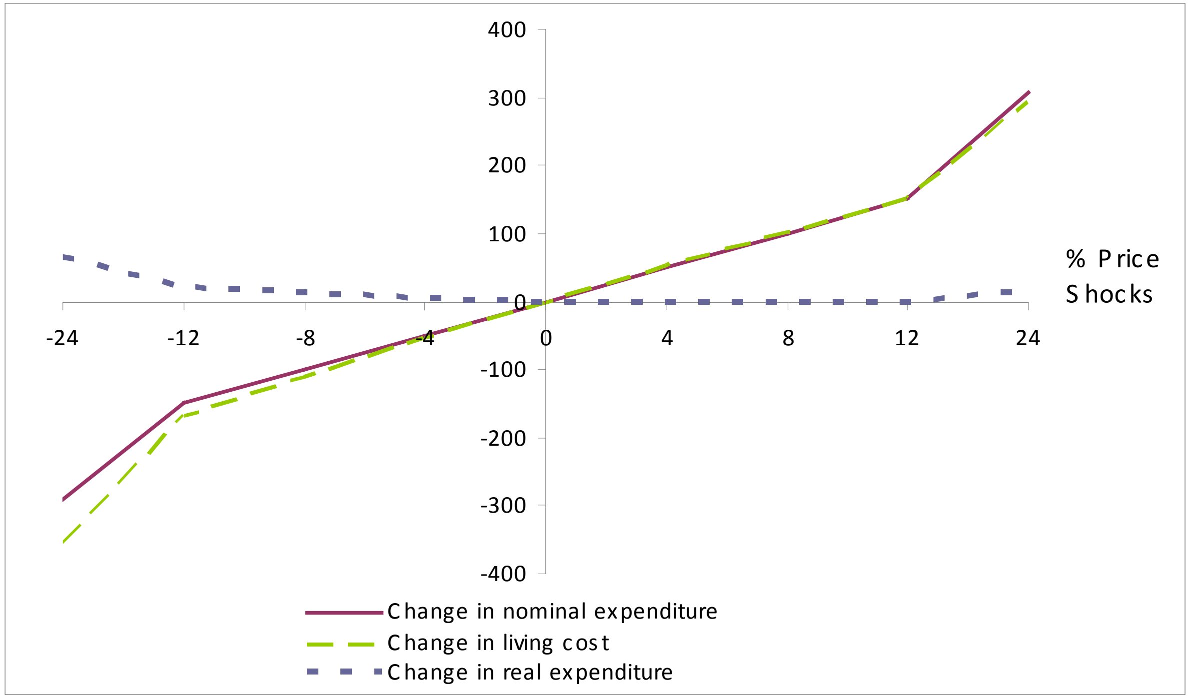


Figure 5. Price shocks and real expenditure: urban household on border of poverty line


400
300
200
100
0
-100
-200
-300
-400
-24
-12
-8
-4
0
4
8
12
24
% Price Shocks
Change in nominal expenditure
Change in living cost
Change in real expenditure

Appendix: Equation set

Demand for labor

$$l_i + a_i^L = x_i + \varepsilon_i^{LL}\left(w - a_i^L\right) + \varepsilon_i^{LK}\left(r_i - a_i^K\right)$$

Demand for capital

$$k_i + a_i^K = x_i + \varepsilon_i^{KL}\left(w - a_i^L\right) + \varepsilon_i^{KK}\left(r_i - a_i^K\right)$$

Zero profit in production

$$p_i = C_i^L\left(w - a_i^L\right) + C_i^K\left(r_i - a_i^K\right)$$

Zero profit in exporting ($e \in EXP$)

$$p_c = \pi + p_c^* - 100\frac{VE_c + VRE_c}{VE_c}\Delta TE_c$$

Zero profit in importing ($e \in IMP$)

$$p_c = \pi + p_c^* + 100\frac{VM_c - VRM_c}{VM_c}\Delta TM_c$$

Market clearing for labor

$$SLH_h \cdot l_h^S = \sum_i S_i^L l_i$$

Market clearing for capital

$$VK_i \cdot k_i = \sum_i VKH_{hi} k_{hi}^S$$

Import

$$\sum_h VQ_{hc} q_{hc} = VX_c x_c + VM_c m_c$$

Export

$$\sum_h VQ_{hc} q_{hc} = VX_c x_c - VE_c e_c$$

Household factor income

$$y_h^0 = RLY_h\left(w + l_h^S\right) + \sum_i RKY_h\left(r_i + k_{hi}^S\right)$$

Tariff revenue

$$\Delta RM_c = \left(VM_c - VRM_c\right)\Delta TM_c + \frac{1}{100} VRM_c\left(\pi + p^* + m_c\right)$$

Export tax revenue

$$\Delta RE_c = (VE_c + VRE_c)\Delta TE_c + \frac{1}{100} VRE_c(\pi + p^* + e_c)$$

Tariff and tax revenue distribution

$$\Delta R_h = SR_h\left(\sum_{c\in IMP} \Delta RM_c + \sum_{c\in EXP} \Delta RE_c\right)$$

Household total income

$$VY_h y_h = VY_h^0 y^0 + 100\Delta R_h + 100\Delta J_h + VJ_h \pi$$

Household demand for commodity

$$q_{hc} = y_h - p_c$$

Current account balance

$$100\Delta B = \sum_{c\in EXP} (VE_c + VRE_c)(p^* + e_c) - \sum_{c\in IMP} (VM_c - VRM_c)(p^* + e_c)$$

Principal notation

Lowercase Roman letters indicate the proportional change in variables whose levels are indicated by uppercase Roman letters. Thus $x = dX / X$.

l_i	Proportional change in labor used in industry *i*
k_i	Proportional change in capital used in industry *i*
x_i	Proportional change in output of industry *i* = production of commodity *i*
a_i^L	Labor-saving technical change shifter in industy *i*
a_i^K	Capital-saving technical change shifter in industy *i*
w	Proportional change in wage rate
r_i	Proportional change in rental of specific factor in industry *i*
p_i	Proportional change in price of commodity *i*
C_i^L	Cost share of labor in industry *i*
C_i^K	Cost share of capital in industry *i*
π	Proportional change in nominal exchange rate

Chapter 12

Poverty Belts and Vulnerability Zones in the Philippines: Implications for Crisis Management in the ASEAN Region

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CHAPTER 12

Poverty Belts and Vulnerability Zones in the Philippines: Implications for Crisis Management in the ASEAN Region

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1. Introduction

Countries cannot avoid being buffeted by natural disasters and economic crises that threaten their vulnerable population groups. The absence or lack of the necessary safety nets and appropriate social protection programs can permanently damage the people's future welfare due to permanent loss of human and physical capital.[2] Furthermore, the inability to cope with adverse shocks may lead households to adopt risk-mitigating strategies that, while offering some stability, often also yield low returns, trapping them in a perpetual cycle of poverty.

[1] Senior Research Fellow at the Philippine Institute for Development Studies and Research and Administrative Officer of the CBMS Network, respectively. The authors are grateful to the excellent research assistance provided by Jeremy de Jesus.

[2] Luc Christiaensen, "Measuring Household Vulnerability: Conceptual Issues and Illustrative Examples" (presentation made at the PADI Conference on Measuring, Understanding and Alleviating Household Vulnerability, Dar esSalaam, Tanzania, February 2--3, 2004).

This leads to the important issue of identifying these vulnerable population groups and understanding the nature and extent of their capacities to respond to various crises. The lack of necessary disaggregated and timely data for effective policymaking and program implementation is a prevailing issue among many developing countries. It can hinder the conduct of risk assessment, design of safety nets and policy actions, and impact monitoring.

This study generally aims to examine the impacts of crises on the poor and vulnerable in the Philippines and, to some extent, Cambodia and Lao PDR. In particular, it shall attempt to provide empirical evidence, based on the findings of the community-based monitoring system (CBMS), on the risks of various types of shocks to improvements in the quality of life. It aims to draw insights for crisis and disaster management in the region covered by the Association of Southeast Asian Nations (ASEAN).

2. What is the CBMS?

This section will describe CBMS as it is implemented in selected areas in Cambodia, Indonesia, Lao PDR, the Philippines and Viet Nam. It presents the information that can be generated by CBMS and how this information is being used in these countries.

CBMS was developed in the early 1990s to track the impacts of macroeconomic adjustment policies on vulnerable groups in society. This stems from the need to better understand the multidimensional nature of poverty and its importance in effective policymaking and program implementation. The lack of necessary disaggregated and timely data is prevalent among countries due to the high cost of conducting national censuses. Official statistics is usually available only down to the regional or provincial level at most.

CBMS was designed to fill in the inadequacy of existing monitoring systems to monitor the welfare status of households, particularly the vulnerable groups and poor segments of the population. It is intended to be a support mechanism for the decentralization policy, to provide greater support for the efficient delivery of basic social services at the local level.

The need for a CBMS (in the case of the Philippines) was further intensified with the advent of the 1997 Asian financial crisis together with the occurrence of the El Niño and La Niña phenomena, which adversely affected the vulnerable groups.

CBMS Indicator System and Poverty Maps

The CBMS generates household- and individual-level data on the different dimensions of poverty. It monitors a core set of indicators of poverty that is designed in local context. These indicators relate to the status of well-being in the areas of health and nutrition, education, income and livelihood, shelter, peace and order, and community-participation (table 1).

The system is also designed to accommodate community-specific indicators. For instance, it can generate information on the frequency of victims of natural calamities, disabilities, migration, and access to information/social programs, among others. CBMS data can also be disaggregated across population subgroups (e.g., age, sex, ethnicity or membership in an indigenous people's group, and urbanity).

Data from CBMS can be consolidated at the village, municipal/city, and provincial levels. It can be used to generate color-coded poverty maps to show the extent of the vulnerabilities of households to various shocks. These maps, which can indicate the geophysical location of households/individuals, can be used by policymakers to design safety nets and to draw up targets for the necessary interventions.

Table 1. CBMS Core Indicators

Deprivations	CBMS Indicators	
A. Health	1	Proportion of children under 5 years old who died
	2	Proportion of women who died due to pregnancy-related causes
B. Nutrition	3	Proportion of children aged 0--5 years old who are malnourished
C. Housing	4	Proportion of households living in makeshift housing
	5	Proportion of households that are informal settlers
D. Water and Sanitation	6	Proportion of households without access to safe water supply
	7	Proportion of households without access to sanitary toilet facilities
E. Education	8	Proportion of children aged 6--12 years old who are not attending elementary school
	9	Proportion of children aged 13--16 years old who are not attending secondary school
F. Income	10	Proportion of households with income below the poverty threshold
	11	Proportion of households with income below the food threshold
	12	Proportion of households that experienced food shortage
G. Employment	13	Proportion of persons in the labor force who are unemployed
H. Peace and Order	14	Proportion of persons who are victims of crimes
CBMS Composite Indicator		Average number of deprivations

The CBMS Process

Trained local enumerators collect CBMS data through a household census. These data are processed and validated by the community. The commitment and proactive participation of communities are crucial to the process of conducting CBMS. Databanks are established at each geopolitical level for use in local development planning, program design and implementation, and impact monitoring. The development of the system takes into account existing local capacities for data collection, processing, and analysis.

CBMS research work started under the Micro Impacts of Macroeconomic Adjustment Policies (MIMAP) Program of the International Development Research Center (IDRC). The system was designed and pilot-tested in the Philippines in 1994—95. Related initiatives to develop and pilot-test CBMS have likewise been supported simultaneously by IDRC in Bangladesh, Vietnam, Senegal, and Burkina Faso. Over time, the development and implementation of CBMS expanded to other countries in Asia (e.g., Cambodia, Indonesia, Lao PDR), Africa (e.g., Benin, Ghana, Kenya, Tanzania, and Zambia), and Latin America (e.g., Peru).

Current Uses of CBMS in selected ASEAN Member Countries

Philippines

CBMS is currently being used for various development processes in the Philippines. Since its first province-wide adoption in Palawan in 2000, the system is now being used by local government units (LGUs) in sixty provinces as a tool for local planning and budgeting. CBMS-generated data are used as inputs for poverty diagnosis and disaster risk planning and management as well as in calamity-relief operations. Furthermore, CBMS has been adopted by the country's national government agencies and local government units (backed by various related national and local policy issuances) as a vital tool for (1) localizing the millennium development goals (MDGs); (2) designing the poverty-related interventions of concerned national government agencies; and (3) identifying the intended beneficiaries of these interventions.

Aside from establishing databases at the LGU level, a national repository of CBMS data is now lodged and maintained at the National Anti-Poverty Commission (NAPC) and the Department of Interior and Local Government (DILG). CBMS data have been used for various purposes, such as (1) in the LGUs' preparation of their annual investment plans and in securing counterpart funding from international development partner agencies for local development projects; (2) in the preparation of the country's first subnational MDG reports for nine pilot provinces; (3) in the hazard mapping done by LGUs in Olongapo City and in drawing up the Integrated Community Disaster Planning Program of the National Red Cross in Puerto Princesa City; and (4) in analyzing the impacts of the 2007 food and fuel price hikes and the 2008 global financial crisis. Details of the findings of these studies are discussed in sections 4 and 5.

Data from selected CBMS sentinel sites were used in analyzing the impacts of the food and fuel price hikes and the global financial crisis. The province of Surigao del Norte is one of the current users of CBMS for its disaster risk-management program.

Cambodia

The implementation of CBMS in selected areas in Cambodia resulted in the production of commune statistics books in the pilot areas, which are used for planning and monitoring purposes. In addition to determining the poverty rates at the village level, CBMS provided scientifically generated statistics on demography, education, housing, land, water, health, household expenditure, occupation and income, assets, livestock, and domestic violence. The data is expected to be periodically updated, perhaps every two or three years. The results have been widely shared with various stakeholders for possible adoption in other areas.

As part of the successful advocacy for CBMS, the government of Cambodia has authorized the National Institute of Statistics (NIS) as the only institution approved by law to use CBMS as a model to conduct statistical activities at the commune level. This will help establish a new program using statistics for local development planning in aid of local governance and decentralization. This is a five-year commitment strongly supported by the Cambodian government and major donors as part of the effort to explore various approaches in identifying poor households. These initiatives are being done as part of the overall strategy of reducing the poverty rate.

Indonesia

The city of Pekalongan has adopted CBMS to support its poverty reduction programs and to monitor the achievement of the MDGs. Earlier on, data from CBMS implementation in four villages in Java were used to score family welfare status. These data are currently being used to monitor the impacts of the global financial crisis on poverty in selected CBMS areas in Pekalongan.

Lao PDR

Data from selected CBMS implementation sites in Lao PDR are being used to enhance the preparation of village books and to monitor the impacts of the global financial crisis on poverty.

Viet Nam

The implementation of CBMS in selected sites in Viet Nam has created opportunities for communes to define poverty and to take part in poverty reduction efforts.[3] The managing office of the National Target Programme for Hunger Eradication and Poverty Reduction (NTP-HEPR) has used CBMS data to assess government-run poverty reduction programs, such as the provision of healthcare services, housing, education, and credit.

CBMS data on poor households and their characteristics generated in Ha Tay Province have also been used by the Department of Labor, Invalids and Social Affairs (DOLISA) in its poverty reduction initiatives. Critical data generated include information on vulnerable groups needing government support, such as the invalids, the blind, orphans, and single

[3] Celia Reyes and Evan Due, *In-Focus: Fighting Poverty With Facts; Community Based Monitoring Systems* (Singapore: IDRC, 2009).

elderly people. The data also included relevant information on the rate of adult illiteracy, the dropout rate of schoolchildren, "information poverty" (i.e., nonownership of audio-video equipment), "communication poverty" (i.e., nonownership of means of transport), and "productive-property poverty" (i.e., lack of land and productive machines).

3. Poverty Belts and Vulnerable Zones

The CBMS can identify who and where the poor are and who are more vulnerable to natural disasters and food crises. It can identify poverty belts and vulnerable zones.

The following poverty maps show sample CBMS data revealing the location of the income poor in two Philippine provinces that are located in pathways of typhoons. The areas shaded red have the highest proportion of the income poor while the areas shaded green are where the households have incomes above the food threshold. The subsistence poverty level across all municipalities in each province is compared in figures 1 and 2. The deeper the shade of red in a particular municipality, the higher is its subsistence poverty level.

Figure 1. Proportion of households with income below food threshold, by municipality, Eastern Samar, Philippines, 2005—2006

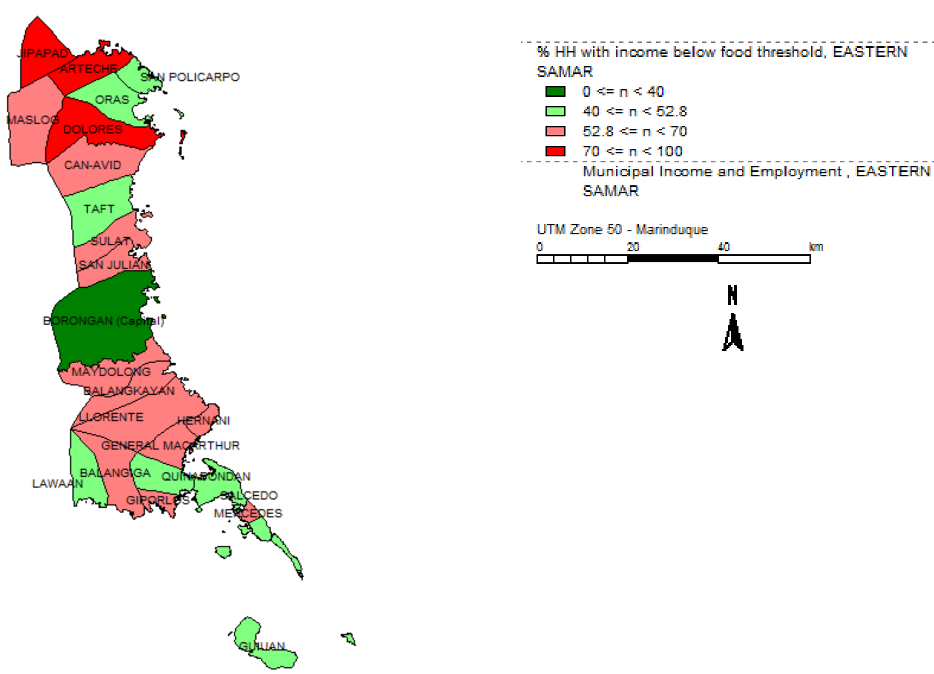
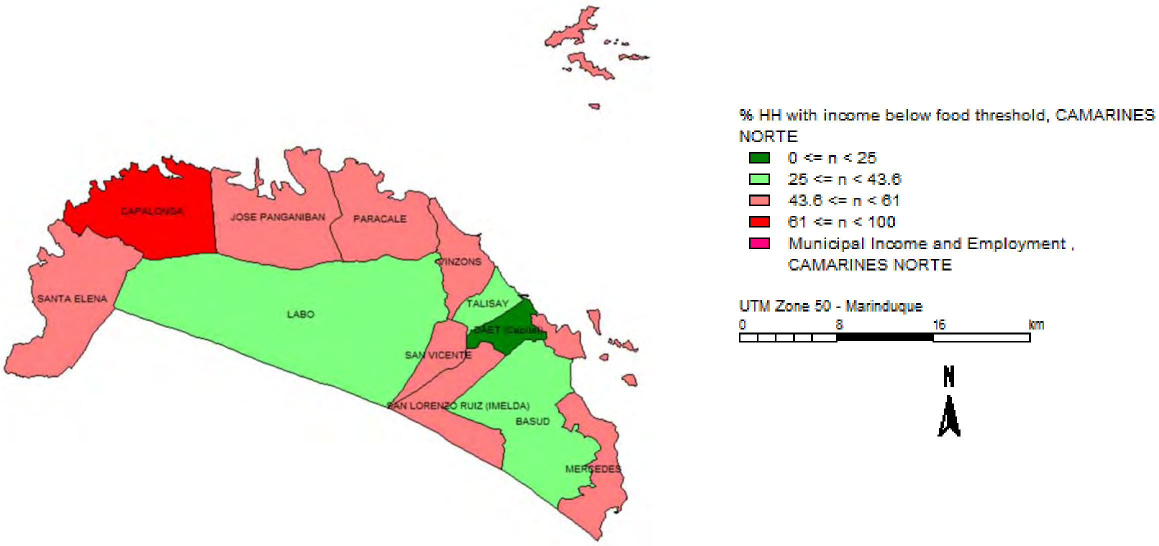
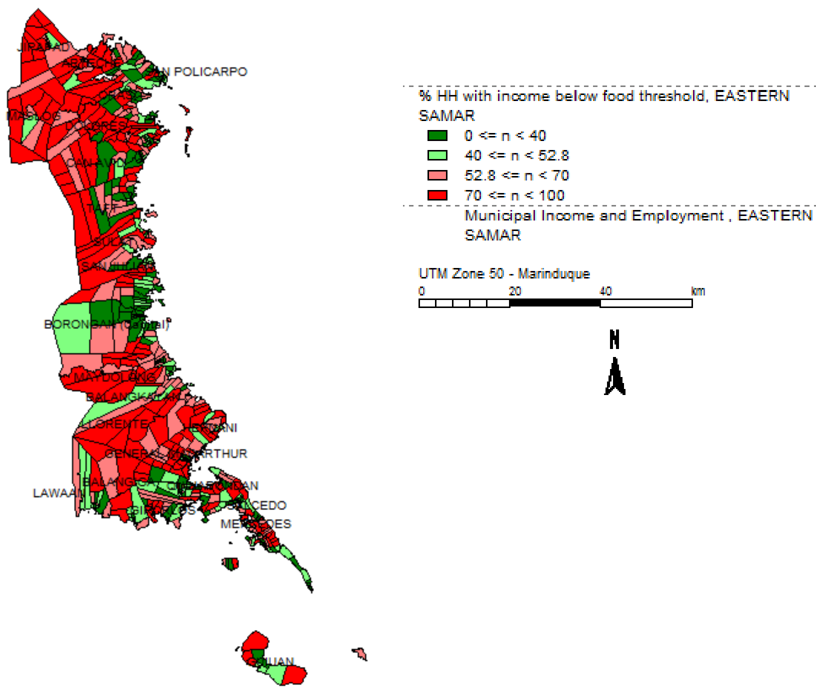


Figure 2. Proportion of households with income below food threshold, by municipality, Camarines Norte, Philippines, 2005—2006



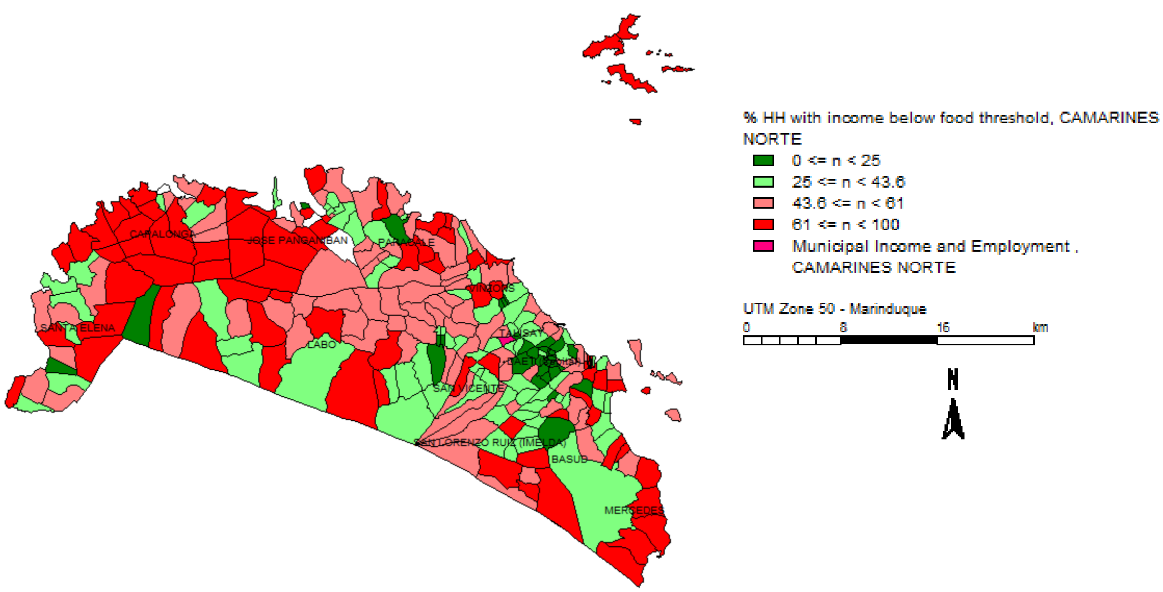
Figures 3 and 4 illustrate the subsistence poverty condition across villages (barangays).

Figure 3. Proportion of households with income below food threshold, by villages, Eastern Samar, Philippines, 2005—2006



Source: CBMS survey

Figure 4. Proportion of households with income below food threshold, by villages, Camarines Norte, Philippines, 2005—2006



***Source*:** CBMS survey

4. Impact of Food and Fuel Price Shocks

This section discusses the food and fuel price hikes that occurred in 2008. It uses CBMS data to analyze the impacts of the crisis on households in selected areas in the Philippines and Cambodia. It also presents the coping mechanisms employed by affected households.

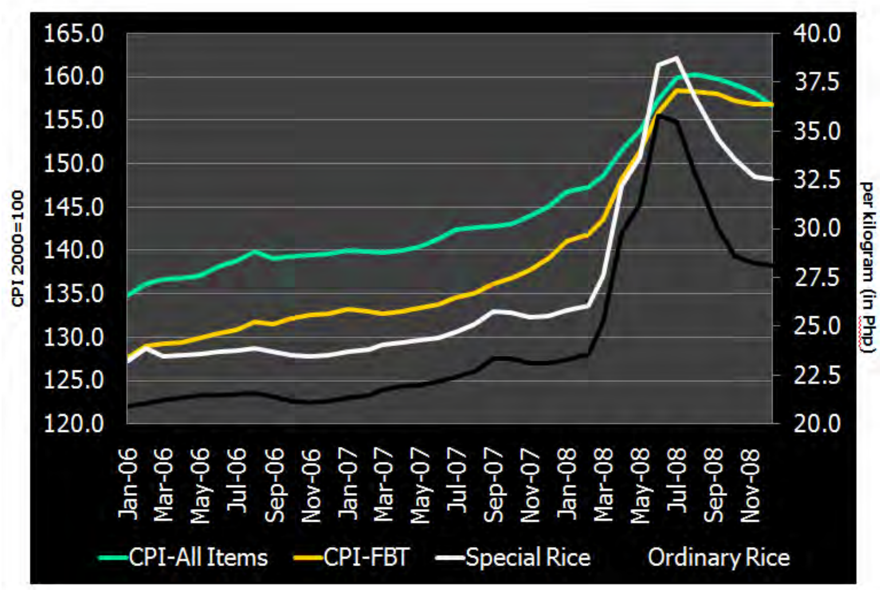
Background on the Food and Fuel Crisis in the Philippines and Cambodia

Philippines[4]

The prices of rice and fuel in the Philippines increased dramatically in 2008, following trends in the global market. Although the movement in the farmgate and retail prices of rice was fairly stable from January 2006 to December 2007, prices significantly increased starting January 2008. The average retail price of rice from January to September 2008 increased by 34.3 percent compared to the 3.7 percent increase the previous year. Meanwhile, farmgate prices increased 26.7 percent in January to September 2008 compared to the previous year's increase of only 4.5 percent. During this period, the price of rice was at its highest in June 2008, with farmgate and retail prices of ordinary rice at PHP 27.98 per kg and PHP 35.78 per kg, respectively.

[4] Reyes, Sobreviñas, Bancolita, and De Jesus, *Impact of the Changes in the Prices of Rice and Fuel.*

Figure 5. Movements in food and rice prices, 2006—2008



Meanwhile, data on fuel prices also showed a significant increase in 2008. From January to September 2008, the average price in unleaded gasoline increased by 31.6 percent compared to 2007 when unleaded gasoline prices stood 2.5 percent lower than in 2006. Moreover, average prices of diesel increased by 36.9 percent from January to September 2008 compared to the previous year's decline of 3.11 percent.

Despite the price increases in 2008, the estimated pass-through rates of prices reveal that there was no complete pass-through of changes in the foreign price of rice and fuel. This is partly attributed to the interventions made by the government in these sectors during the period.

Direct estimation based on changes in the consumer price index (CPI) resulting from the rice and fuel price increases during this period could force more than 1.8 million more people to fall below the poverty threshold. This translates to a 2 percent increase in poverty incidence among families. On the other hand, using the 2000 input-output accounts of the Philippines to estimate the direct and indirect impact transmitted through other sectors of the economy, the simultaneous changes in the prices of rice and oil would cause a 2.5 percent increase in poverty incidence among families. This translates to an increase in the number of poor people by about 2.3 million, holding other factors constant. Other measures, including poverty gap index and severity of poverty, also reflect a general worsening of the living condition of households in the Philippines as a result of the rice and fuel price hikes.

Cambodia[5]

Consumer prices in Cambodia remained stable between 2000 and 2003. However, prices increased starting mid-2004 and peaked between May and October 2008. Although the increase in the prices of consumer goods reversed after October 2008, the prices of many consumer and productive goods remained higher in December 2008 compared to the previous year. Furthermore, although the price of food consumer items started to decline after reaching the highest recorded annual inflation rate of 37 percent in August 2008, it still remained 32 percent higher in November 2008 than the previous year. Official statistics show that the average price of rice in November 2008 was KHR 2,780 per kg, which is 77 percent higher than the previous year. Meanwhile, the prices of various meats, such as pork, beef, and chicken remained 17 percent higher. This phenomenon provoked enormous policy debates and strong clamor to ensure food security as well as speed up poverty reduction in Cambodia.

Cambodia is a net importer of oil and many consumer goods, except rice. The integration of its economy in the international market has enhanced its economic performance and poverty reduction efforts in the last decade or so. Any change in demand for its produce and in the prices of important products will unduly affect productivity and society as a whole. While the government's economic and administrative reforms and infrastructure development are are being put in place, Cambodia is still grappling with how to dealwith shocks and or seizeeconomic opportunities generated by, rising prices. The 2008 fluctuation in prices undermined the government's poverty reduction efforts.

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[5] Sothearith and Sovannarith, *Impact of Hiked Prices of Food and Basic Commodities.*

About 20 percent of Cambodia's landless rural population is considered net food buyers. Furthermore, about 45 percent of Cambodians in the rural areas are considered landless poor as they own one hectare or less to grow rice for their own household consumption (Chan 2008). Majority of agricultural producers are rice growers. However, most of the large-farm rice producers did not make any profits from selling their rice since the price hikes began after the harvests when they had already sold out their produce.

Household-Level Impact: Evidence from CBMS

To examine the impact of the rice and fuel price hikes on households and the households' corresponding coping strategies, CBMS data were used to conduct a case study in selected villages in the Philippines and Cambodia.

Table 2 shows the coping strategies adopted by households in selected villages in the Philippines. Borrowing was revealed to be the most common strategy employed in the urban and rural areas to obtain additional cash.

Table 2. Coping Strategies Adopted by Households in Selected CBMS Villages in the Philippines, 2009

Coping strategies	Rural Santa Rita Poor (%)	Rural Santa Rita Nonpoor (%)	Urban Pasay Poor (%)	Urban Pasay Nonpoor (%)
Tapped Various Fund Sources				
Borrowed money	76.1	71.6	41.6	34.1
Pawned properties	14.1	26.9	3.5	4.4
Sold properties	12.7	15.3	5.2	2.0
Used savings	7.0	16.4	10.4	23.8
Sought Additional Source of Income				
Sought work outside of area/country	5.6	12.7	--	2.6
Tried to seek additional work	12.7	9.3	2.4	4.2
Did additional work aside from main occupation	9.9	9.3	--	2.1

***Source*:** CBMS Philippine survey 2009.

The price shocks had varying impacts on different households due to their different initial resource capacities. This fact should be taken into account in the implementation of safety net and social protection programs. Changes in the households' consumption patterns and spending decisions on health, food, and education would have critical implications on individuals' opportunities to expand or improve their condition and on the households' long-term ability to sustain and improve their quality of life. Table 3 shows the strategies adopted by households to cope with the higher prices of food and fuel.

Table 3. Modified Spending and Consumption Behavior Used as Coping Strategies by Households in Selected CBMS Sites, 2009

Modified spending and consumption behavior	Rural Santa Rita		Urban Pasay	
	Poor	Nonpoor	Poor	Nonpoor
Changed health-seeking behavior	60.6	30.8	24.1	18.5
Decreased electricity usage	45.5	22.2	6.1	12.3
Shifted to NFA rice	42.3	17.8	4.8	6.8
Changed electricity-consumption pattern	36.6	26.5	36.5	43.5
Changed food-consumption pattern	22.5	14.9	34.9	22.9
Food market preference shifted to NFA rolling stores/TNG	21.4	13.3	6.9	7.1
Children stopped attending school	8.5	6.7	4.8	0.8
Changed conduct of recreational and leisure activities	6.8	8.2	66.7	45.4
Shifted to low-cost cooking fuel	5.6	3.3	2.4	0.8
Transferred children from private to public schools	0.0	1.1	0.0	0.8
Decreased usage of cell phone	0.0	0.0	3.3	36.8
Shifted to cheaper means of transportation	0.0	0.4	0.0	0.4

***Source*:** CBMS Philippine survey 2009.

In response to the price increases, the Philippine government implemented policies and programs aimed at mitigating the negative impact of soaring prices. One of the most popular interventions was the direct sale of rice at subsidized prices. Although the efforts of the government to provide cheaper rice to the population were recognized, one important issue with this intervention was effective targeting. In particular, it was noted that only 46.6 percent of the consumers of the subsidized rice were poor. Furthermore, although poor households were supposed to be the target beneficiaries of the highly subsidized rice, results confirmed that only 24 percent of the poor households were able to access the subsidized rice (sourced from the National Food Authority [NFA]) based on the 2006 Family Income and Expenditures Survey (FIES). These findings imply serious leakage and undercoverage problems with the current targeting system. The results of the 2009 CBMS survey results also confirm the problem of mistargeting. In the areas covered in the study, it was found that the leakage rate was 77 percent, indicating that 77 percent of the benefits were going to nonpoor households. Moreover, the exclusion rate was 36 percent, suggesting that 36 percent of the poor did not benefit from the subsidy (table 4).

Table 4. Leakage and Exclusion Rate in the Distribution of Subsidized NFA Rice in Selected Villages in the Philippines, 2009

Rate	**All sample households (%)**
Leakage	76.6
Exclusion	35.7

Source: CBMS Philippine survey 2009.

Meanwhile, results in selected CBMS sites in Cambodia show how the surge in food prices adversely affected even rural households located in a rice-producing area. Only about 23 percent of the households surveyed, characterized as large rice farmers, petty traders, and/or moneylenders, were able to seize the opportunity generated by rising prices to produce surplus for sale or to increase income. Of the number of households consisting of the landless and the land-poor (i.e., those with one hectare of land or less), 77 percent were either already net food buyers or became net food buyers during the period covered by the price hikes. Many of these households did not earn enough income to offset the price increase or to meet basic household expenditures and had to work harder to earn money to buy food. In terms of food security, the condition of several rice-producing households worsened.

In response to rising prices, many children in the CBMS sites in Cambodia were taken out from school to help their families cope with the higher cost of living. Village out-migration also became a coping strategy for many. Children and the elderly had to work to help earn and sustain household income for food and other basic household expenditures. Affected households also resorted to loans in order to support businesses, purchase food items, or obtain healthcare services. In many cases, the price hikes contributed to the number of landless households in the CBMS villages.

Table 5. Poverty Headcount and Characteristics of Selected Villages in Cambodia, 2006—2008

Village	**NHH**	**Poverty headcount**		**Change**	**Village characteristics**
		2006	**2008**	**2006--08**	
Svay Chrum	216	28	44	16	Close to the market center; rice farming and petty trade are the main source of income

Reach Dounkeo	150	72	68	-4	Remote; wet- and dry-season rice and fishing
Samraong Outrea	343	63	36	-27	Good road access and connection to market; rice farming, fruit trees and petty trade
Sdei Leu	234	61	38	-23	Cash crop and wet-rice farming
Bak Amraek	189	66	40	-25	Wet- and dry-season rice farming and fishing
Total	1132	58	43	-15	

Sources**:** 1,132 CBMS panel households surveyed in 2006 and again in 2008 in Cambodia.

Table 6. Movement In and Out of Poverty of Panel Households in Selected Villages in Cambodia, 2006 and 2008 (% of 1,132 households)

Village	**Stayed nonpoor**	**Moved out of poverty**	**Fell into poverty**	**Stayed poor**	**Total**
Svay Chrum	47	10	25	18	100
Reach Dounkeo	9	23	19	49	100
Samraong Outrea	27	36	9	27	100
Sdei Leu	35	27	4	34	100
Bak Amraek	25	34	9	31	100
Total	30	27	13	30	100

Source**:** CBMS Cambodia survey 2008.

5. Impact of Global Financial and Economic Crises

This section draws from the findings of the CBMS study on the impact of the global financial and economic crises in the Philippines. It presents and analyzes the coping responses of households and the response of the government.

CBMS survey results confirmed that the impact of the crises on poverty varied across different groups of households or individuals. Certain groups were more affected by the crises than other groups.[6]

The recent global financial and economic crises, which started in the United States and expanded to other developed countries, also affected developing countries to some extent. Since the United States, one of the Philippines' major trading partners, suffered a recession due to the crises, the Philippines braced for a reduction in demand for its exports to the United States and to other major trading partners also affected by the crises. Since the Philippines is heavily dependent on exports for growth—exports account for about 46.7 percent of the Philippines' GDP as of 2008—the country may be considered to be vulnerable to external demand shocks.

The economic crisis was also expected to reduce income transfers from Filipino workers employed in affected countries. Furthermore, the economic slowdown in affected countries was also expected to lead to weaker demand for foreign workers in order to protect domestic labor. This was considered a negative development considering that the Philippines relies substantially on the overseas deployment of workers.

Results at the macro and micro levels revealed that although the impact of the crises was not as large as initially expected, it affected specific sectors of the economy to varying degrees. For instance, workers in the manufacturing sector were either displaced or experienced reduction in wages or in the number of working hours. Households that depended largely on remittances as a source of income were also adversely affected when remittances declined.

Macro-Level Impacts. Simulation exercises that captured the direct impact through these channels revealed an increase in poverty incidence by 0.14 percent, which would translate to approximately 120,000 people (table 7). The poverty gap and severity of poverty also increased by 0.06 percent and 0.05 percent, respectively. Meanwhile, wage reduction among

[6] Reyes, Sobrevinas, and de Jesus, *Impact of the Global Financial and Economic Crisis*.

affected households led to a 0.22 percent increase in poverty rate (representing about 201,000 households), with poverty gap index and severity of poverty index increasing slightly by 0.08 and 0.01, respectively.

Table 7. Results of Counterfactual Simulation

Indicator	Slower growth in remittance	Wage reduction
Δ in poor population	~120,000	~201,000
Δ in poverty incidence	0.14	0.22
Δ in poverty gap index	0.06	0.08
Δ in poverty severity index	0.05	0.01

Source: CBMS survey 2009.

Micro-Level Impacts. Monitoring the impact of the global financial crisis at the micro level was done through the conduct of the CBMS surveys[7] in selected sentinel sites where household- and community-level data were collected to capture the different dimensions of poverty. In addition to the CBMS core indicators, outcome and impact indicators were monitored in line with the identified key transmission channels for the Philippines: (1) overseas employment and remittances and (2) local employment. Thirteen barangays all over the Philippines were selected to serve as poverty observatories or sentinel sites for monitoring the impact of the crisis.

CBMS survey results showed that about 7.6 percent of the households were directly affected by the global financial crisis through the two major transmission channels mentioned earlier (table 8). About 2.3 percent were directly affected through overseas employment and remittance (OER) while 5.5 percent were affected through domestic employment. The most affected households were in the urban areas. Households highly dependent on agriculture were not directly affected by the global crisis.

[7] Data collection was conducted in May--July 2009 using the following reference period: November 2008--April 2009.

Table 8. Households Affected by the Global Financial Crisis (GFC)

	Affected by GFC		OER[1]		Local employment	
Barangay	**No.**	**%**	**No.**	**%**	**No.**	**%**
Urban NCR[2]	65	7.6	22	2.6	46	5.4
Urban outside NCR	196	8.3	64	2.7	138	5.8
Rural	114	4.4	29	1.1	86	3.3
TOTAL	**375**	**7.6**	**115**	**2.3**	**270**	**5.5**

***Source*:** CBMS survey 2009.

[1] Overseas employment and remittance

[2] NCR = National Capital Region

Results of the CBMS survey confirmed that the impact of the global financial crisis on poverty varied across different groups of households. In fact, certain groups of households or individuals were more affected by the crisis compared to other groups. Households highly dependent on remittances as a source of income were adversely affected through reduced remittance receipts. About 12.1 percent of households that received remittances during the six months prior to the survey reported that the remittances they received declined, while 9.1 percent said that the frequency of receipt of remittances during said period declined (table 9).

Table 9. Households Affected by the Global Financial Crisis through Remittances

Indicator	**No.**	**%**
HHs that received remittances	372	
Experienced a decline in amount of remittances received	45	12.1
Experienced a decline in the frequency of receipt of remittances	34	9.1

***Source*:** CBMS survey 2009

Households with members working in crisis-hit sectors were also negatively affected. An estimated 1.6 percent of employed persons in the households surveyed lost their jobs during the period while another 1.2 percent suffered a decrease in wages (table 10). Some workers also experienced reduced working hours (1.1 percent) and reduced benefits (0.1 percent).

Table 10. Specific Indicators of the Global Financial Crisis on Employment Situation and Job Conditions

	No.	**%**
No. of employed persons	7,114	
Members who lost jobs	115	1.6
Reduced wages	88	1.2
Cut in working hours	80	1.1
Reduced benefits	8	0.1

Source**:** CBMS survey 2009

Coping Mechanisms Adopted. In response to the crisis, households adopted various coping strategies. One of the most common of these strategies was to modify food expenses (table 11), which was adopted by 89.3 percent of the directly affected households. Results across all sentinel sites showed that poor households were more predisposed to changing food-consumption patterns, withdrawing children from school, and changing health-seeking behavior. These coping strategies are damaging and counterproductive in the medium- and long-run, especially for women, children, and other vulnerable groups. Withdrawal of children from school has negative long-term consequences. The health status of the affected households is also likely to be adversely affected if the members do not seek medical attention.

Table 11. Coping Strategies Adopted by Affected Households

Coping strategy	**No.**	**%**
1) Modified their Expenses on:		
Food	335	89.3
Clothing	324	86.4
Electricity	321	85.6
Communication	281	74.9

Fuel	268	71.5
Health	234	62.4
Water	209	55.7
Transportation	176	46.9
Recreation	163	43.5
Education	90	24.0
2) Tapped various fund sources		
Borrowed money	184	49.1
Used savings	87	23.2
Pawned assets	29	7.7
Sold assets	15	4.0
3) Sought additional source of income		
Looked for additional work	52	13.9
Did additional work	31	8.3
Employed member not previously working	11	2.9
Looked for work abroad	15	4.0

***Source*:** CBMS survey 2009.

Government Responses. The government also identified and implemented certain programs to mitigate the impact of the crisis. For example, its Economic Resiliency Plan (ERP) was intended to cushion the populace from the impact of the crisis and jumpstart the economy through a mix of accelerated government spending, tax cuts, and public-private sector investments in infrastructure projects. Several government agencies also assisted those directly affected by the crisis such as overseas Filipino workers (OFWs) and local workers displaced by the crisis. However, many of these programs suffered from low impact and/or weak targeting.

Summary. The Philippines experienced a slight increase in poverty as a result of the global financial and economic crises. The effect on the poverty situation can be traced to the slowdown in the growth of remittances and the reduction in wages. Coupled with the impact of the price shock in 2008 and recent natural calamities, the poverty incidence is expected to rise significantly in the future. This is more worrisome given the recent reversal in poverty incidence observed in 2006 when poverty incidence went up for the first time since 1985.

Although recent estimates reveal that the Philippines and the global economy in general have started recovering from the crises, there must be a continuing effort to improve the targeting of relevant government programs. As the CBMS results show, leakage and exclusion rates are still high for programs such as the NFA rice subsidy program, the conditional cash transfer called *Pantawid Pamilyang Pilipino Program* (4Ps), and the health insurance program for the poor (sponsored PhilHealth).

The recurring problem of targeting in social protection programs highlights the need for a good targeting mechanism in order to minimize leakages and exclusion. Current programs need to be evaluated in order to (1) identify those that are ineffective and need to be stopped and (2) to determine how the programs that should be continued can be improved. This is one area where CBMS can be very useful. Household-level data, such as those being generated by CBMS, are very useful in identifying eligible beneficiaries and monitoring impact of these programs. CBMS data can also be used to validate results obtained at the macro level as well as enrich available information in terms of identifying who will be affected.

6. Impact of Natural Disasters

Climate change will bring about more severe, frequent, and less predictable weather events. This means that responses have to be prepared ahead of time. Again, CBMS data can provide information on vulnerable populations. This section will describe recent trends in natural disasters in the region and their impacts on production and income.

The frequency and severity of disasters is evident across the globe. According to the International Disaster Database (EM-DAT), between 1980--1989 and 1999--2009, the number of disaster events reported globally increased from 1,690 to 3,886.[8] Data reveal that the Asia-Pacific region accounts for 45 percent of this increase. Within this region, disaster events are most prevalent in South and Southwest Asia and in Southeast Asia, resulting to massive loss of human lives and economic damage (table 12).

Table 12. Disaster Events and Impacts in Asia and the Pacific, 1980—2009

Region	Events	Killed	Affected ('000s)	Damage (US$ million)
East and Northeast Asia	908	162,804	2,567,214	578,602
North and Central Asia	297	34,644	17,231	15,636
Pacific (Oceania)	406	5,425	19,126	39,078
South and Southwest Asia	1,283	566,423	1,914,696	141,506
Southeast Asia	1,069	394,687	272,777	48,220
Total	**3,963**	**1,163,983**	**4,791,044**	**823,041**

***Source of data*:** The Asia Pacific Disaster Report 2010, UNESCAP.

Table 13 shows the number of disasters across countries in Southeast Asia for the period 1980--2009. In terms of frequency of disaster events, the Philippines ranked the highest followed closely by Indonesia. Based on the data, the magnitude of impact in terms of human and economic losses was highest in Indonesia. The Philippines, on the other hand, tops the list in terms of the number of people affected by disasters.

Table 13. Disaster Events and Impacts by Country in Southeast Asia, 1980—2009

Country	Events	Killed	Affected ('000s)	Damage (US$ million)
Brunei Darussalam	1	--	--	4
Cambodia	30	1,959	16,404	518

[8] UNESCAP, *Protecting Development Gains: Reducing Disaster Vulnerability and Building Resilience in Asia and the Pacific; The Asia Pacific Disaster Report* (Bangkok: ESCAP/UNISDR, 2010).

Indonesia	312	191,164	17,545	22,582
Lao PDR	30	945	3,998	337
Malaysia	58	1,239	579	1,723
Myanmar	25	139,095	3,315	2,726
Philippines	349	32,578	109,423	7,168
Singapore	3	36	2	-
Thailand	101	11,730	53,762	5,983
Timor-Leste	8	27	14	-
Viet Nam	152	15,914	67,735	7,180
Total	**1,069**	**394,687**	**272,777**	**48,220**

***Source of data*:** The Asia Pacific Disaster Report 2010, UNESCAP.

The aforementioned trend in disaster events in the region and the possible hazards of climate change have serious implications on poverty reduction efforts and protection of gains from related development initiatives. For instance, earlier research reports estimated that Typhoons Ketsana (Ondoy) and Parma (Pepeng), which hit the Philippines in 2009, could have increased poverty incidence in the country by as much as three percentage points in the worst affected areas of Luzon and by 0.5 percentage points nationwide, resulting to a total increase in the number of poor by 480,000.[9] In the case of Vie Nam, it was estimated that an additional 4 to 5 percent of the population could be pushed into poverty in the event of a disaster. Disasters have negative impacts on the different dimensions of human development (e.g., health, levels of educational attainment, access to clean water, and livelihood opportunities).

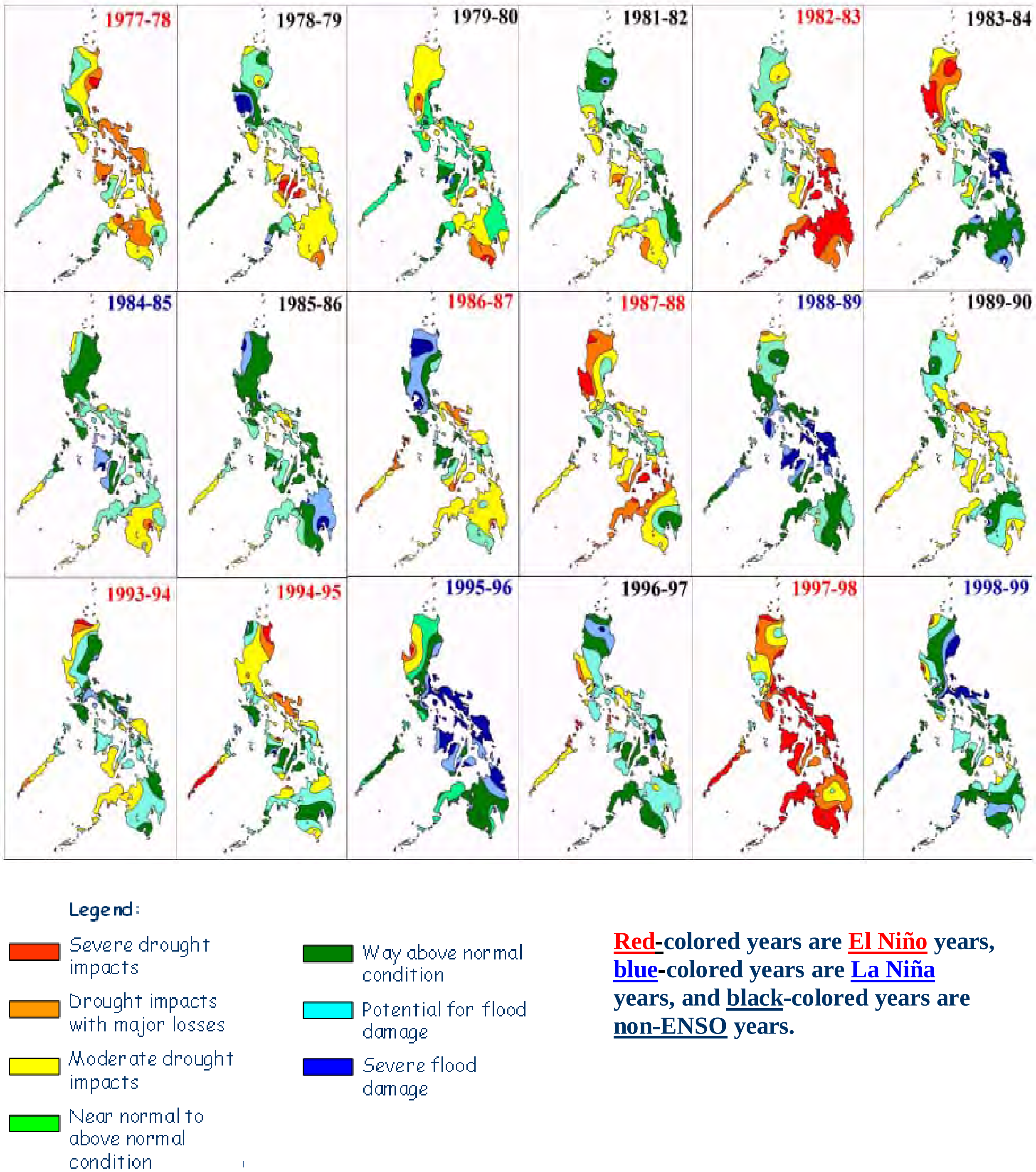
The risks of natural disasters and climate change coupled with economic, social, and life cycle shocks adds pressure to the challenge already inherent in meeting the MDGs. This underscores the need for developing nations, with their very meager resources, to put in place well-designed and targeted policies that would enable their vulnerable population to cope with these crises. The development of effective policies and programs requires a sound and

[9] Ibid.

reliable basis for understanding the resource (both human and physical) capacities of the vulnerable population to face and surpass the consequences of various shocks on their present quality of life. In mitigating these challenges, the choice of public policy must also consider the possible adverse impacts of current coping mechanisms/strategies used by the vulnerable population against natural and man-made disasters on the quality of life of the future generation. A critical issue at this point is the need to bridge information gaps in order to facilitate the identification, location, and understanding of the nature and extent of the inadequacies of these vulnerable groups. Household-level data are particularly important in analyzing the impacts of disasters and in preparing disaster-risk plans and programs. Unfortunately, many countries have limited availability to generate the necessary disaggregated data. CBMS can fill this gap and complement existing information from national surveys.

Figure 6 shows the impact of the El Niño Southern Oscillation (ENSO) on the rainfall pattern in the Philippines. It shows which areas have been subjected to droughts and floods that could adversely affect agricultural production in those areas.

Figure 6. Impact of the El Niño Southern Oscillation on Philippine rainfall



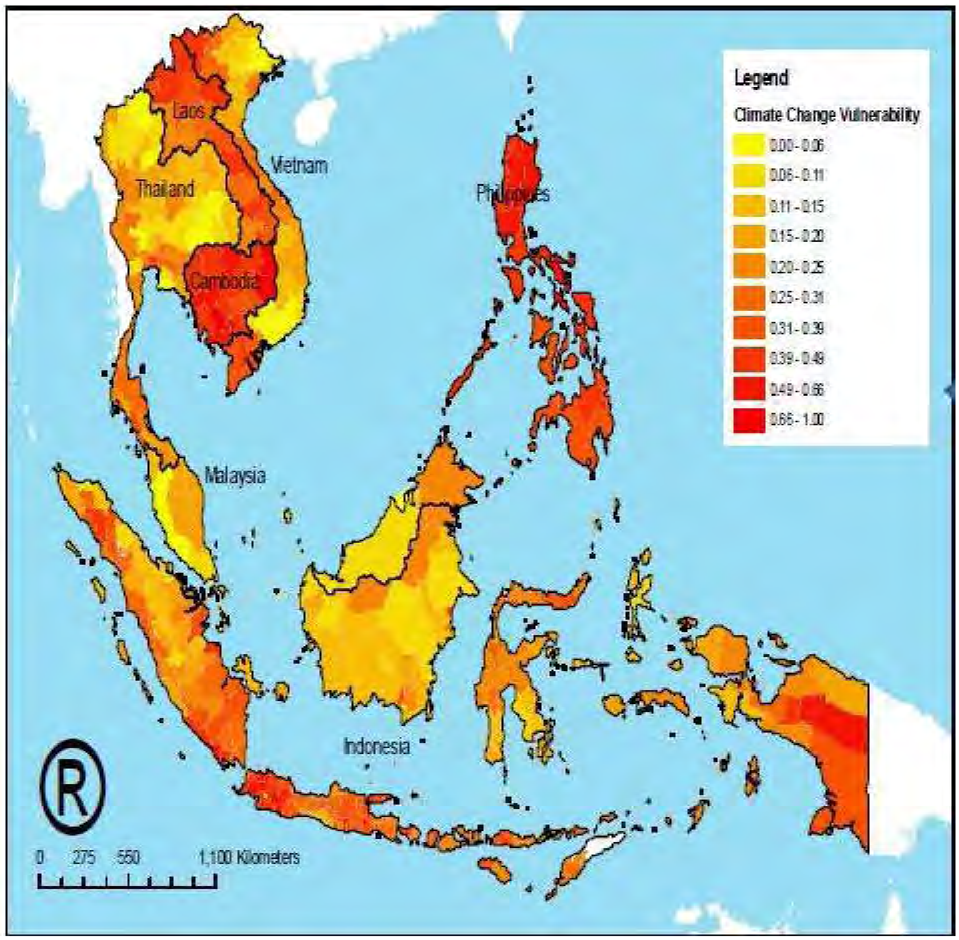
Source**:** Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA).

For instance, data from one province reveal that certain areas are more vulnerable to calamities than other areas (table 14). The data further reveal that there are some areas that are more prone to certain types of natural disasters. This information can help local governments craft better risk- and disaster-management policies and programs.

Table 14. Proportion of Calamity-Stricken Households in Eastern Samar, By Calamity, By Municipality					
Municipality	**Typhoon**	**Flood**	**Drought**	**Fire**	**At least one calamity**
Arteche	49.50	24.77	1.58	0.18	52.08
Balangiga	15.54	2.06	1.03	0.08	15.83
Balangkayan	0.06	0.40	0.17	0.00	0.62
Borongan	3.96	3.84	0.42	0.08	4.42
Can-avid	26.16	8.81	4.88	0.14	27.19
Dolores	4.14	3.93	0.52	0.10	6.29
General Macarthur	3.90	0.04	0.18	0.04	4.16
Giporlos	1.50	0.13	0.09	0.04	1.54
Guiuan	2.48	0.81	0.00	0.01	2.50
Hernani	1.31	0.00	0.00	0.00	1.31
Jipapad	98.19	92.38	16.55	0.20	98.19
Lawaan	64.06	10.57	17.97	0.19	65.64
Llorente	6.73	11.22	0.05	0.08	13.05
Maslog	97.94	61.18	15.59	0.15	98.68
Maydolong	0.77	2.09	0.00	0.00	2.56
Mercedes	1.36	0.00	0.00	0.09	1.36
Oras	1.80	2.02	1.09	0.03	3.77
Quinapondan	3.69	4.88	0.04	0.00	6.52
Salcedo	8.79	0.05	0.03	0.03	8.81
San Julian	4.74	0.42	0.60	0.04	5.44
San Policarpio	47.91	0.15	0.00	0.00	47.91
Sulat	22.99	0.08	0.04	0.00	23.07
Taft	59.97	13.90	0.23	0.03	59.97
Eastern Samar	**14.68**	**5.86**	**1.38**	**0.06**	**15.79**

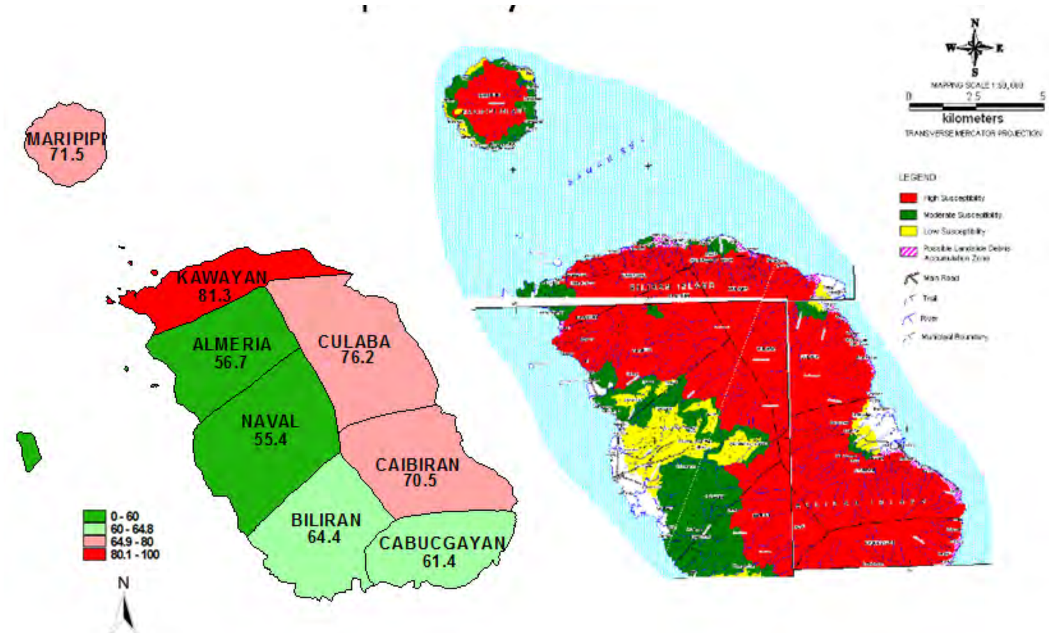
There have been efforts to produce maps of vulnerable areas. For instance, Francisco (2009) prepared a map that shows the vulnerability of countries in the ASEAN region to climate change (figure 7). Vulnerability was based on climatic hazards, sensitivity, and the adaptive capacity of the affected population. These maps used provincial-level data because these were the only data available. It would be more useful to local governments and the population to disaggregate this to the subprovincial level. CBMS can provide the needed disaggregated socioeconomic data which could then be combined with the physical data (e.g., from the geohazard maps of the Mines and Geosciences Bureau [MGB]) to generate more disaggregated vulnerability maps. Examples of these maps are shown in figures 8 to 11. Figures 8 and 9 show municipal- and village-level CBMS data for poverty incidence, which could be linked with the susceptibility-to-landslide map of the MGB. Figures 10 and 11 show municipal- and village-level data for poverty incidence from CBMS and a susceptibility-to-flooding map from the MGB.

Figure 7. Climate change vulnerability mapping, 2009



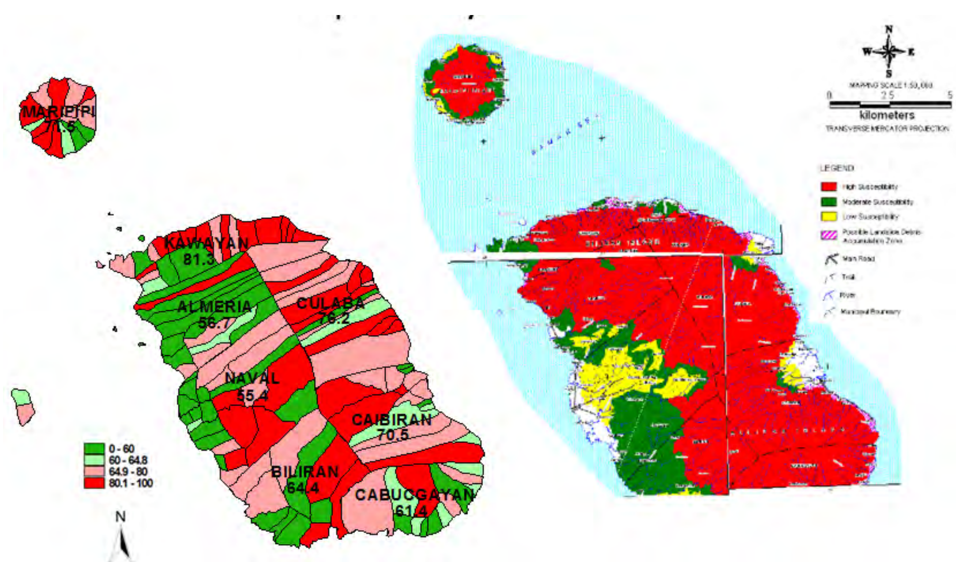
***Source*:** Yusuf and Francisco, Economy and Environment Program for Southeast Asia (EEPSEA) 2009.

Figure 8. Poverty incidence by municipality and susceptibility to landslides



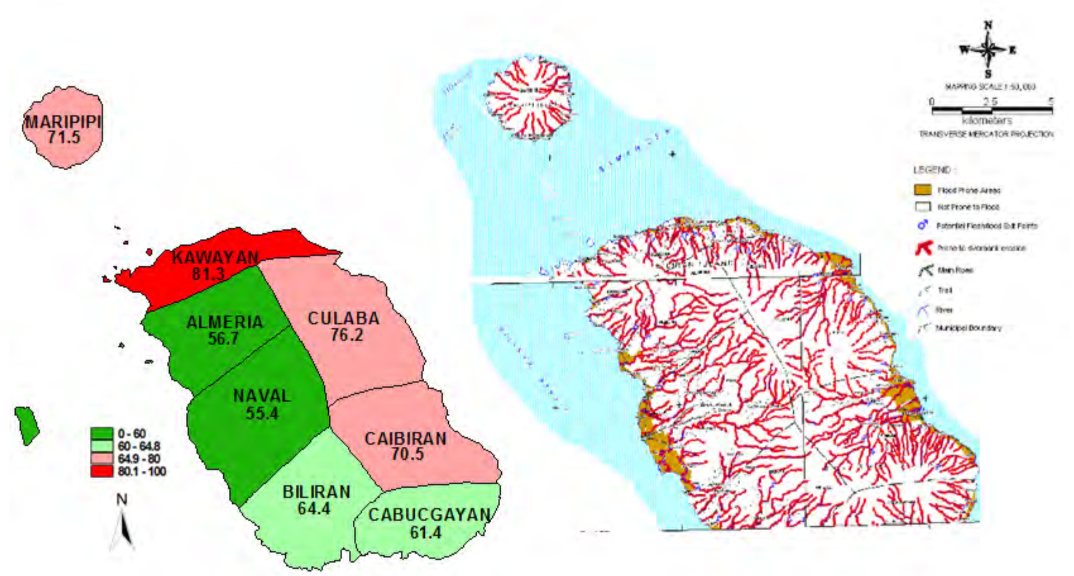
Sources of basic data: CBMS Survey and MGB

Figure 9. Poverty incidence by barangay and susceptibility to landslides



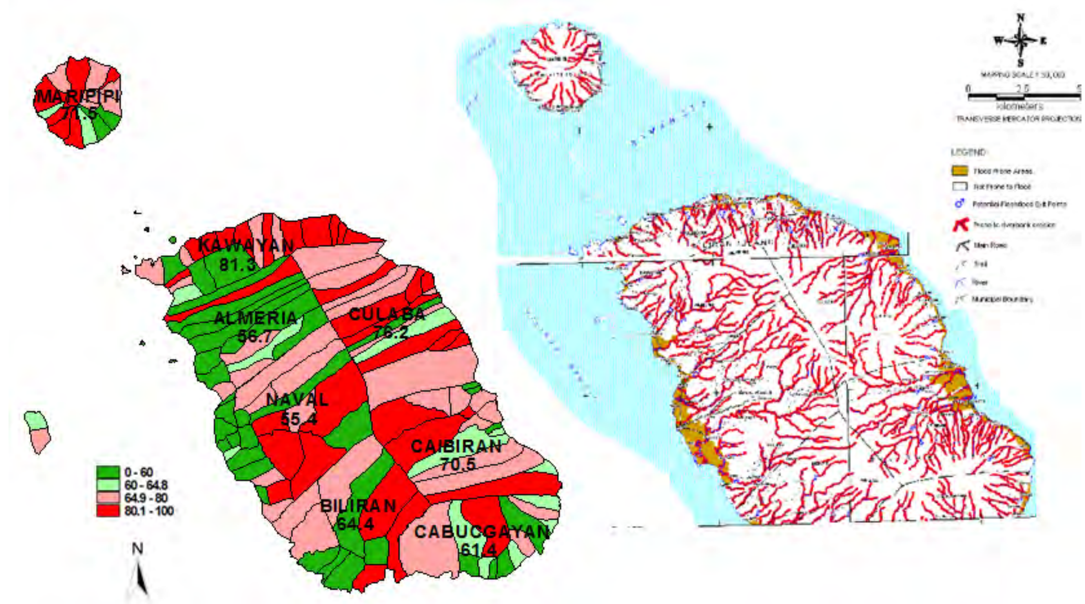
Sources of basic data: CBMS survey and MGB.

Figure 10. Poverty incidence by municipality and susceptibility to flooding



***Sources of basic data*:** CBMS survey and MGB.

Figure 11. Poverty incidence by barangay and susceptibility to flooding



***Sources of basic data*:** CBMS survey and MGB

Modeling vulnerability to natural calamities

Calamities can affect the poverty status of households. Natural disasters can damage production, destroy businesses, and limit income-earning opportunities to the extent that the nonpoor may fall into poverty and the poor become even poorer. Using CBMS panel data for selected sites in the Philippines, logistic regression models were estimated to empirically examine whether the occurrence of calamities influences a household's poverty situation. Poverty status for 2009 (the current year at the time of this study) was the dependent variable. The explanatory variables used the socioeconomic characteristics of the household in the baseline year, including poverty status, urbanity, dependency ratio, educational attainment, gender, age, sector of employment, occupation of the household head, whether the household was affected by a natural calamity, and whether an adult member has died. The results revealed that a calamity-stricken household had greater probability of being poor in the current year (table 15). The details of model 1 are presented in the appendix. The model provides a relatively good fit to the data as 83 percent of the observations are correctly classified.

Table 15. Summary of Logistic Regression Results

Characteristic in baseline year	**Probability of being poor in 2009**
Being poor	Increases
Urban residence	Decreases
Higher dependency ratio	Increases
Higher educational attainment of household head	Decreases
Older household head	Decreases
Woman as head of the household	Decreases
Household head engaged in agriculture	Increases
Household head is unskilled laborer	Increases
Affected by calamity in current year	Increases
Death of adult member	Increases

Another model was estimated using mainly the characteristics of the household in the current year as variables to explain the poverty status in the same year. The results showed that a household that is affected by a natural calamity in the base year has greater probability of becoming poor. The same household, when subjected to another calamity in the current year, further increases its chances of becoming poor (table 16). The regression results for model 2 are presented in the appendix. In terms of the model's goodness of fit, 80 percent of the observations are correctly classified, which indicates a relatively good fit. The results of both models provide empirical support that calamities, since they tend to damage both income-earning opportunities and assets,therefore increase the likelihood of affected households moving into poverty.

Table 16. Summary of Logistic Regression Results

Characteristic in baseline year	**Probability of being poor in 2009**
Urban residence	Decreases
Higher dependency ratio	Increases
Higher educational attainment of household head	Decreases
Older household head	Decreases
Woman as head of the household	Decreases
Household head engaged in agriculture	Increases
Household head is unskilled laborer	Increases
Affected by calamity in 2009	Increases
Tapped savings	Decreases
Affected by calamity in baseline year	Increases

7. Insights for Crisis and Disaster Management

The nature and extent of the impacts of food crises and shocks have implications on the appropriate responses to mitigate the impacts of these crises. This section presents insights on crisis management for the ASEAN region.

- Climate change-induced disasters will become more frequent, so knowing the vulnerable belts in advance will be useful in minimizing losses to lives and property. Preparing vulnerability maps for municipalities and even villages would be very useful in the preparation of disaster response plans.

- The existing official statistical systems in the ASEAN member countries can generally provide national, regional, and even provincial data. However, more disaggregated data, such as the kind that CBMS can generate, are necessary to identify population groups that are vulnerable to disasters. This would facilitate the preparation of better risk and disaster management policies and programs.

- CBMS has been recognized by LGUs as a useful tool for the identification and prioritization of disaster-prone areas and corresponding programs, projects, and activities at the local level. The expansion of CBMS in the ASEAN region would strengthen the statistical system of these countries at the local level.

- Safety nets may need to be deployed quickly to avert long-term, adverse consequences on the well-being of households. This implies the need to have a menu of tested safety nets that will respond to different risks and vulnerabilities. Thus, program implementers need to regularly assess the effectiveness of programs. The sharing of best practices as well as failed programs among countries in the region would be useful.

- Studies have shown that the targeting schemes of government programs need to be improved. The use of CBMS data can facilitate household-level targeting to help reduce leakages and exclusion.

- There is scope for regional cooperation in dealing with crises in the ASEAN region. The fiscal capacities of governments may also be constrained in times of crises. Thus, the ability of governments to respond to shocks may be limited at the time that their assistance is needed most by the population. In these cases, regional funds may need to be established to allow governments to address the impacts of shocks and to facilitate earlier recovery. This may help avert the long-term, adverse consequences of some of the coping strategies used by households.

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Appendix

RESULTS OF LOGISTIC REGRESSIONS

DESCRIPTION OF VARIABLES: MODEL NO.1

<u>Dependent variable:</u>

povp2 (poverty status in 2009)

<u>Independent variables:</u>

1. *povp1* (poverty status in baseline year): poor=1; nonpoor=0

2. *hurb* (urbanity): urban=1; rural=0

3. *depratio* (dependency ratio): proportion of members aged 0--14 and aged 60 and over to members aged 15--59

4-8. educational attainment of head;

4. *hheduc2*: hh head is elementary graduate=1; otherwise=0

5. *hheduc3*: hh head is high school undergraduate=1; otherwise=0

6. *hheduc4*: hh head is high school graduate=1; otherwise=0

7. *hheduc5*: hh head is college undergraduate=1; otherwise=0

8. *hheduc67*: hh head is college graduate=1; otherwise=0

9. *age* (age of household head)

10. *sex* (sex of household head): female=1; male=0

11. *hhagri* (job sector of household head): agricultural=1; nonagricultural=0

12. *hhunskilled* (occupation of household head): unskilled=1; skilled=0

13. *calamind* (calamity indicator): experienced calamity=1; otherwise=0

14. *deathadult* (adult death indicator): a member aged 20 and over died=1; otherwise=0

MODEL NO. 1

Logistic regression						Number of obs	=	706
						LR chi2(14)	=	399.91
Log likelihood	=	-289.35951				Prob > chi2	=	0.0000
						Pseudo R2	=	0.4086

povp2	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
povp1	1.971615	0.2378865	8.29	0.000	1.505366	2.437864
hurb	-1.158329	0.3053582	-3.79	0.000	-1.756820	-0.559838
depratio	0.317587	0.1386337	2.29	0.022	0.045870	0.589304
hheduc2	-1.002309	0.4693324	-2.14	0.033	-1.922184	-0.082435
hheduc3	-0.830942	0.3308249	-2.51	0.012	-1.479347	-0.182538
hheduc4	-1.534855	0.3826481	-4.01	0.000	-2.284832	-0.784879
hheduc5	-1.417973	0.4044029	-3.51	0.000	-2.210588	-0.625358
hheduc67	-1.979453	0.4305518	-4.60	0.000	-2.823319	-1.135587
age	-0.015607	0.0092264	-1.69	0.091	-0.033690	0.002477
sex	-0.148160	0.4030539	-0.37	0.713	-0.938131	0.641811
hhagri	0.182085	0.2883851	0.63	0.528	-0.383140	0.747309
hhunskilled	1.385745	0.3907780	3.55	0.000	0.619835	2.151656
calamind	1.515663	0.3106699	4.88	0.000	0.906761	2.124565
deathadult	0.576085	0.7101927	0.81	0.417	-0.815867	1.968037
_cons	0.695498	0.6270894	1.11	0.267	-0.533575	1.924571

SENSITIVITY AND SPECIFICITY OF MODEL NO. 1

	---------TRUE--------		
Classified	D	~D	Total
+	290	59	349
-	59	298	357
Total	349	357	706

Classified + if predicted Pr(D) >= 0.5
True D defined as povp2 != 0

Sensitivity	Pr(+| D)	83.09%
Specificity	Pr(-|~D)	83.47%
Positive predictive value	Pr(D| +)	83.09%
Negative predictive value	Pr(~D| -)	83.47%
False + rate for true ~D	Pr(+|~D)	16.53%
False - rate for true D	Pr(-| D)	16.91%
False + rate for classified +	Pr(~D| +)	16.91%
False - rate for classified -	Pr(D| -)	16.53%
Correctly classified		83.29%

DESCRIPTION OF VARIABLES: MODEL NO.2

Dependent variable:

ovp2 (poverty status in 2009)

Independent variables:

1. *hurb* (urbanity): urban=1; rural=0

2. *depratio* (dependency ratio): proportion of members aged 0--14 and aged 60 and over to members aged 15--59

3-7. educational attainment of head;

3. *hheduc2*: hh head is elementary graduate=1; otherwise=0

4. *hheduc3*: hh head is high school undergraduate=1; otherwise=0

5. *hheduc4*: hh head is high school graduate=1; otherwise=0

6. *hheduc5*: hh head is college undergraduate=1; otherwise=0

7. *hheduc67*: hh head is college graduate=1; otherwise=0

8. *age* (age of household head)

9. *sex* (sex of household head): female=1; male=0

10. *hhagri* (job sector of household head): agricultural=1; nonagricultural=0

11. *hhunskilled* (occupation of household head): unskilled=1; skilled=0

12. *calamind* (2009 calamity indicator): experienced calamity during past 12 months before 2009 survey=1; otherwise=0

13. *savings* (savings indicator): household used savings=1; otherwise=0

14. calamind1 (baseline calamity indicator): experienced calamity during past 12 months before baseline survey=1; otherwise=0

MODEL NO. 2

Logistic regression							Number of obs	=	639
							LR chi2(14)	=	296.99
Log likelihood	=	-293.76874					Prob > chi2	=	0.0000
							Pseudo R2	=	0.3358

povp2	Coef.	Std. Err.	z	P>z	[95% Conf.	Interval]
hurb	-2.037387	0.3212458	-6.34	0.000	-2.667017	-1.407756
depratio	0.547731	0.1459435	3.75	0.000	0.261687	0.833775
hheduc2	-0.378184	0.3938565	-0.96	0.337	-1.150128	0.393761
hheduc3	-0.426380	0.3659097	-1.17	0.244	-1.143550	0.290790
hheduc4	-0.670281	0.3531157	-1.90	0.058	-1.362375	0.021813
hheduc5	-1.142631	0.4085329	-2.80	0.005	-1.943341	-0.341922
hheduc67	-2.089583	0.4645330	-4.50	0.000	-3.000051	-1.179115
age	-0.004159	0.0089795	-0.46	0.643	-0.021758	0.013441
sex	-0.572093	0.3624813	-1.58	0.115	-1.282543	0.138357
hhagri	0.663654	0.2868790	2.31	0.021	0.101382	1.225927
hhunskilled	0.678591	0.3028637	2.24	0.025	0.084989	1.272192
calamind	0.403412	0.2485451	1.62	0.105	-0.083727	0.890552
savings	-1.185065	0.2736017	-4.33	0.000	-1.721315	-0.648816
calamind1	2.045353	0.3220292	6.35	0.000	1.414187	2.676519
_cons	0.844898	0.6422075	1.32	0.188	-0.413805	2.103602

SENSITIVITY AND SPECIFICITY OF MODEL NO. 2

Logistic model for povp2

Classified	D	~D	Total
	---------TRUE--------		
+	249	73	322
-	56	261	317
Total	305	334	639

Classified + if predicted Pr(D) >= 0.5
True D defined as povp2 != 0

Sensitivity	Pr(+| D)	81.64%
Specificity	Pr(-|~D)	78.14%
Positive predictive value	Pr(D| +)	77.33%
Negative predictive value	Pr(~D| -)	82.33%
False + rate for true ~D	Pr(+|~D)	21.86%
False - rate for true D	Pr(-| D)	18.36%
False + rate for classified +	Pr(~D| +)	22.67%
False - rate for classified -	Pr(D| -)	17.67%
Correctly classified		79.81%

Chapter 13

On the Effectiveness of Overall Insurance Mechanisms against Disasters in East and Southeast Asia

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CHAPTER 13

On the Effectiveness of Overall Insurance Mechanisms against Disasters in East and Southeast Asia

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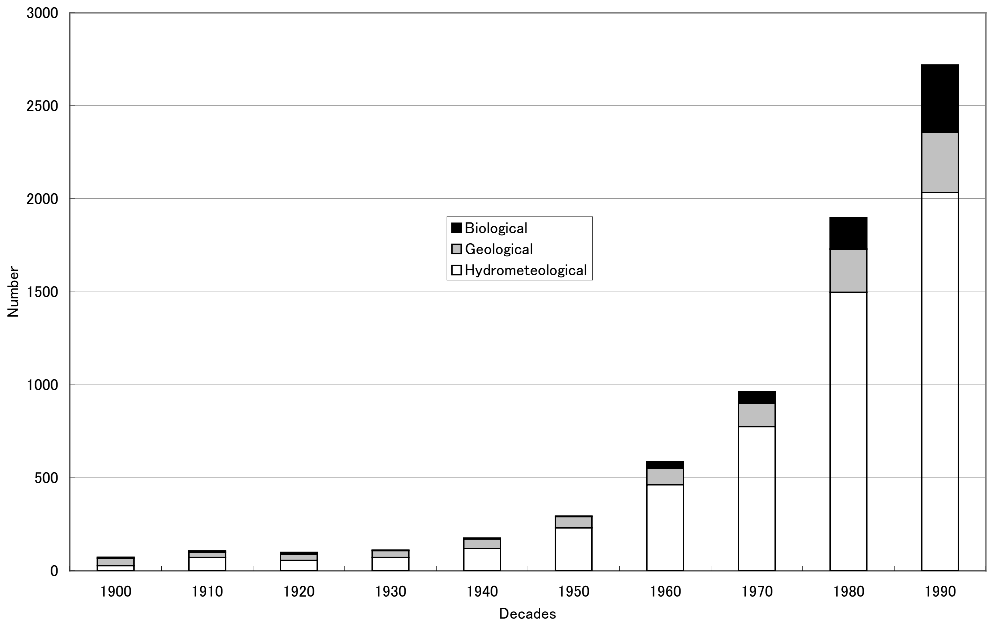
1. Introduction

Regardless of whether they live in developed and developing countries, people face a wide variety of risks in daily life. These risks can come from health-, weather-, contract-, or policy-related shocks. Accidents, sickness, or sudden death can disable the head of a household or even an entire family. Agricultural production involves a variety of price and yield risks, especially for poor, small-scale farmers. Even households in urban areas and industrial or commercial sectors experience fluctuating income over time due to price, demand, and contractual shocks in business transactions. Macroeconomic instability, credit crunches, and recessions tend to generate harsh inflation/deflation and widespread unemployment, which negatively affect livelihoods.

By far the most serious consequences come from natural disasters of the hydro-meteorological, geophysical, and biological kind (Sawada, Bhattacharyay, and Kotera 2011). We remember vividly the natural disasters that hit the Asian region and took a huge toll on lives: the Great East Japan earthquake, the flood in Pakistan; Typhoon Fengshen (Frank) of the Philippines in 2008; the Indian Ocean tsunami in 2004; and the earthquakes in Sichuan, northern Pakistan, and Kobe, Japan. A disaster is defined as an unforeseen, large, negative event that overwhelms local capacity. Disasters are generally classified into four types. The first type is natural disasters, which may be hydrological (e.g., floods), meteorological (e.g., storms or typhoons), climatological (e.g., droughts), geophysical (e.g., earthquakes, tsunamis, volcanic eruptions) or biological (e.g., epidemics and insect infestations) in nature. The second type is technological disasters, such as industrial accidents (e.g., chemical spills, collapse of industrial infrastructure) and transport accidents (e.g., accidents involving air, rail, road, or water transportation). The remaining two types are economic crises (e.g., hyperinflation, banking crises, currency crises) and violence (e.g., terrorism, civil strife, riots, war).

Figure 1 shows the number of natural disasters registered in the Emergency Events Database (EM-DAT) covering the period 1900—2004. EM-DAT is the international disaster database maintained by the Office of U.S. Foreign Disaster Assistance and Centre for Research on the Epidemiology of Disasters (OFDA/CRED). From the figure, we can see the obvious increase in the number of natural disasters, especially hydro-meteorological disasters (Sawada 2007). A regional disaggregation shows that Asia, in particular, has suffered an uptick in natural disasters compared to other regions in the world. A closer look at the data for 1995—2004 by type of triggering hazards reveals that floods are the most common natural disasters followed by droughts (and related disasters), epidemics, and earthquakes and tsunamis (table 1). Table 1 also reveals that epidemics are a serious problem in Africa while Asia was hit by a large number of earthquakes and tsunamis.

Figure 1. Number of natural disasters, 1900—1990



Source: EM-DAT at www.em-dat.be , Université Catholique de Louvain (UCL), Brussels, Belgium.

Table 1. Number of Natural Disasters by Type of Triggering Hazards, Regional Distribution, 1995—2004

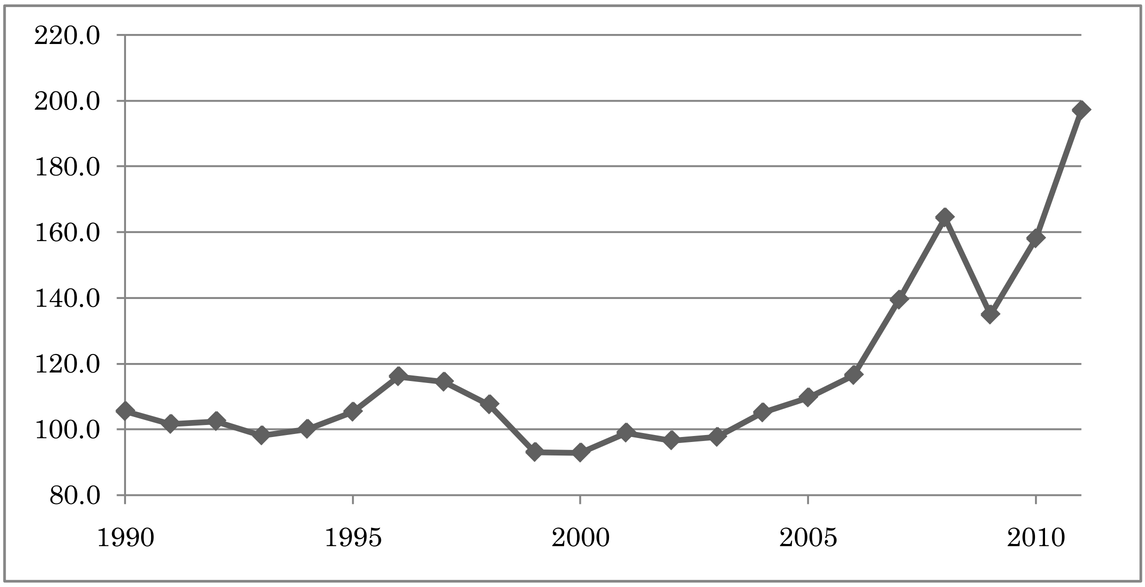
	Hydrometerorological disasters						Geological disasters		Biological disasters	
Region	Floods	Wind Storms	Droughts and related Disasters	Landslides	Avalanches	Waves and Surges	Earthquakes and Tsunamis	Volcanic Eruptions	Epidemics	Insect Infestations
Africa	277	70	123	11	0	0	18	4	346	14
America	269	298	205	43	1	1	51	23	48	2
Asia	444	326	229	97	16	6	193	13	154	3
Europe	180	86	156	7	10	0	28	2	37	1
Oceania	35	68	37	8	0	0	9	6	10	3
World	1205	848	750	166	27	7	299	48	595	23

Source: EM-DAT at www.em-dat.be, Université Catholique de Louvain (UCL), Brussels, Belgium.

Economic disasters such currency crises, financial crises, and credit crunches can also inflict serious negative impacts on people’s livelihoods. While its impact in the Asian region was smaller than initially expected, the ongoing global financial crisis still caused serious economic problems in Asia. Indeed, the number of complex economic crises seems to be increasing over the years. A seminal work by Kaminsky and Reinhart (1999) reveals that the number of currency crises per year did not increase much during the 1980s and 1990s while the number of banking crises and simultaneous banking and currency crises (i.e., twin crises) increased sharply in the 1980s and 1990s.

Inflation is another type of economic disaster. There were repeated spikes in the price of food on the global market in 1997—98, 2007—08, and 2010 (figure 2). Since price stability is the key to food and livelihood security, especially for the poor, instabilities in the global food price (which also usually involve social and political instabilities) directly affect the choice of trade regime of developing countries. In any case, it should be noted that economic crises also cause loss of human lives—many people in Japan and Korea committed suicide when financial crises hit these countries (Chenet al. 2009).

Figure 2. Annual real food price indices (2002—2004 = 100)



Source: Food and Agriculture Organization (FAO) at www.fao.org/worldfoodsituation/FoodPricesIndex/en/

By nature, it would be difficult for private credit and/or insurance markets to cover extreme contingencies arising from natural and economic disasters.[1] Hence, *ex post* informal insurance mechanisms through family and community networks as well as self-insurance mechanisms should play an important role in handling shocks from disasters. In this paper, we will investigate the overall effectiveness of formal and informal insurance mechanisms against natural and economic disasters in East and Southeast Asian countries. By doing so, we will also explore possible regional cooperation in disaster management. To this aim, we will employ the test framework of international consumption risk sharing, which will enable us to investigate the overall effectiveness of mutual insurance across national borders. While existing papers show that the extent of international risk-sharing remains small (Obstfed and Rogoff 2001; Lewis 1996), some studies show that aggregated shock arising from natural disasters can be insured, at least partially, through international financial flows (Yang 2008).

The rest of this paper is organized as follows. Section 2 presents the theoretical and econometric frameworks addressing two main questions:

- Are market and nonmarket (i.e., formal and informal) insurance mechanisms effective in diversifying disaster risks across Asian economies?
- If overall insurance mechanisms are not effective, which risk affects welfare significantly?

Section 4 shows data and empirical results followed by the final concluding section.

2. Theoretical and Econometric Framework

In the last fifteen years, there has been remarkable progress in formulating and testing full consumption risk sharing (Mace 1991; Cochrane 1991; Townsend 1994; Hayashi, Altonji, and Kotlikoff 1996; Ligon 1998; Ogaki and Zhang 2004; Dubois et al. 2008;

[1]According to the Go Risk Research of NatCatSERVICE of Munich RE, it is apparent that global formal insurance against natural disasters is very limited.

Kinnan 2010). The canonical model of consumption risk sharing shows that under complete markets, idiosyncratic income changes should be absorbed by all other members in the same insurance network. As a result, after controlling for aggregate shocks, idiosyncratic income shocks should not affect consumption when risk sharing is efficient. We will employ this testable implication to evaluate the overall effectiveness of the insurance network in East Asian countries. More concretely, we will regress per capita consumption growth rates (or changes) in per capita growth rates (or changes) in gross domestic product (GDP) as their idiosyncratic shock variables to test the full consumption risk-sharing hypothesis.

The test of full consumption risk sharing can be interpreted as a test of overall insurance mechanisms, which consist of formal market mechanisms, informal or nonmarket mechanisms, and self-insurance mechanisms. The first market mechanism includes credit markets to reallocate future resources to today's consumption, formal insurance market transactions involving *ex ante* insurance contracts, and *ex post* labor market participation to use returns to human capital. The second mechanism (i.e., informal or nonmarket mechanisms) includes public and private transfers. The third and final mechanism (i.e., self-insurance mechanisms) is meant to reduce consumption expenditure by maintaining total calorie intakes or to use accumulated financial and physical assets (i.e., precautionary saving).

To investigate the implications of complete consumption risk sharing (or insurance), we will solve a benevolent social planner's problem by maximizing the weighted sum of people's lifetime utilities given social resource constraints (Mace 1991; Cochrane 1991; Townsend 2004).[2] In addition, we will follow the approach of Lewis (1996) who incorporated consumption of nontradables to test the international consumption risk-sharing hypothesis.

[2]Strictly speaking, in order to derive tractable and testable implications, we need to impose additional assumptions. The first assumption is that all market participants can perfectly observe uncertainty realizations. In other words, there is no private information and thus the information structure is symmetric. The second assumption is that the contingent securities span the state space and markets are thus complete. The third assumption is that the probability distribution of state realization, $\pi^i(s^t)$, is identical across agents (i.e., agents have identical beliefs about the future). The fourth assumption is that agents have identical utility functions with identical time discount rates.

Suppose an East Asian regional economy is composed of N infinitely lived country members or representative agents from N countries, each facing serially independent income draws. In this pure exchange economy, there is no possibility of lending, borrowing, and storing. Hence, the self-insurance possibility is ruled out. Thus, we can set up a social planner's problem of deriving conditions for full consumption risk sharing with nontradables (Lewis1996):

(1)
$$\begin{aligned} &\max_{\{c^T, c^N\}} \sum_{j=1}^{N} \lambda^j \left\{ \sum_{t=1}^{\infty} \sum_{s^t} \left(\frac{1}{1+\delta^j} \right)^t \pi\left(s^t\right) u\left[c_{jt}^T\left(s^t\right), c_{jt}^N\left(s^t\right) \right] \right\} \\ &s.t. \sum_{j=1}^{N} c_{jt}^T\left(s^t\right) \le \sum_{j=1}^{N} y_{jt}^T\left(s^t\right), \forall s^t, \\ &c_{jt}^N\left(s^t\right) \le y_{jt}^N\left(s^t\right), \forall s^t, \end{aligned}$$

where δ is an agent's subjective discount rate, π denotes the probability of realizing state of nature s, c^T is tradable consumption, c^N is the amount of consumed nontradables, y^T represents consumable and transferable initial endowment of each agent, and y^N represents nontransferable initial endowment of each agent (i.e., nontradables). As is well known, a full insurance contract or social planner solves the above maximization problem for some Pareto-Negishi weight λ.

Following Backus and Smith (1993), the first-order conditions of the above problem under an isoelastic utility function gives the following testable equation:

(2)
$$\gamma \Delta \log \left(c_i / c_j\right) = \Delta \log \left(e_{ij}\right),$$

where c is a composite consumption and e_{ij} is the real exchange rate of country i against country j. This equality holds across all N countries at any point in time. The intuition behind this first-order equation is that the real marginal utilities of country *i* against country *j* are equalized.

By summing across these *N* equalities of equation (2), we have the following testable equation:

$$(3) \qquad \Delta \log c_i = \underbrace{a_1 \frac{1}{N}\sum_{j=1}^{N} \Delta \log c_j}_{\text{region } level\ average} + \underbrace{a_2 \frac{1}{N}\sum_{j=1}^{N} \Delta \log e_{ij}}_{real\_exchange\_rate} + \zeta \Delta \log y_i + u_i,$$

where u_{it} is a well-behaved error term. Note that in equation (3), income shock variables are added and the full consumption risk-sharing hypothesis implies that ζ=0.

However, per capita GDP is not necessarily exogenous, resulting in possible estimation biases arising from endogeneity when we estimate equation (3). As an unexpected, exogenous event, a natural disaster provides an unusual and clean experimental situation under which we can test whether agents are able to insure because a disaster cannot be affected by agents. Hence, we use disaster variables as instrumental variables when we test the risk-sharing hypothesis.

Thus, an alternative specification is the one of reduced form equations in which income shocks are caused by natural and economic disasters. More specifically, we estimate the following equation:

$$(4) \qquad \Delta \log c_i = \underbrace{b_1 \frac{1}{N}\sum_{j=1}^{N} \Delta \log c_j}_{\text{region } level\ average} + \underbrace{b_2 \frac{1}{N}\sum_{j=1}^{N} \Delta \log e_{ij}}_{real\_exchange\_rate} + S_i \gamma + \varepsilon_i,$$

where *S* is a vector of natural and economic disasters. In equation (4), full consumption risk sharing can be tested using a joint test in which all the elements of γ equal zero.

In actual empirical implementation of equations (3) and (4), we follow Ravallion and Chaudhuri (1998) and replace regional average consumption and average real exchange rate in the first and second terms, respectively, on the right hand side by time dummies.

3. Data and Descriptive Statistics

For the empirical analysis, we focused primarily on two broad categories of disasters—natural disasters and economic disasters. The list of variables used, their definitions, and data sources are shown in table 2.

First, for the macroeconomic data of per capita consumption and GDP growth rates, we used data from the Penn World Table (PWT). In computing both growth rates, we took the differences of per capita variables in logarithms.

Second, the data on economic disasters pertain to economic crises, including currency, inflation, and banking crises. A currency crisis is defined as an annual depreciation rate against the US dollar of 15 percent or more. An inflation crisis is defined as an annual inflation rate above 20 percent. A banking crisis is composed of two types of events: (1) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions and (2) if there are no bank runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions' growth collapse, hyperinflation, financial crisis, or currency crisis. For data on economic disasters, we used data from the Carmen Reinhart Crisis database (Reinhart and Rogoff2010).

Third, our data on natural disasters come from the publicly available, CRED-maintained EM-DAT. The Belgium-based CRED classifies natural disasters based on the following criteria: ten or more people were killed; 100 or more people were affected, injured, or rendered homeless; significant damage was incurred; and a declaration of a state of emergency and/or an appeal for international assistance was made.[3] We used five subgroups of natural disasters: (1) meteorological disasters (e.g., storms or typhoons); (2) hydrological disasters (e.g., floods); (3) climatological disasters (e.g., droughts); (4) geophysical disasters (e.g., earthquakes, tsunamis, and volcanic eruptions); (5) and biological disasters (e.g., epidemics and insect infestations). We then constructed dummy variables for each disaster. These variables take the value of one if there is at least one disaster and zero otherwise.

We used the dataset covering the period 1980 to 2007. Twelve countries were used for natural disasters (Cambodia, China, Indonesia, Japan, Korea, Laos, Malaysia, Mongolia, the Philippines, Taiwan, Thailand, and Viet Nam) and eight for economic disasters (China, Indonesia, Japan, Korea, Malaysia, the Philippines, Taiwan, and Thailand).

Table 2. Definition and Sources of Variables

Variables	Definition	Source
Log (consumption growth rate)	Logarithm of per capita consumption rate	PWT
Log (per capita GDP growth rate)	Logarithm of percentage change in per capita GDP	PWT
Nominal exchange rate and PPP	Rate per U.S. dollar	PWT
Currency crises	Currency crises over the years defined as an annual depreciation rate against the US dollar of 15 percent or more	REINHART
Inflation crises	Annual inflation above 20 percent	REINHART
Banking crises	Banking crises over the years including two types of events: (1) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions and (2) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial	REINHART

[3]http://www.emdat.be/

	institution (or group of institutions) that marks the start of a string of similar outcomes for other financial institutions	
Geophysical disasters	Total number of geophysical disasters, defined as events originating from solid-earth movement (earthquakes, volcanic eruptions, or mass movement)	EM-DAT
Meteorological disasters	Events caused by short-lived small-scale to mesoscale atmospheric processes in the spectrum, spanning minutes to days (e.g., storms)	EM-DAT
Hydrological disasters	Total number of hydrological disasters caused by deviations in the normal water cycle and/or overflow of bodies of water due to wind set-up (e.g., floods or wet mass movement)	EM-DAT
Climatic disasters	Total number of climatic disaster events caused by long-lived mesoscale to macroscale processes in the spectrum, spanning intraseasonal to multidecade climate variability (e.g., extreme temperatures, droughts, wildfires)	EM-DAT
Biological disasters	Total number of biological disaster events caused by the exposure of living organisms to germs and toxic substances (e.g., epidemics, insect infestations, animal stampedes)	EM-DAT

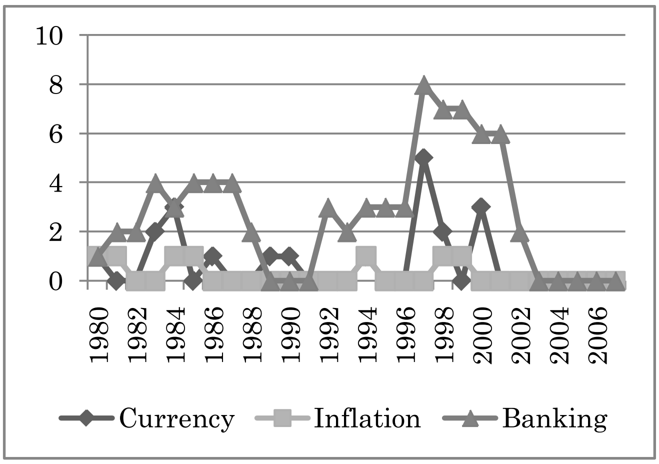
Tables 3 and 4 show descriptive statistics of the variables used and the incidence of disasters for each year, respectively. Figure 3 shows the time series data of incidence of disasters. While we can verify that after there have been only a few occurrences of economic disasters after the Asian financial crises, natural disasters have occurred continuously in the region.

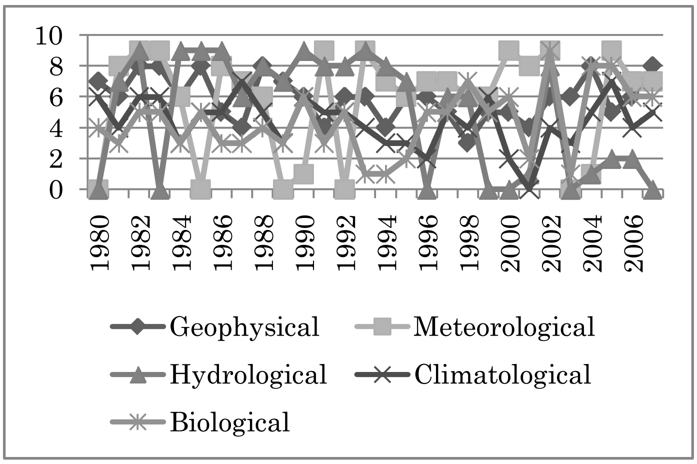
Table 3. Descriptive Statistics of Variables Used

	Number of sample	Mean	Standard deviation
Per capita consumption growth rate	336	-0.002	0.085
Per capita GDP growth rate	336	-0.001	0.061
Currency crises	223	0.090	0.286
Inflation crises	223	0.031	0.175
Banking crises	214	0.355	0.480
Geophysical disasters	336	0.494	0.501
Meteorological disasters	336	0.688	0.464
Hydrological disasters	336	0.741	0.439
Climatic disasters	336	0.366	0.482
Biological Disasters	336	0.399	0.490

Source: Author's calculation using data shown in table 2.

Figure 3. Incidence of disasters





***Source*:** See table 2.

Table 4. Incidence of Disasters in East and Southeast Asia

	Currency	Inflation	banking	Geophysical	Meteorological	hydrological	climatological	biological
# of countries	**8**	**8**	**8**	**12**	**12**	**12**	**12**	**12**
Year								
1980	1	1	1	7	0	0	6	4
1981	0	1	2	6	8	7	4	3
1982	0	0	2	8	9	9	6	5
1983	2	0	4	8	9	0	6	5
1984	3	1	3	6	6	9	3	3
1985	0	1	4	8	0	9	5	5
1986	1	0	4	5	8	9	5	3
1987	0	0	4	4	7	6	7	3
1988	0	0	2	8	6	8	5	4
1989	1	0	0	7	0	7	3	3
1990	1	0	0	6	1	9	6	6
1991	0	0	0	4	9	8	5	3
1992	0	0	3	6	0	8	5	5
1993	0	0	2	6	9	9	4	1
1994	1	1	3	4	7	8	3	1
1995	0	0	3	6	6	7	3	2
1996	0	0	3	6	7	0	2	5
1997	5	0	8	5	7	6	5	5
1998	2	1	7	3	6	6	4	7
1999	0	1	7	5	6	0	6	5
2000	3	0	6	5	9	0	2	6
2001	0	0	6	4	8	1	0	2
2002	0	0	2	6	9	8	4	9
2003	0	0	0	6	0	0	3	1
2004	0	0	0	8	1	1	5	8
2005	0	0	0	5	9	2	7	8
2006	0	0	0	6	7	2	4	6
2007	0	0	0	8	7	0	5	6

Twelve countries were covered for natural disasters (Cambodia, China, Indonesia, Japan, Korea, Laos, Malaysia, Mongolia, the Philippines, Taiwan, Thailand, and Viet Nam) and eight for economic disasters (China, Indonesia, Japan, Korea, Malaysia, the Philippines, Taiwan, and Thailand).

4. Empirical Results

Table 5 shows the estimation results of the consumption risk-sharing model with year dummy variables. To cope with potential biases arising from omitted variables and endogeneity, we included country fixed effects. Specifications (1) to (4) show the results based on equation (3). First, we verified that the estimated coefficients on per capita GDP growth rate are all positive and highly significant. These robust results indicate that the full consumption risk-sharing model is strongly rejected. Second and intriguingly, the income sensitivity parameter exceeded one for specifications (1) and (2), implying that a 1 percent increase in income will lead to more than 1 percent increase in consumption. Yet, once we control for the potential endogeneity problem using disaster variables as instrumental variables, the point estimates dramatically drop. This indicates that there is serious endogeneity bias in estimating equation (3) by the ordinary least squares (OLS) method. There would be unobserved factors affecting income and consumption simultaneously in the same direction. The estimated income coefficients in specifications (3) and (4) are 0.426 and 0.897, respectively. Hence, in specification (3), 57 percent of income shocks caused by natural and economic disasters are diversified among eight middle- or high-income countries in the region. On the other hand, only 10 percent of income shocks from natural disasters are shared in the wider set of countries. Third, we found that inflation and climatological disasters cause serious income shocks. These results indicate that market and nonmarket insurance mechanisms within the region are incomplete, especially against extreme shocks caused by changes in commodity prices and climate.

Specifications (5) and (6) show the results of estimating the reduced form equation (4). While individual point estimates are largely insignificant, the joint test results indicate the rejection of the full consumption risk-sharing hypothesis. In specification (5), the joint F test statistics of natural and economic disaster variables is 10.06 with p-value of 0.0035. In specification (6), the joint F test statistics of natural disasters is 9.60 with p-value of 0.0010. These results are consistent with the incomplete consumption risk sharing within East and Southeast Asian countries. According to the point estimates of equations (5) and (6), a currency crisis may generate serious, adverse impacts on consumption change in addition to inflation and climatological disasters.

Table 5. Test of Full Consumption Risk-Sharing Hypothesis (with per capita consumption growth rate as dependent variable)

	(1)	(2)	(3)	(4)	(5)	(6)
Method	OLS	FE	IV-FE	IV-FE	FE	FE
Per capita GDP growth rate	1.009***	1.010***	0.426***	0.897***		
	(0.128)	(0.179)	(0.093)	(0.090)		
			1st stage significance	1st stage significance		
Currency_crises			-		-0.0114	
					(0.009)	
Inflation_crises			**		-0.0031	
			-		(0.006)	
Bankingcrises					0.0028	
			-		(0.003)	
Geophys				-	-0.0120	0.0064
			-		(0.008)	(0.016)
Meteo				-	0.0009	-0.0085
			-		(0.011)	(0.014)
Hydro				-	-0.0017	-0.0090
			-		(0.005)	(0.010)
Climate			**	*	-0.0163	-0.0131
					(0.010)	(0.008)
Bio			-	-	-0.0052	-0.0149
					(0.009)	(0.015)
Constant	0.0108	0.0108	-	-	0.0025	0.0332
	(0.013)	(0.014)			(0.019)	(0.026)
Observations	336	336	214	336	214	336
Adjusted R-squared	0.538	0.539	0.506	0.514	0.350	0.070
Number of countries	8	12	8	12	8	12
First stage joint F statistics			7.28	8.40		
Sagan's over identification test (p-value)			0.2239	0.1885		

Note: Robust standard errors in parentheses. *** p<0.01; ** p<0.05; * p<0.1. Year dummies are included.

5. Policy Discussions

In this paper, we investigated whether market and nonmarket (i.e., formal and informal) insurance mechanisms are effective in diversifying disaster risks across Asian economies. Our approach was to employ the test framework of international consumption risk sharing so that we could examine the overall effectiveness of formal and informal insurance mechanisms against natural and economic disasters in East and Southeast Asian countries. Using data from twelve countries covering the period 1980—2007, two empirical findings emerged from our econometric analysis. The first finding was that the full consumption risk-sharing model was significantly rejected. However, point estimates show that 57 percent of income shocks caused by natural and economic disasters are diversified among the eight middle- or high-income countries in the region. On the other hand, only 10 percent of income shocks from natural disasters were shared among the wider set of countries. The second finding was that inflation and climatological disasters cause the most serious and significant income shocks. The findings on the negative impact of inflation and climatological disasters on income imply that overall insurance mechanisms against agricultural-commodity price jumps within the region are rather incomplete. These results highlight the necessity of developing more regional cooperation mechanisms in disaster management.

In addition to the estimation results reported in this paper, estimated coefficients on time dummies in equation (3) or (4), which are not reported in the paper, show that there was a dip in per capita consumption growth rates in 1997 or 1998. This means that the average consumption level within the region declined temporarily in either of these two years. This decrease may have been caused either by the financial crisis or the El Niño phenomenon. Indeed, according to the Food and Agriculture Organization's (FAO) World Food Prices Index presented in figure 2, there was a sharp worldwide increase in food prices in 1997 and 1998 due to El Niño-caused droughts. This price increase might have led to the dip in per capita consumption. Using household survey data for 1998, Datt and Hoogeveen (2003) found that in terms of its impact on poverty, the 1998 economic crisis in the Philippines was more of an El Niño phenomenon than a financial crisis. While our data did not cover the year 2008 when the global food crisis occurred, a future study with updated data may uncover the reasons behind the lack of insurance mechanisms against inflation and climatological disasters.

There are some implications we can derive from these empirical results. Our results highlight the need and potential for regional cooperation in disaster management. First, it is imperative to develop formal mechanisms to diversify aggregate disaster risks. We may need to elaborate on multicountry risk-pooling schemes (e.g., a regional fund to cover sovereign disaster risk). As for economic disasters, the Chiang Mai Initiative (CMI) has been playing, and will be continue to play, an important role. CMI is a bilateral or multilateral currency swap arrangement that involves pooling foreign exchange reserves. It was designed as an *ex post* coping mechanism against a financial crisis. It is important to note that the Chiang Mai Initiative Multilateralization (CMIM), i.e., a uniform facility to manage regional financial crises, has been agreed upon.

Further development of the Asian bond markets will also be indispensable. It was commonly thought that the Asian financial crisis was driven by the vulnerability of the bank-led financial system within the region. Naturally, the crisis created an awareness of the need for better-diversified debt markets, specifically for bond markets, to supplement the availability of bank finance (Eichengreen 2006). Since bond markets are composed of a large number of individual bond holders, idiosyncratic risks can be diversified effectively. Hence, bond markets are generally considered to offer better risk-sharing mechanisms than credit markets, which are composed of a limited number of creditor banks. In order to diversify the shocks caused by disasters, developed bond markets can play an important role.

Second, for natural disasters, a regional natural-disaster fund or some other alternative formal mechanisms are worth pursuing. Since 2007, the Caribbean Catastrophe Risk Insurance Facility (CCRIF) has been functioning effectively as the world's first multinational risk pool fund to cover sovereign risk via parametric insurance against hurricanes and earthquakes (see box). A key feature of the CCRIF is its structure. The CCRIF combines the pooled reserves of insurance premiums paid by member countries with the financial capacity of the international reinsurance markets. By doing so, the CCRIF can achieve its cost-effectiveness in diversifying risks among member countries and international reinsurance markets. Similarly, in the formal insurance market, insurers need international reinsurance markets to pool disaster risks. It is a known fact, however, that reinsurance markets and trades of catastrophe (CAT) bonds are still thin. At the microlevel, microcredit programs can play the role of disaster insurance through a flexible repayment system (Shoji 2010). Moreover, index insurance contracts, which are written against specific aggregate events such as droughts or floods defined and recorded at a regional level will be a promising formal insurance mechanism.

It is also important to note that we found that climatological disasters significantly affect income and consumption. This suggests that such risks cannot simply be diversified within the region just yet. This finding indicates the importance of adaptation issues against global climate change in Asia. In addition to the possible formal insurance facilities discussed above, efforts to tackle adaptation issues should include research and extension (R&E) services on drought-resistant varieties, investments in irrigation infrastructure, and preventive infrastructure against floods and landslides.

BOX: Caribbean Catastrophe Risk Insurance Facility (CCRIF)

The Caribbean Catastrophe Risk Insurance Facility (CCRIF) is a mutual pooling mechanism of catastrophic risks arising from hurricanes and earthquakes to Caribbean member countries. The CCRIF was developed with funding from the Japanese government and is the result of collaborative work between governments in the region and donor partners. A key feature of the facility is that insurance policies are designed on a pre-established parametric trigger basis. In the case of hurricanes, the hurricane index, which is computed by location-weighted wind speed, is used. In the case of earthquakes, ground-shaking thresholds are employed. By its parametric nature, the CCRIF can provide short-term liquidity to a government at the onset of a catastrophe. Unlike traditional indemnity insurance, which requires time-consuming loss verifications and estimations, payouts under the CCRIF can be calculated and made very quickly based on the predetermined triggers together with quickly observed data.

Another feature of the CCRIF is its structure. It combines the pooled reserves of insurance premiums paid by member countries with the financial capacity of the international reinsurance markets. By doing so, the CCRIF can achieve its cost-effectiveness in diversifying risks among member countries and international reinsurance markets.

The CCRIF is now expanding its facility to cover excess rainfall coverage during the 2010/11 policy year. The excess rainfall product will utilize the rainfall amounts generated by the model as the parameter that triggers coverage. The CCRIF is now also considering developing a product for the agriculture sector (i.e., index-based agricultural insurance for farmers).

Theoretically, it is also possible to set a parametric insurance on extreme food price changes. However, a potential problem is that while winds and earthquakes cannot be manipulated by humans, food prices can be affected by government policies and market transactions or speculations. Hence, there is room for creating moral hazard problems, which may undermine the transparency and efficiency of parametric insurance facilities.

Source: *Caribbean Catastrophe Risk Insurance Facility (CCRIF) < www.ccrif.org/>*

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Chapter 14

Integrating Myanmar with its Western and Northern Neighbors: A Shared Vision through the Promotion of Sustainable Agricultural Development

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CHAPTER 14

Integrating Myanmar with its Western and Northern Neighbors: A Shared Vision through the Promotion of Sustainable Agricultural Development

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1. Introduction

Regional integration has gained currency over the years in Southeast Asia following the successes of the Association of Southeast Asian Nations (ASEAN), the ASEAN Free Trade Area (AFTA), and the growth triangles. ASEAN began as a platform to address political threats that have been emerging in the region since the late 1960s, with particular concern over communism in Indochina but subsequently evolving into more of an economic entity. The synergies of a common trading bloc and the cooperation enabled when coordinating or competing with other regions have been well documented (Rasiah 1995). The success of this kind of cooperation has stimulated an enlargement of the region to include several other countries in different geographical arrangements (e.g., China, Korea, Japan, Australia, and India). The sheer land and population size of the countries bordering Myanmar promises considerable economic synergies if only the countries involved seek peaceful integration. It is in this light that Surin Pitsuwan helped move the Suwanabumi agenda to integrate the regions stretching from the Ganges to the Mekong in 2006 (Rajaretnam 2006). This shared vision unraveled the potentially strong growth and socially beneficial ties integration would entail for Northeast East India, East and Southeast Asia, Southwest China, Bhutan, and Bangladesh.

As pointed out by the Rajaretnam (2006), regional cooperation or integration of the proximate states promises the unleashing of tremendous economic synergies that will enable Myanmar to join in and reap benefits from the rapidly developing East and Southeast Asia. Political transformation, especially democratization and the agreement to engage constructively for the sole purpose of increasing social exchange, is fundamental to realizing this goal. Therefore, a strategy towards integration is a must to explore the possibilities of regional cooperation in order to maximize welfare effects and enable the realization of human potential in the region.

Conceptually, any regional strategy for integration would require some essential points of departure. First, one needs to depart from the geographical and economic framework that has hitherto shaped cross-border relations. Second, political barriers have to be overcome in order to implement a set of policies that can stimulate economic synergies. Territorial claims and illegal immigration have, for a long time, proved too thorny to break the cross-border ice in the region. The Chinese government announced plans in 2010 to build more dams over rivers in Southwest China, which will have considerable implications for Northeast India, Bangladesh, and Myanmar as the headwaters of the Brahmaputra, Mekong, Irrawaddy, and Salween rivers are in that region. Currently, there has been considerable use of environment-friendly, small-scale power units installed in many parts of Northeast India. The damming of the rivers at the source and the rising demand for food production may add to the already fragile political situation there. More important, there are doubts over the superiority of dams over environment-friendly, power-generating alternatives. Therefore, political diplomacy must be coordinated carefully to weigh in the socioeconomic objectives related to the promotion of growth, equity, stability, poverty alleviation, and environmental sustainability in the region.

With rich alluvial lands and a number of big rivers, Myanmar, Northeast India, and Bangladesh have great potential to expand agricultural production (Rajaretnam et al. 2006). However, infrastructure and irrigation have to be improved and political issues have to be addressed in order to increase the practice of multicropping and raise access to domestic and international markets. Harnessing such a potential through economic integration to expand synergies will certainly bring enormous benefits to the whole region. Cooperation is especially important for the small provincial economies of Myanmar, Northeast India, Bangladesh, and Southwest China. Such connections will facilitate the connections necessary to integrate these regional markets and value chains to the bigger markets of East and Southeast Asia and India. Policy makers should develop a common platform across the related borders to initiate the diversification of intraindustry trade. All efforts should be taken to raise the possibilities for collaboration between the bordering country governments in general and states in particular. Efforts should also be made to draw up a road map and increase the exchange of technology and knowledge across borders in the region. The milestones towards integration should be governed by strong delivery codes on actions and execution by those regions to accelerate economic growth. Greater interaction and trade between the states involved will also provide the necessary impetus to accelerate infrastructure development. The AFTA is an excellent regional platform from which to learn how to proceed with the integration process.

Thus, the focus of this paper is to examine in general the benefits the bordering regions and countries will gain from political and economic integration. The rest of paper is organized as follows. Arguments for global and regional economic integration are summarized in Section 2. Section 3 presents the state and scope of agricultural development in the region, which is based on regional macroeconomic indicators. Section 4 analyzes agricultural commercialization from the perspective of shared integration. Section 5 discusses the policies the governments of Myanmar, Bangladesh, and India should pursue to accelerate agro-based economic development in the region. Section 6 presents the conclusions and policy implications.

2. Theoretical Considerations

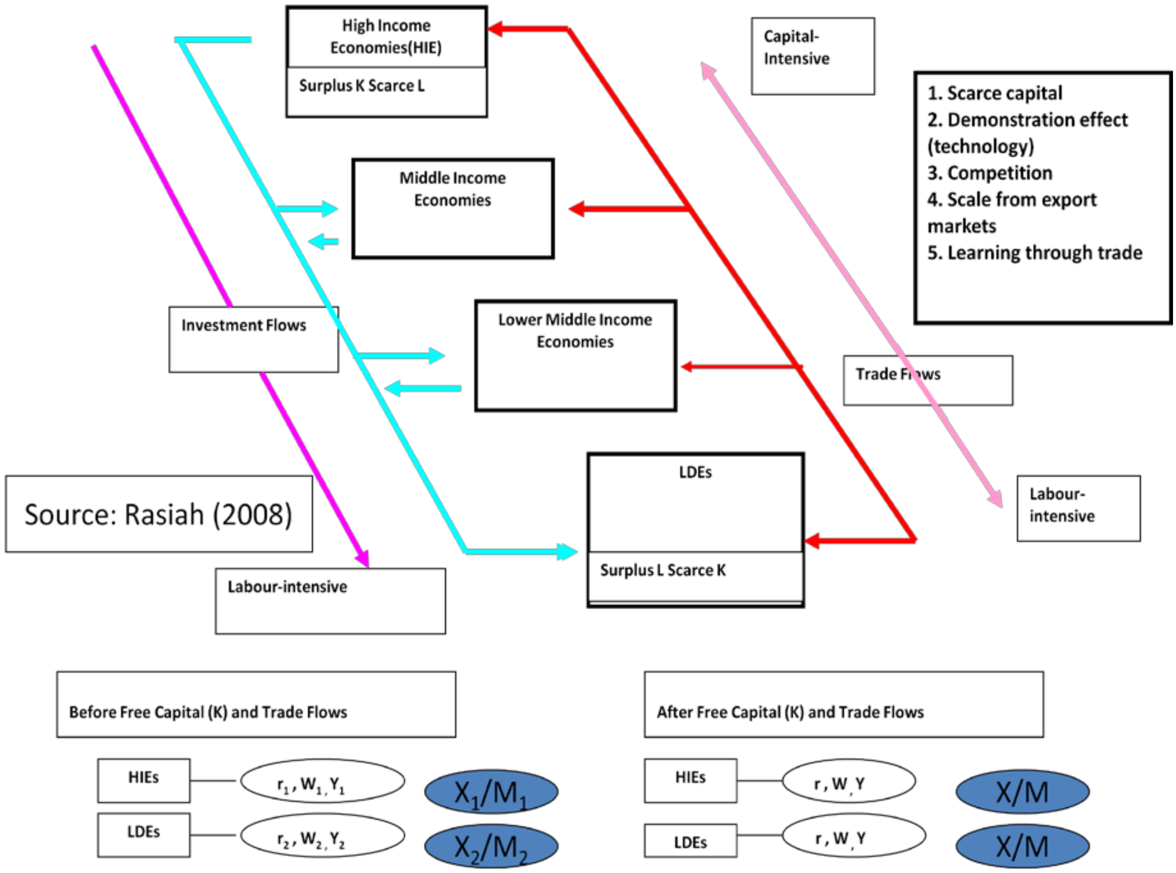
The arguments for establishing close economic ties in the promotion of economic growth and sustainable development is overwhelming. On the global stage, the World Trade Organization (WTO) has set the parameters for trade governance among member countries. There are regional and bilateral trade agreements that establish governance parameters for a smaller group of regional economies and two economies, respectively. This section provides the arguments for economic integration and subsequently addresses the implications of these theories from the standpoint of Northeast India and Bangladesh among the economies belonging to the South Asian Association for Regional Cooperation (SAARC) and Myanmar from the ASEAN. The neoclassical take on the form of economic integration is first examined critically before the flying geese and heterodox arguments are reviewed. The specific forces of integration in the region are examined next.

Benefits of Economic Integration

Although there are serious contestations over Ricardo's (1830) and the Heckscher and Ohlin (Flam and Flanders 1991) trade models of specialization on the basis of static comparative advantages, there is little disagreement over the benefits of opening up economies for trade. The opening up of borders for trade will not affect economies from pursuing economic integration to speed up economic growth, structural change, and sustainable development. The fundamental difference in theoretical arguments on trade varies between those focusing on static comparative advantage and those focusing on dynamic comparative advantage.

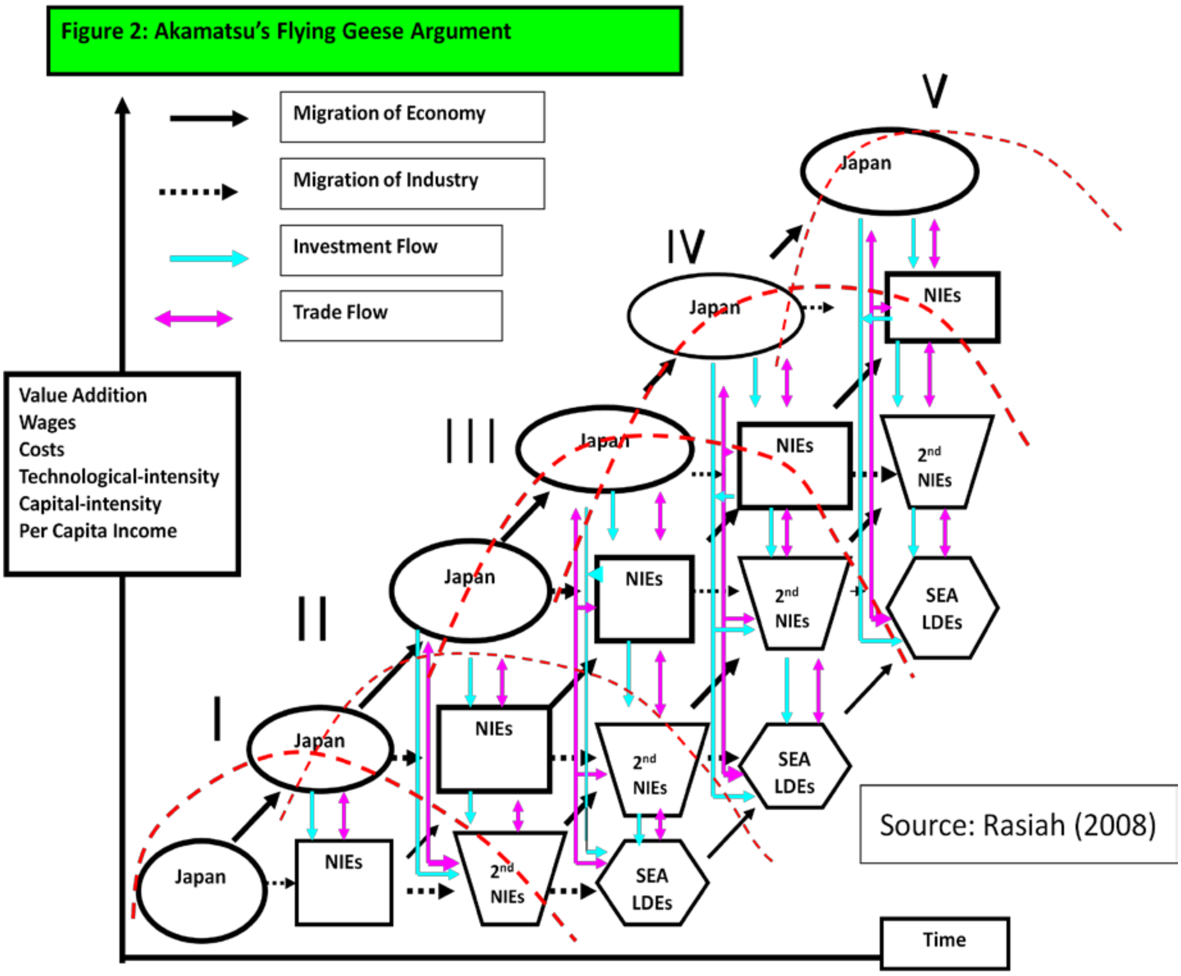
The Heckscher and Ohlin model (Flam and Flanders 1991) was predicated on the assumptions that economies enjoy perfect factor mobility within borders and total immobility across borders. Bhagwati (1982) relaxed the capital immobility assumption to allow cross-border flows of capital seeking labor to establish productive enterprises. A hybrid extension of Bhagwati's model is presented in figure 1. Myanmar and Bangladesh come under the category of least developed countries (LDCs). Although Southwest China and Northeast India are in more technologically sophisticated economies, the provinces of Tibet and Guizhou in Southwest China and all provinces in Northeast India have low income levels. This theory simply posits that liberalization will stimulate capital to flow from capital-surplus, labor-scarce countries such as the United States to capital-scarce, labor-surplus economies such India and China. The consequences of this will be an eventual equalization of the factor prices of capital (interest rates) and labor (wages).

Figure 1: Neoclassical Globalization Thesis of Development Convergence



Source: Rasiah (2008).

However, as a consequence of the strategic roles governments play and the significance of complementary and increasing returns industries, successful governments have promoted technological upgrading and structural change to raise incomes and living standards and equity. Such elements are in harmony with the Flying Geese model of Akamatsu (1962), which takes on the investment-trade linkages framework on a regional scale as the spur for economic growth and structural change (see figure 2). Although this model also has several flaws (Rasiah 2010), it does drive regional economies through cross-border investment and trade flows. With greater integration, one can expect the region to appropriate the economic synergies of growth and structural change from the fast-growing East and Southeast Asia as well as India.



Source: Rasiah (2008).

Endogenous growth modelists such as Romer (1986), Krugman (1986), and Helpman and Razin (1991) acknowledge the significance of building dynamic comparative advantage involving industries that generate scale economies. However, because of concerns over potential government failure, these theorists have not detailed the empirical consequences of executing such a dynamic comparative advantage model. This task is taken on by heterodox economists who argue that governments should strategize to stimulate technological upgrading and structural change (Abramowitz 1956; Kaldor 1957; Cripps and Tarling 1973).[1] Nevertheless, strategic trade policy will stimulate rather than reduce economic synergies from economic integration.

[1] This logic was advanced earlier by Smith (1776) and Young (1928).

In the region's quest to quicken agricultural development, it is important to address sustainability transition, which would obviously mean that the old route to dirty industrialization should be avoided. Instead, the focus should be on the proliferation of green technologies that avoid the use of toxic materials while focusing on renewable resources so as to arrest the processes of global warming and climate change (Mol and Sonnenfeld 2010; Berkhout and Wieczorek 2010). One alternative would be the use of natural fertilizers, chemical-free multicropping, and a focus on renewable forest resources such as bamboo.

Specificity of Regions and States Involved

The ASEAN member countries have a proven record of economic cooperation with strong harmonization of trade and investment. The last landmark milestone in this direction was achieved under the AFTA with the common effective preferential treatment (CEPT) acting as the prime instrument governing harmonization. China was added to the fold starting 2010 for the promotion of free trade. India is still a dialogue partner but bilateral negotiations with ASEAN member countries indicate that India will soon enter the fold.

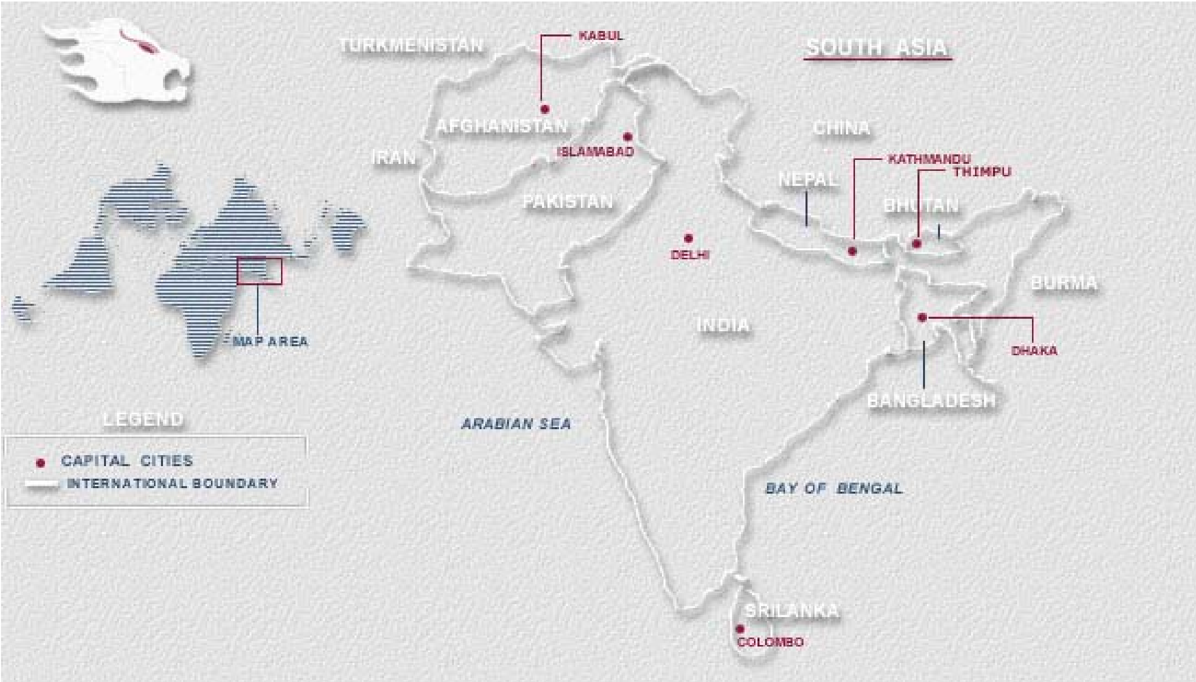
Recent developments in the South Asian economies, such as growth momentum and greater openness in macroeconomic aspects, warrant a fresh look at enhancing regional integration. A similar advocacy was evident at the Ninth ASEAN Summit in Bali where ASEAN leaders agreed to establish an ASEAN Economic Community (AEC) by 2020. The AEC is envisioned to become a single market in the production of goods and services and in the free flow of investment and capital. Basic arguments were developed to support sustained economic growth in ASEAN regions (Hew 2003). These included enabling faster customs clearance and the harmonization of product standards, reducing the transaction cost in the regions, and making ASEAN member countries attractive to multinational corporations (MNCs). Evidence of regional cooperation benefits from the manufacturing and agricultural sectors and gained through trade expansion and economies of scale can be seen in the North American Free Trade Agreement (NAFTA), South Asian Free Trade Area (SAFTA), and in the countries included in the SAARC and the European Economic Community (EEC). The removal of some trade barriers by the NAFTA, SAFTA, EURO, SAARC, and ASEAN stimulates competition, which helps foster production efficiency. Economic integration initiatives such as the AFTA, the ASEAN Investment Area (AIA), and the ASEAN

Framework Agreement on Services (AFAS) were designed to become a step on the economic-integration ladder in Asia. There were also valuable lessons learned from the experiences of the European Union (EU), which was borne out of a strong political desire and a common, better vision to integrate the economies of member countries or states (Hew 2003).

The review of the literature on the potentials and prospects of regional economic integration, such as that exemplified by the ASEAN, NAFTA, and the European Community (EC), show that such groupings offer a common platform to stimulate economic synergies through production, trade, and investment networks. However, economic dynamism depends not only on guidelines or policy blueprints but also on a strong political desire and a common vision to seek integration. The integration of Northeast India, Myanmar, Bangladesh, and Southwest China will obviously open the way for further integration of this region with other neighboring provinces and countries. In other words, the market potential of such integration will geographically involve several countries. Without the desire and proper execution, such an attempt will be doomed, which has been very much the experience of the SAARC regional cooperation initiative where political disputes have undermined the group's evolution. Specifically, intra-SAARC trade has suffered because of political impediments to regional integration. Regional integration cannot be achieved unilaterally by any one of the participants. All the governments involved must participate equally to make it a success (Rajiv and Manjeeta 2009).

Pitigala Nihal (2005) argued that shortfalls in political desire can affect regional integration and cooperation. What has been economically established as beneficial for the participating members is formal integration. In this case, formal integration can be realized in reality only if governments show the political will to draw up a timetable to implement it. Participating members should see the broader goal that can be generated for the region as a whole in relative terms rather than what the individual states can appropriate in absolute terms. To integrate Myanmar with its northern and southwestern neighbors, it is important to first open up the political space. Second, create strategic grounds for greater regional trade and investment. And what is the strategic ground that is known to policy makers in these regions? To integrate Myanmar with its northern and southwestern neighbors, the Indo-Myanmar political dispute must be addressed and resolved. There has been so little progress over the last two and a half decades in promoting regional economic cooperation with Indo-Myanmar that it has become clear that this issue must be resolved in order to achieve and sustain economic growth (Kumar and Singh 2009).

Figure 3. Myanmar and its northern and western neighbors



Source: Downloaded from http://www.google.com.my on December 12, 2010.

The flow of information, knowledge and technology, infrastructure development, and regulatory cooperation and harmonization in Myanmar, Northeast India, Bangladesh, and Southwest China can make the mother economies of these countries more dynamic. Poverty reduction in these regions is also a major issue, and the alleviation of poverty can be achieved through robust and sustained regional growth. A recent growth accounting exercise by Collins (2007) reveals that although both capital accumulation and sustained efficiency may contribute to higher growth in South Asia, these countries may have been characterized by high rates of investment, especially in comparison with East Asian economies. Therefore, to maximize the benefits of higher growth, regional cooperation needs to be strengthened and the countries need to consider the possibility of integrating with extraregional markets. In this study, we critically evaluate the prevailing realities of a shared integration approach. The broader objective of this paper is to open up the political space essential to integrating two regions and two countries economically. While that is unavoidable, the first step is to demonstrate to the authorities concerned the potential economic benefits that such an exercise offers for Myanmar, Northeast India, Bangladesh, and Southwest China. Hence, the focus of the current study is to produce a document that will capture the economic synergies that will help these countries integrate economically and provide a better understanding of the issues related to regional cooperation.

3. Agricultural development

The central governments of China, Bangladesh, and India have identified agriculture as a major platform for stimulating economic development and alleviating poverty.[2] The rural background of most peoples in this region and in Myanmar obviously makes the targeting of agriculture for poverty reduction good. Access to Southwest China, Northeast India, and most of Bangladesh and Myanmar is difficult because of the distance from their respective capitals and the terrain (rugged mountains and devastating rivers). Only Southwest China is linked well to the rest of China. Nevertheless, efforts to integrate these areas will provide the economic impetus to stimulate infrastructure development. The preceding section had already advanced the economic rationale for specialization and cross-border trade.

The 2010 elections may open up opportunities for the Myanmar government to implement economic development and poverty-alleviation policies to strengthen cross-border relations. The national government has raised investment expenditure on infrastructure development across the country, including the area bordering Southwest China. Bangladesh has also embarked on similar policies to strengthen its economic activities although it remains seriously disadvantaged in terms of infrastructure. The federal government of India has likewise attempted to integrate the Northeast region with the rest of India although the focus has been more on financing the budgets of each of the states involved. Local states have been given the power to handle economic development and poverty alleviation.

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[2] The state of Sichuan and the federal territory of Chongqing are also industrialized. The former is dominated by heavy industries but the production of light, manufactured goods, such as electronics, has been growing rapidly.

Previous work has shown that political problems in the region and bureaucratic weaknesses in the planning of economic development since 1980 have been grossly exaggerated (CPR 1995). Much of the past assessments took little account of the empirical evidence and information pertaining to the planning processes in the region although a considerable part of planning has been based on ad hoc bureaucratic procedures. It has to be acknowledged, however, that the development strategies implemented so far have failed to produce the desired results to integrate the poorer regions of Myanmar, Northeast India, Bangladesh, and Southwest China (Sachdeva 2000). The experience can be taken from the Indian perspective. The state and sectoral plans of the Planning Commission in India have not been able to provide enough impetus for local development to generate processes of self-sustained growth with Myanmar. Instead of creating an efficiency-oriented economic process, the policy framework resulted in the creation of a politically-led, distribution-oriented process. The result is that natural resources, profits, savings and the like are, in fact, moving away from the region to other high-productivity regions (Sahni 2000).

Although development processes have been taking place in the poorer regions of Myanmar, Northeast India, Bangladesh, and Southwest China, the present policy framework has not been able to provide much dynamism for agriculture, including good transport and other infrastructural facilities (Sachdeva 2000). It has not been able to attract a tangible number of investors or to produce skilled labor and entrepreneurial resources. The policy framework has failed to transform the primitive agricultural practices of the region into modern commercial agriculture (Sahni 2000). As pointed out in the shared integration report (2006), regional integration could become the basis for unleashing economic synergies to alleviate poverty. To do this, the existing policy framework has to be reshuffled and regional political disputes must be resolved through intellectual dialogues. Economic integration, however, cannot engender its maximum benefits for the peoples of the region if greater political freedom cannot be generated. The bordering countries should coordinate their legal and political instruments to drive the sort of economic integration that produces specialization on the basis of comparative and competitive advantage and where investment and technology inflows are received from the other areas of the countries involved and from abroad.

3.1 Sectoral Economic Change

Economic sanctions by the United States and a lack of integration with Northeast India and Bangladesh has restricted the growth of the nonagricultural sectors in Myanmar. Although agriculture still contributed over 41 percent of Myanmar's Gross Domestic Product (GDP) in 2009, it is characterized by low value-added activities (see table 1). Rapid economic development in Bangladesh, China, and India has fundamentally reduced the relative contribution of agriculture to GDP. The basic reason behind the changes is the differential rate of technical change in the nonagricultural sector. The faster growth in technical change in nonagricultural activities has caused a decline in the share of agricultural value added in these economies. The other reason is the capital accumulation on nonlabor endowments, which has resulted in the decline in the share of output of the labor-intensive agricultural sector. Figures from 1970 to 2009 clearly indicate that the share of agriculture in the GDP of Bangladesh has been steadily declining. This decline began in the 1970s. By 2009, the agriculture sector's percentage contribution to Bangladesh's GDP had dropped from 55 percent to 19 percent (World Bank 2010; FAO 1998).

Similar developments were observed in India and China. The decline in the share of agriculture in India's GDP began in the early 1970s. By 2009, the percentage change in the value added to GDP by the agriculture sector had declined from about 45 percent to 17 percent. The rate of relative decline in agriculture was directly related to the faster rate of GDP growth in the nonagricultural sectors. India experienced a substantial and steady decline in the share of agriculture although it happened from a higher initial level and not as rapidly as it did in East and Southeast Asian countries (World Bank 2010). Similarly, the decline in the share of agriculture in China's GDP also began in the 1970s; the percentage change in value added to GDP by the agriculture sector declined from 45 percent to 10 percent in 2009. The decrease in the share of agriculture in China's GDP was greater compared to Bangladesh and India. However, changes in the share of agriculture in Myanmar's GDP did not show any clear trend (World Bank 2010), with little changes in technical change and labor productivity.

Table 1. Share of Agriculture in GDP, 1970—2009 (%)

Country/ Year	**1970**	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2009**
Bangladesh	54.56	31.55	32.76	30.25	26.38	25.51	20.14	18.64
Myanmar	38.00	46.54	48.19	47.80	46.00	55.90	50.10	41.7
India	45.17	35.70	31.16	29.28	26.49	23.35	18.81	17.12
China	45.52	30.17	28.44	27.12	19.96	15.06	12.12	10.34

Sources**:** World Bank (2010); FAO (1998).

Table 2. Share of Agricultural Employment in Total Employment, 1970—2009 (%)

Country/ Year	**1970**	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2009**
Bangladesh	83.5	58.0	57.7	66.5	63.2	62.1	48.1	-
Myanmar	78.4	67.1	66.1	69.7	66.1	63.0	64.4	-
India	72.6	69.5	66.5	64.0	61.1	42.8	23.1	22.6
China	-	-	62.0	53.4	48.5	46.3	43.1	40.1

Sources**:** World Bank (2010); FAO (1998).

The contribution of agriculture to GDP, however, is not reflected in the employment structure in Myanmar (see table 2). In China, India, and Bangladesh, the declining relative importance of agriculture in the economic structure was not dramatic enough to significantly reduce employment in the sector. More attention has been placed on nonagricultural sectors in these countries. However, apart from Myanmar, the share of agricultural exports in total exports has fallen dramatically in the remaining countries over the period 1970-2009 (see table 3). The declining share of agricultural exports in the region's total exports is directly linked to the declining contribution of agriculture to total GDP, which started in the 1970s. The share of the labor force in agriculture declined more slowly in Bangladesh and India— more than 60 percent by 1990 and less than 50 percent by 2009 (World Bank 2010; FAO 1998). While the share of labor in agriculture declined over a thirty-year period in China, Bangladesh, and India, it remained high in Myanmar.

Table 3. Share of Agricultural Food Exports in Total Exports (%)

Year Country	1970	1980	1985	1990	1995	2000	2005	2009
Bangladesh	39.57	12.45	17.91	14.31	10.45	7.6	6.22	6.22
Myanmar	65.81	65.0	-	51.28	46.02	-	-	55.53?
India	30.97	28.17	25.34	15.58	18.67	12.79	8.97	7.98
China	-	12.5	12.56	12.65	8.24	5.53	3.23	2.93

***Sources*:** World Bank (2010); FAO (1998).

Myanmar has undergone structural change over the period 1992—2009 (see table 4). While the share of agriculture, livestock, and forest products gradually fell from 47.3 percent in 1992—93 to 42.8 percent in 2000—01 and then to 41.7 percent in 2008—09, the commensurate share of manufacturing rose from 8.9 percent in 1992—93 to 10.1 percent in 2000—01 and then to 16 percent in 2008—09. Growth and structural change have obviously driven the increasing demand on food and agricultural output. Given the strong dependence of the labor force on agriculture, economic integration alongside reforms and the introduction of modern farming methods are the key to maintaining the sector's strong contribution to GDP.

Table 4. Economic Structure, Myanmar, 1992—2009 (%)

	1992/93	2000/01	2008/09
Agriculture	38.4	33.6	33.7
Livestock and fishery	7.3	8.3	7.5
Forestry	1.6	0.9	0.5
Energy	0.3	0.5	0.1
Mining	0.8	1.9	0.6
Processing and manufacturing	8.9	10.1	16.0
Electric power	0.9	1.1	0.2
Construction	2.9	4.2	4.3
Services	16.8	18.6	15.6
Transport	4.0	4.6	11.6
Communications	1.0	2.1	1.3

Financial institutions	0.7	2.1	0.1
Social and administrative	6.7	6.0	0.8
Rental and other services	4.5	3.8	1.7
Trade value	22.1	20.9	21.5
Gross Domestic Product	**100.0**	**100.0**	**100.0**

***Source*:** Planning Department, MNPED.

With India and China busily transforming into rapid-growth economies since the 1990s, the demand for a wide range of agricultural products, particularly food, has been rising. While per capita incomes have risen, hard-core poverty levels have decreased steadily in these countries (table 5). Indeed, not only have commodity prices been strong during the period spanned by the global financial crisis (i.e., since 2008), food prices have also remained high. Clearly, one need not worry about the Singer, Prebisch, and Sarker fallacy of composition thesis about falling commodity prices setting in to negatively affect Myanmar's export prices if it steps up food production over the next five years.[3] A rise in food production will not negatively affect the country's terms of trade. Greater opportunities can be generated if Myanmar captures this opportunity to expand output of income-elastic agricultural products that offer higher value to farmers. Therefore, it is pertinent that the whole region should have better infrastructure—roads, railways, ports, power and water supplies, and telecommunication networks—to facilitate the initiation and movement of firms to efficient production schedules and to reduce delivery times. The focus of manufacturing, utilities, construction, and services should be one of complementing agricultural development. Hence, off-farm processing and downstream value-adding activities should be the emphasis the governments in this region should initially pursue.

[3] See UNCTAD (1996) on the significance of the fallacy of composition thesis in the trade of the South countries.

Table 5. Regional Hard-core Poverty Levels

Country	**1995**	**2000**	**2005**
Myanmar	-	-	32
Bangladesh	51	48.9	40
India	36	28.6	-
China	6.1	4.3	2.8

***Source*:** World Bank (2010).

3.2 Myanmar's Trade with East and Northwest Neighbors

As shown in table 6, the expansion in regional border trade between Myanmar and its neighbors has been robust over the years. The existing pattern of bilateral trade links between Myanmar and its northern and western neighbors very much demonstrates that formal integration will lead to a massive expansion of economic activities among the proximate states. Of Myanmar's neighboring countries, China enjoys the lion's share of the border trade. Apart from the usual blips, cross-border exports and imports from Myanmar to China expanded from 1996—2010. Exports to Bangladesh are a far second. Both exports to and imports from India remained low. A significant amount of informal and illegal trade currently continues to exist in this region despite existing unilateral or multilateral trade liberalization between these countries (Pohit and Taneja 2003).

Except for the years 1996—97 and 1998—99 when Myanmar recorded a negative balance with China, it has enjoyed a positive border trade balance over the period 1996—2008 with Bangladesh, China, and India (table 6). While these balances could shift with economic integration, the benefits for Myanmar can only be that much stronger as the outlying area of Northeast India is geographically disadvantaged compared to Myanmar. Even the state of Tibet in Southwest China may benefit if infrastructure facilities in Myanmar are developed because the distance to the eastern coast of China is significantly more than that to Sittwe.

Table 6. Myanmar Border Trade, 1996—2008

Year	China			Bangladesh			India		
	Trade Balance	Export*	Import*	Trade Balance	Export*	Import*	Trade Balance	Export*	Import*
1996/97	-0.68	29.82	158.68	0.06	2.21	1.95	-0.41	5.94	14.25
1997/98	0.19	86.44	59.37	0.64	4.71	1.03	0.06	11.75	10.50
1998/99	-0.02	94.88	99.41	0.93	8.92	0.30	0.01	1.82	1.79
1999/200	0.01	96.39	94.89	0.99	22.13	0.15	0.28	5.49	3.06
2000/01	0.11	124.22	100.09	0.99	15.23	0.08	0.13	7.24	5.59
2001/02	0.07	133.12	115.85	0.96	26.55	0.58	0.12	10.79	8.53
2002/03	0.09	158.16	132.57	0.85	13.03	1.05	0.24	7.32	4.47
2003/04	0.04	177.26	163.84	0.35	5.23	2.53	0.49	8.04	2.74
2004/05	0.12	199.44	155.55	0.68	8.82	1.70	0.54	10.67	3.19
2005/06	0.21	314.29	203.65	0.74	18.78	2.83	0.44	11.49	4.44
2006/07	0.02	470.40	451.31	0.89	23.51	1.40	0.34	11.18	5.53
2007/08	0.14	555.48	421.83	0.93	30.81	1.20	0.47	10.91	3.92

***Source*:** GOM (2010).

***Note*:** * in US$ millions; trade balance computed using the formula – (export-import)/(export+import).

Whereas cross-border trade did not produce a significant movement of goods and services between India and Myanmar, the picture is different when overall trade is examined. India was Myanmar's largest trading partner in the region in 2008 (table 7). Although the trade volume is much smaller than that involving India, Myanmar's agricultural trade with China has also been on the rise.

Table 7. Agriculture Trade, Myanmar with India, China, and Bangladesh (US$ millions)

Country	**Fiscal year***	**Agricultural products**	**Animal and animal Products**	**Forest products**
India	2007/08	445.18	0.48	268.75
	2008/09	547.39	0.28	198.29
	2009/10	654.03	1.13	313.51
Bangladesh	2007/08	58.20	-	31.07
	2008/09	60.96	-	25.90
	2009/10	3.56	-	43.63
China	2007/08	16.62	0.05	43.95
	2008/09	15.40	0.59	32.57
	2009/10	20.88	0.49	29.14

Source: GOM (2010).

Note: * Excluding border trade

Border export figures for agricultural trade shows that China is Myanmar's largest border agricultural trading partner (table 8). There remains a serious gap in the border trade figures between Myanmar and Northeast India and Myanmar and Bangladesh. The direction of border trade between Myanmar and its northern and western neighbors can be seen in appendix 1. Regional cooperation and economic integration between the western border countries and Myanmar will go a long way in expanding border trade between these countries.

Table 8. Cross-Border Trade by Outposts, 2000—2007 (US$ millions)

		2000--2001					2006--2007				
	Outposts	**Marine**	**Agri**	**Forest**	**Others**	***Total***	**Marine**	**Agri**	**Forest**	**Others**	***Total***
China	Muse	60.0	42.0	13.6	5.3	*120.9*	113.9	242.5	70.7	24.5	*451.6*
	Lwejel	0.0	0.8	2.6	0.0	*3.3*	0.0	3.4	12.4	0.2	*15.9*
	Laizer	0.0	0.0	0.0	0.2	*0.2*	0.0	0.1	0.0	0.0	*0.1*
	Chin S.H.						0.0	2.5	0.3	0.0	*2.9*
	Total	**60.0**	**42.7**	**16.2**	**5.4**	***124.4***	**113.9**	**248.4**	**83.4**	**24.8**	***470.5***
Bangladesh	Sittwe	2.1	2.0	0.0	1.8	*5.9*	17.2	0.4	0.7	1.0	*19.3*
	Maungtaw	0.4	6.8	0.2	1.8	*9.3*	3.2	0.0	0.1	0.8	*4.2*
	Total	**2.5**	**8.8**	**0.3**	**3.6**	***15.2***	**20.5**	**0.5**	**0.8**	**1.8**	***23.5***
India	Tamu	0.0	3.3	0.4	3.6	*7.2*	0.0	0.0	1.3	5.6	*6.9*
	Rhi	0.0	0.0	0.0	0.0	*0.0*	0.0	0.0	0.1	4.1	*4.3*
	Total	**0.0**	**3.3**	**0.4**	**3.6**	***7.2***	**0.0**	**0.0**	**1.4**	**9.7**	***11.2***

***Source*:** Department of Border Trade, Ministry of Commerce, various issues.

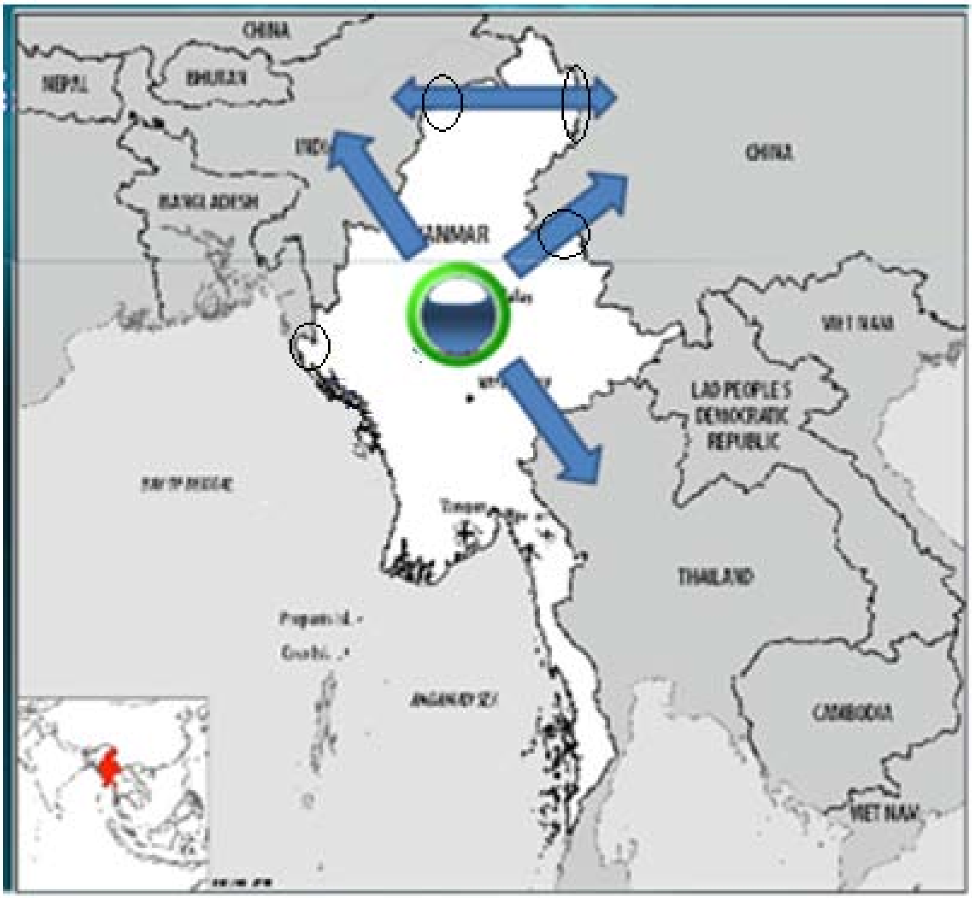
4. Shared Integration and Agricultural Commercialization

While Myanmar has good relations with China, which has stimulated strong cross-border trade, it does not enjoy similar links with Bangladesh and Northeast India. This situation appears to arise from bureaucratic and political problems involving the border states. Economic planning has largely isolated Northeast India and Eastern Bangladesh despite several years of independence. Studies done by CPR (1995), Bonapace and Mikic (2005), and the Asian Development Bank (2005) show that economic integration will be beneficial for these countries and regions. This common finding was the basis of the shared integration report produced by Rajaretnam (2006). In the 1980s, 1990s, and 2000s, the fiscal flow from the central government to Northeast India rose, partly to counter the sense of neglect felt by the latter and partly to quell ethnic riots. Although these inflows expanded the agricultural sector in the region, the pace of development has been very slow. While the evidence of globalization in the Indian economy is visible, there is hardly any visible impact of the process in the form of a boost to production and income-generating activities in Northeast India.

Unless the region integrates smoothly with its border neighbors and posts rapid growth and structural change, it is inconceivable to think of peace in the area (Prabir 2009). Regional coordination to rationalize capital and trade flows must be initiated between the governments because the intensity of cross-border trade and other movements across the Myanmar border and Bangladesh and Northeast India have yet to shift gear. The cost of keeping a fragile peace manageable in the Northeast is also expensive for the Indian government; hence, existing efforts to contain the situation cannot be hailed as an unmitigated boon (Bezbaruah 2007). The consequent expansion of markets and space that will arise from economic integration between the poorer regions of Northeast India, Myanmar, and Bangladesh will stimulate the demand for rapid technical change and economic growth (Rajaretnam 2006).

The inherent deficiency in infrastructure and the bad publicity for recurrent ethnic strife and militant activities in Myanmar, Northeast India, and Southwest China obviously do not present an attractive environment for private capital investment. The experiences of the ASEAN and the European Community (EC) indicate that cooperation is essential to realizing the full economic potential of integration. Agricultural trade between Bangladesh and India has assumed importance in the wake of attempts to forge greater South Asian regional cooperation. Likewise, trade with Myanmar has acquired added significance following India's launching of the "Look East" policy (Rajaretnam 2006; Sanjoy 2011). With integration, Myanmar can serve as a conduit to expand investment and trade linkages and knowledge flows between its eastern and western neighbors (figure 3). Trade across the Indo-Myanmar border is perceived by many not merely as a two-country affair but one that connects the region with East, West, and South Asia (Bezbaruah 2007; see also figure 4).

Figure 4. Border trade flows, Myanmar, 2010



***Source*:** Tin Htoo Naing

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Economic theory suggests that as agricultural production expands horizontally (using similar technologies to produce output at similar productivity levels) and vertically (using increasingly more productive technologies to generate higher unit output), the traded share of agricultural output will tend to increase. The interaction of agricultural commercialization and modernization of production systems can be expected to lead to greater market orientation of farm production. This frees up resources for effecting better rural transformation. It can raise farm-level productivity because there is progressive substitution of nontraded inputs on the basis of specialization, which is driven by competitive advantage. With increasing commercialization, the rising opportunity costs of farm-level determinants of labor productivity and increased market demand for food and other agricultural products will generate the conditions for rural industrialization and agricultural processing. This region can take a leaf out of the Southeast Asian experience where agro-processing has helped raise the productivity of important crops such as oil palm, rubber, and coffee. Indeed, Malaysia's meteoric rise as the world's prime producer of processed palm oil has translated into huge foreign exchange gains as palm oil has now displaced soya oil as the leading edible oil (Rasiah 2006). The region can also go a step further in the use of rattan and bamboo by adding value beyond mere furniture making to include replanting for food and for use as fabric in the manufacture of garments.

Diversification in the production structure can be seen at the aggregate level by the pattern of production growth of staple cereals compared with higher-value agricultural output such as livestock production in Asia during late 1990s, for example. Agricultural transformation and the process of commercialization and crop diversification have been accelerating in East Asian countries starting in the late 1990s. Livestock production grew more than 6.4 percent per annum during this period while the production of vegetables, fruits, and tea grew more than 4.4 percent per annum. However, cereal production increased by only 2.7 percent annually from 1973 to 1996 (Delgado et al. 1998). Economic integration can unleash productive forces to help increase cereal production if the requisite infrastructure can be developed across the region. The experience of Southeast Asia can be used to develop a road map to formulate infrastructure development policies to integrate Myanmar with its northern and western neighbors. The Asian Development Bank (ADB) can serve as a critical support instrument on this.

To stimulate an expansion in agricultural production and structural change, the governments involved must coordinate efforts to improve infrastructure. The performance of the physical infrastructure of South Asian countries has been uneven and is characterized by poor roads and little connectivity. Building the cross-border transportation network will enlarge market size, raise regional trade in agricultural goods and services, and help economies grow through international trade. Hence, infrastructure is a key input factor for economic growth, and investments have been of pivotal importance in the strong economic performance enjoyed by China and India in recent times. Serious efforts must be taken to develop the infrastructure in the whole region (Prabir 2009). The figures of infrastructure index (compared to the United States=1) indicate that the Indian position was 50, 49, and 51 during the years 1991, 2000, and 2005, respectively. Bangladeshi position was 73, 71, and 73 during the years 1991, 2000, and 2005, respectively. Southwest China and Myanmar were ranked lower than India. With the current massive build-up, we believe that the infrastructure in Southwest China would become far better than that in Northeast East India, Myanmar, and Bangladesh. On a comparative global perspective, infrastructure development in South Asian countries, such as Myanmar, Bangladesh, and Northeast India, is obviously not satisfactory (Prabir 2009).

Despite some initiatives taken, the relative ranking in regional infrastructure did not change much from 1991 to 2005 (Kumar and Prabir 2008). Full regional connectivity linking Myanmar, Bangladesh, Southwest China, and India can only be achieved through cross-border cooperation and infrastructure development, which will then reduce the costs of regional trade. The shared objective here is regional cooperation. Integration will also help eliminate the asymmetry between Myanmar, Bangladesh, Northeast India, and Southwest China and help the laggards move ahead through a blend of competition and cooperation. Good infrastructure helps stimulate regional diversification, expands bilateral and multilateral trade, and generates employment as well as reduces poverty in the process.

Economic integration between these regions and countries will require careful negotiations on rationalizing tariffs; streamlining trade practices; and coordinating the movement of goods, services, and people across the borders. These developments must take place alongside initiatives to modernize agriculture. Rice and pulses are a staple food of the people in this region. As such, it is fundamentally important to step up production of these commodities through land reform and agricultural commercialization (Baruah and Sanjib 2004). The movement of goods from Northeast India to neighboring countries in the region involves large transportation costs. Supply routes are prone to disruption during the monsoon season due to floods and the poor quality of road infrastructure. Myanmar is traditionally a surplus producer and exporter of rice and pulses. Improved infrastructure can facilitate increased exports of rice and pulses from Myanmar to Northeast India and Bangladesh. Indeed, Northeast India can serve as a market for other agricultural products of Myanmar, and this can only evolve with cooperation and regional integration among the regions and countries (Bezbaruah 2007).

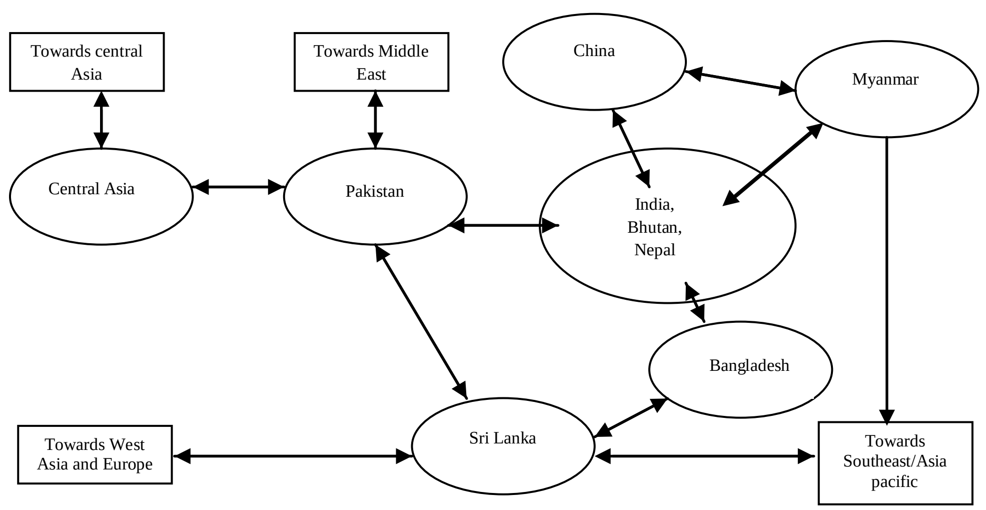
Goods from Myanmar often appear in the agricultural markets of border towns in India, such as Manipur, whenever there is a shortage of agricultural supplies in the region. With economic integration, these items can be regularly traded with Northeast India and Bangladesh (see figure 3). Increased and sustained trade in agricultural products on a regular basis can have a beneficial effect on farm production in Myanmar, Northeast India, and Bangladesh. Market expansion will provide an incentive for farmers in Myanmar to adopt better technology and expand commercial production. Economic integration will generate a pooling of expanded markets for scale. Its cumulative dynamic differentiation and the division of effects of demand will transform the region into a high-volume, low-unit-cost hub for agricultural production and off-farm processing. Carefully coordinated planning among the different governments involved can ensure steady technological and value-added upgrading and a shift towards environment-friendly production activities in the region.

The major challenges faced by Myanmar, Southwest China, Northeast India, and Bangladesh in their quest for effective regional integration include strengthening the political will to cooperate and develop the infrastructure while harmonizing trade practices in the region. The poor-quality, inefficient infrastructure services currently in place make production and distribution in the regions highly expensive and slow. It constrains the capacity of the region to compete with other countries (Bezbaruah 2007). The capital resource requirement for bridging the gap in these regions is substantial. It would be feasible to mobilize resources in order to narrow the gap. However, financing of infrastructure development is beyond the capacity of one country, such as by India or China alone. This makes it necessary to seek innovative financial instruments and institutional arrangements. The ADB should be approached for the funds to develop infrastructure in the region, which should follow after the four countries involved agree to pursue economic integration following a definite set of milestones.

Bonapace and Mikic (2005), ADB (2005), Gilbert et al. (2001), and Scollay and Gilbert (2001) identified some issues on infrastructure development and identified the benefits of larger regional trade groupings for the poorer regions of the South Asia. Quantitative research shows the advantages of regional trade groupings in South Asia and why regional integration is economically preferable to a spaghetti bowl of smaller and bilateral groupings. Scollay and Gilbert (2001) also recognized similar ideas on regional integration and demonstrated "open regionalism" in the Asia-Pacific Economic Cooperation (APEC). Prabir (2008) complements this study on Asia to show that geographically contiguous countries potentially stand to gain substantial benefits. Obviously, many barriers stand in the way of appropriating such benefits, including the vexing problem of regional trade reforms. The ASEAN itself has evolved its coordination sphere to embrace China, with negotiations to include India and the Republic of Korea, Japan, Australia, and New Zealand in other cooperation platforms.

This paper views cross-border integration involving Myanmar, Southwest China, Bangladesh, and Northeast India as a crucial opening towards the goal of stimulating cross-border economic synergies. As it is now, the borders between Bangladesh and Northeast India and between Myanmar and Southwest China have served as a wall, restricting the realization of the Suvanabumi goal that Surin Pitsuwan announced in 2006, which is to stimulate economic synergies and human interactions between the fertile rivers of the Ganges and Mekong.

Figure 5. Integrating Myanmar in Asia



Source: Adapted from Prabir (2009).

Rajaretnam (2006) pointed out some of the dynamic capabilities in the poorer regions of Northeast India, Bangladesh, Myanmar, and Southwest China and identified the advantages of scale that economic integration will generate. Interest is growing among concerned scholars in the relationship between coordinated rationalization, regional income inequality, and poverty reduction in Myanmar, Northeast India, Bangladesh, and Southwest China. These four countries could serve as the gateway to doing trade and business with Southeast and East Asia for South and Central Asia (see figure 4). Rajaretnam (2006) presented a flexible approach that can go a long way in hastening the processes of integration between these regions and countries. Political issues may be raised and analyzed but in an effective manner and within the context of institutions, laws, markets, and resource endowments, including managerial capacity. Political transformation and accommodation is inextricably linked to economic prosperity. These developments will surely encounter many disconcerting obstacles and setbacks but political leaders must persevere to ensure progress in implementing the political reforms necessary to achieving economic integration. The formation of guidelines, extension or revision, and subsequent merger of regional integration with the concept of trade corridors in Myanmar, Northeast India, Bangladesh, and Southwest China can be facilitated through the rules of origin, trade facilitation, and agricultural agreements that Harrigan et al (2007) referred to as “good practices implementation” by the WTO.

There is a need to establish a development strategy for regional agricultural development. Such a strategy must be based on the national nature and scope of socioeconomic objectives and must be within the national agro-policy framework. Regional cooperation on social and economic objectives should contribute to the pursuit of the overall objectives. Hence, policy makers must develop a common platform in the regions and provide an opportunity to identify and assess the main sectoral structural features, highlighting the factors representing both development opportunities and constraints. Strategies need to be developed and possibilities of regional cooperation should be explored to find broad priorities among alternative sets of policies and institutions consistent with objectives and structure. A strategy is not expected to specify a detailed, fixed blueprint of policies to be pursued and institutions to be built. Rather, it should offer alternative priorities, and options among sets of policies should be open for member countries. The actual cost-benefit analyses of economic integration would require a more careful study using dynamic computable general equilibrium models, which can perhaps be commissioned after this initial articulation to win over the doubters.

It may also be appropriate to emphasize that the success of a regional strategy depends on the coordination of resource allocation and distribution to generate growth and structural change. It will require strategic decisions on market and state instruments to achieve the objective of distributive equity. It could be based on the ASEAN model of constructive engagement as a starting point that can then be adapted to take account of the specificity of Myanmar, Bangladesh, Northeast India, and Southwest China. With regard to political and technical recognition of the efficacy of agricultural markets, the following factors must be considered to constitute the analytical core of the regional strategy: regional agricultural marketing channels, system for the development and transfer of farming technology, rural infrastructure, and other factors that enable a farmer to be more productive.

5. Policy Space

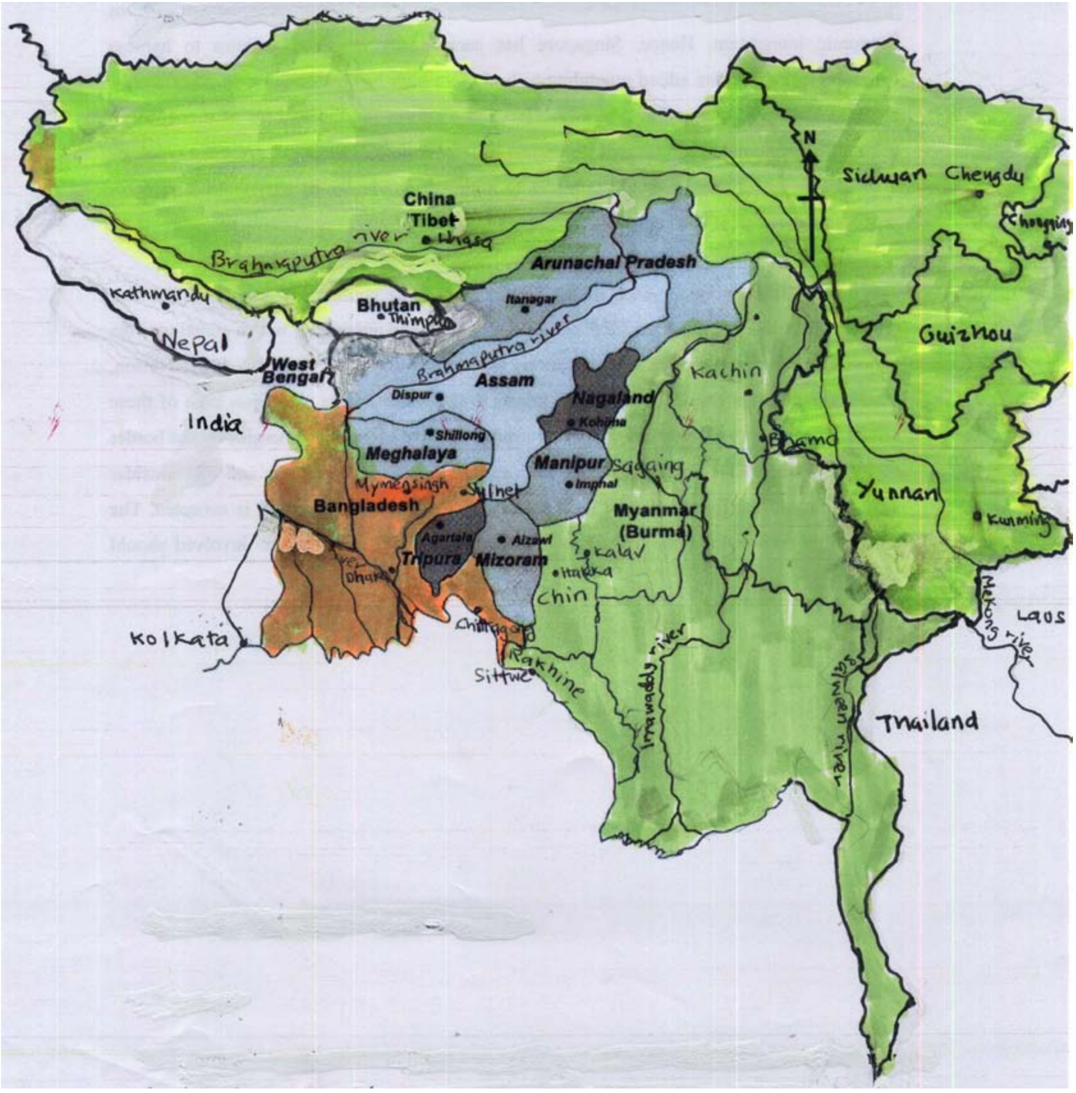
There have been positive signs for greater cross-border integration as India already has a number of projects with Myanmar and Bangladesh. The focus of the region should remain on agriculture, mining, tourism, and the appropriation of forest products. However, the addition of downstream processing will not only add value to these products but also help stimulate differentiation and division of labor in the region. Sustainability considerations must remain foremost in whatever policy is formulated to develop the region. Tea is arguably the most important agricultural item that all the regions involved produce in significant amounts, but natural bamboo could be the thread integrating the region. Given the importance of bamboo, its value chain should be expanded to include its cultivation, its consumption as food, and its processing into furniture and flora-based fur. The bamboo-processing center in Guwahati could be upgraded and its network expanded with smaller stations located in the Northeast Indian, Myanmar, Bangladeshi, and Southwest Chinese provinces where bamboo grows in large amounts.

The states of Sichuan and Yunnan are the most developed in the region, and the states of Guizhou and Tibet enjoy fairly modern highways and other transportation links. Quite clearly, development in Southwest China appears well coordinated. Hence, the only space worth creating is the one integrating Southwest China with Northeast India. The focus should then be on cross-border politics rather than economic stimulation in Southwest China although the states of Guizhou and Tibet, being poor, will benefit economically from the integration process.

Given the underdeveloped status of the remaining countries and provinces involved, it will be useful to focus considerable energies on the development of basic infrastructure with initiatives to establish and strengthen the remaining three pillars shown in table 8. The economic experience of Southeast Asia has demonstrated that higher performers, such as Singapore and Malaysia, have focused policy initiatives to stimulate economic synergies from economic integration. Hence, Singapore has successfully launched policies to harness technological and value-added upgrading in order to become a high-income country. In other words, regional economic integration typically offers the platform but the success of a country in generating economic synergies will depend on its own policies. Hence, we present a typology that all four governments should consider to gradually stimulate their agriculture and agro-processing industries (see table 8).

The general framework for each of the provinces and the countries should focus on four critical pillars that are not only essential for driving development and upgrading but which also constitute the national and regional system of innovations (Lundvall 1985; Freeman 1987; Nelson 1993). Government can then jointly coordinate with private agents to deepen each of these pillars. A more focused strategy will be necessary to drive economic synergies by the border region and is presented in table 8. We have extensive experience on this and will consider participating in the formulation of such in-depth strategies if our proposal is accepted. The rest of this section focuses on the specific policy issues the governments involved should evolve.

Figure 6. Myanmar with Northeast India, Southwest China, and Bangladesh



***Source*:** Drawn by the authors (not to scale).

Myanmar

The border states of Kachin in the north, Sagaing in the middle, Chin and Rakhine in the south, and Kachin and Shan in the north of Myanmar are the states directly linked to the borders of Northeast India, Bangladesh, and Southwest China. Although the development of this region is affected by insurgency, integration is expected to lower the incidences of insurgency. The existing projects between the governments of India, Bangladesh, Myanmar, and Southwest China show promise that integration is possible and can be quickened.

All the border states enjoy considerable endowments for horticulture—vegetables and fruits, bamboo, and medicinal plants. In addition, the states of Kachin, Sagaing, and Shan are also rich in minerals. Rakhine borders Bangladesh but can also be reached through proximate sea links. Rich deposits should be mined to finance infrastructure development. Tourism is another economic activity that can be promoted.

The relationship between Myanmar and China has hisorically been good, but infrastructure development on the Myanmar side can further strengthen interborder trade. Now that the national elections are over, the government should seriously accelerate infrastructure development and cross-border integration in coordination with Northeast India and Bangladesh. Interviews with officials in Myanmar show that its government is giving top priority to the construction of a network of roads and bridges across the nation and to linking up with Northeast India. Since Sagaing, Kachin, Chin, and Rakhine are mountainous and endowed with rivers and creeks, the cost of building roads will be high. The government has been building many new roads in the three border states and is expected to do the same in the Shan state. Earth roads have been upgraded to gravel ones and gravel roads to tarred ones. Extension of motor roads in Sagaing, Kachin, Chin, and Rakhine regions accounted for about 40 percent increase in road connectivity within two decades (1990—2010) while other modes of transportation also increased at slower rates. Transportation in the border area is specially developed by the Government's Border Area and National Races Development Projects. The ADB should be approached to finance the building of the infrastructure linking the three countries and the states of Yunnan and Tibet in Southwest China.

Since early 1990s, the government has been upgrading the economies of the Sagaing, Kachin, Chin, Rakhine, and Shan states together with the economies of the other states. The government is making the utmost effort to enable the local people to utilize the land and water resources of the mountainous regions in the border areas. The government reclaimed virgin and secondary lands and constructed water-pumping stations, dams, and diversion weirs to promote agriculture.[4] As a consequence, the agricultural produce of the three states

[4] Chronicle of National Development Comparison Between Period Preceding 1988 and After (Up to 12-2-2005), Ministry of Information, 2005.

increased starting in the 1990s. Total production of paddy rice in the three regions increased almost three times within two decades (CSO 2010). The government has designated Kachin State Special Region-1 and Kachin State Special Region-2 for the development of industrial zones. Special industrial zones have also been planned for Sagaing division (e.g., Monywa), while special assistance has been given to the Chin state for large-scale tea cultivation.[5] The Shan state has also been receiving plenty of attention since the turn of the millennium.

We would recommend that government promotion instruments should encourage the following agricultural crops for further development:

- Horticultural products of vegetables, fruits, herbs, medicinal plants, agro-processing and plantation crops such as tea.
- Northwest Myanmar should take advantage of its scenic beauty—from the hill slopes and valleys around the mountain ranges, including the wide range of fauna and flora—to promote tourism.
- The Chin state has a high percentage of educated people who are literate in English; hence, knowledge-intensive industries could be developed here.
- The rivers in this region should be carefully harnessed without any ecological desasters to support power and water supply.
- Bamboo farming, harvesting, and processing into furniture, food, and fur should be a major economic activity in the region.

Myanmar should take advantage of the peace currently prevalent in the country to connect its borders with economically similar border regions so as to promote rapid growth and structural change. Stronger initiatives from the Myanmar government to develop the states of Kachin, Sagaing, Chin, Rakhine, and Shan will receive a strong fillip from integration with Northeast India, Bangladesh, and Southwest China.

[5] Chronicle of National Development Comparison between Period Preceding 1988 and up to 12-2-2005), Ministry of Information, 2005.

Northeast India

Northeast India, comprising the states of Assam, Arunachal Pradesh, Meghalaya, Manipur, Mizoram, Sikkim, Tripuram, and Nagaland, have, since the formation of India and Bangladesh, been cut off from the sea.[6] Linking Myanmar with Northeast India and Bangladesh will open up opportunities for trade and investment across these countries and provinces as well as the neigboring countries of Nepal, Bhutan, and Southwest China. India has a number of pacts with Myanmar to develop the infrastructure in the border states. On February 13, 2001, the 160 km-long Tamu-Kalewa-Kalemyo road was opened (Sanjoy 2011, 33). The trilateral project signed between India, Myanmar, and Thailand will see roads connecting Moreh (Manipur), Bagan (Myanmar), and Mae Sot (Thailand). India is also involved in the Kaladan River project at a cost of INR 13 crore to it (India). This project attempts to bring railway and gas pipeline links from Negpui in South Mizoram to Sittwe Port. This link will help complement the current route through the congested Siliguri corridor.

Meghalaya offers mineral resources (e.g., coal, limestone, kaolin, and granite) that are important in the development of Bangladesh. It also has rich uranium deposits. Shella and Ichamati rivers offer important trade routes to Bangladesh, but the roads from Shillong to Shella require major improvement (Sanjoy 2011, 37). Trade can also be expanded through Ghasuapara in India to Gobragona in Bangladesh.

The Kaladan multimodel transport project linking Mizoram with Myanmar has been approved by the Indian government. India will provide US$95 million with the balance of US$10 million to be borne by Myanmar (Sanjoy 2011, 40).

The Northeast Indian states should focus on the following:

- Climatic conditions support the development of horticultural products like vegetables, fruits, herbs, medicinal plants, agro-processing and plantation crops such as tea.

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[6] See Sanjoy (2011) for a lucid historical account of the political developments that eventually left the Northeast Indian states as part of India.

- Northeast India should take advantage of its scenic beauty—from the hill slopes and valleys around the Bramahputra, including the wide range of fauna and flora. The Kaziranga National park is one such natural attraction.
- In states such as Mizoram where there is a high percentage of educated people, knowledge-intensive industries could be developed.
- Some states are endowed with massive hydropower resources that can be developed for use in Northeast India and then exported to Myanmar and Bangladesh.
- Bamboo farming, harvesting, and processing into furtniture, food, and fur should be a major economic activity in the whole of Northeast India.

Myanmar's integration with Northeast India would help expand India's trade linkages with Southeast Asia, which is currently primarily driven by the sea and air routes from South India and Delhi. The development of these linkages will help elevate the standard of living in Northeast India to catch up with the rest of India.

Bangladesh

Bangladesh borders Northeast India in the north, the state of West Bengal in the west, and Myanmar's Chin and Rakhine states in the east. Bangladesh is among the largest exporters of garments from the LDC category. It also remains a major base for the harvesting of jute, for which new uses have been found and which may make this commodity important again. With its dense population, Bangladesh remains a haven of labor-intensive activities but its infrastructure needs to be developed. The development of infrastructure in Bangladesh is not easy because of the ferocity of the Brahmaputra River, which not only causes heavy flooding during the rainy season but also dismembers and opens up new estuaries from time to time.

Nevertheless, as has been previously argued, integration with Northeast India, Southwest China, and Myanmar will only increase the opportunities for the people of Bangladesh to enjoy more economic synergies. Within this integration framework, Bangladesh should focus on:

- Climatic conditions in the border states of Bangladesh support horticultural crops such as fruits and vegetables.

- The towns of Mymensingh and Sylhet in Bangladesh can serve as transit routes for the export of minerals, processed tea, and bamboo furniture and fur from Northeast India through Chittagong.
- Silk farming and cultivation should also be encouraged, with the prime target being the Indian market.
- Bangladesh should utilize its learned human capital to promote knowledge-intensive industries.
- There should be strong emphasis on research and development (R&D) to further expand the economic use of jute.
- Bamboo farming, harvesting, and processing into furtniture, food, and fur should be a major economic activity in the northern and eastern regions of Bangladesh.

Southwest China

The Myanmar-Northeast India boundary is bordered on the north by the states of Tibet and Yunnan in China. Both states are highly mountainous, with the former having some of the highest points in the world. Much of the trade and other formal economic and human flows along these borders occur between Yunnan and Myanmar.

With its enormous financial surplus and growing demand for energy, the government of China has targeted the development of several dams to meet national demand. Indeed, hydroelectric power from the states of Tibet and Yunnan is expected to constitute a significant part of China's renewable energy. Mining is a key opportunity in Yunnan, which has eighty-six types of proven mineral deposits with extensive amounts of aluminum, lead, tin, and zinc (Wikipedia 2011, 1). Yunnan also hosts the largest amount of natural species. It is home to more than 30,000 species of high-altitude plants, a number of which could be harvested. The rivers of Mekong, Salween, and Irrawaddy pass through Yunnan into Myanmar. The Mekong borders Yunnan and Myanmar in the north. The city of Kunming is very well-connected with airline routes to a number of destinations in China and Southeast Asia.

Tibet is a large state that is potentially rich in minerals but is heavily mountainous and sparsely populated. Most of the populace work in agricultural farms devoted to crops and livestock. The state stretches from Yunnan in the east to North India in the west. The Brahmaputra River starts in Tibet just north of Nepal and enters India through Arunachal Pradesh.

Bordering Tibet and Yunnan is one of China's industrialized states, Sichuan, which has several industrial zones populated by high-tech firms, including electronics manufacturers. Mineral-rich Sichuan is dominated by heavy industries, such as coal, energy, iron, and steel. It is also into light manufacturing of building materials, wood products, food, and silk. Chengdu and Mianyang specialize in textiles and electronics while Deyang, Panzhihua, and Yibin have strong focus on machinery, metal, and wine manufacturing, respectively.

With such modern infrastructure and heavy concentration of industries, Southwest China is clearly the most developed of the regions around the Northeast India and Myanmar border. The Burmah Road still links Yangon through Yunnan to the municipal city of Chongqing, which is directly controlled by the federal government. Guizhou is a poor state in Southwest China whose terrain considerably resembles that in Northeast India.

As noted earlier, Southwest China is the most developed in the region but it can still benefit from cross-border trade economically and in the management of its natural resources and rivers. Presently, China enjoys cordial economic and political relations with Myanmar and Bangladesh. Although China and India have economic and political links, relations between the two countries in general and at their shared border in particular need improvement. Perhaps the main focus of integration with Southwest China should emphasize the normalization of relations between China and India.

Table 9. Systemic Pillars for Driving Economic Development

	Basic Infrastructure	High Tech Institutions	Network Cohesion	Integration in Regional and Global Markets
Initial Conditions (1)	Political stability and efficient basic infrastructure	Critical mass of economic agents	Social bonds driven by the spirit to compete and achieve	Integrated in global economy
Learning Phase (2)	Strengthening of basic infrastructure with better customs and bureaucratic coordination	Import, learning by doing and duplicative imitation. Human capital development	Expansion of tacitly occurring social institutions to formal intermediary organizations to stimulate connections and coordination between economic agents	Access to foreign knowledge through machinery and equipment import and FDI Integration in global value chains
Catch Up Phase (3)	Smooth integration with all institutions in 4 pillars	Import, creative duplication and innovation. Developmental research. Creative destruction is a major source of technological catch up (Schumpeterian Mark I).	Participation of intermediary and government organizations in coordinating technology inflows, initiation of commercially viable R&D	Access to foreign knowledge through licensing, acquisition of foreign companies and imitation. Access to imports and exports. Upgrading in global value chains
Frontier Phase (3)	Novel basic infrastructure support instruments to support short lead times	Basic research. Creative accumulation (Schumpeterian Mark II system).	Participation of intermediary organizations in two-way flow of knowledge between producers and users	Access to R&D human capital and collaboration with R&D institutions, high tech resources and markets abroad

***Source*:** Rasiah (2007).

Thus, the opportunities from regional integration for Bangladesh, Myanmar, Northeast India, and Southwest China are massive but the progress towards appropriating it requires considerable and painful effort from all the governments concerned. On the positive side, Myanmar already had general elections, India recognizes its neglect of its northeastern region, and Bangladesh is fairly peaceful again. These factors may quicken the process of integration. Once this is done, efforts should be taken to integrate Bhutan and Nepal.

The key areas that the focus of integration should be on should include massive infrastructure development, earmarking of agricultural development based on factor endowments, and the provision of basic amenities to all the peoples in the region. Because of the low position occupied by these states and countries in the development ladder, funding will remain an issue. However, there must be systematic efforts to build all the four pillars critical to promoting the region to developed status.

In addition, the governments of Bangladesh, Myanmar, and India should liberalize the flow of legal goods and services in coordination with Myanmar and Bangladesh in order to remove incentives for smuggling. Security should be tightened to ensure law and order and to reduce to a minimum the trafficking of humans and illegal goods (e.g., drugs).

By and large, Akamatsu's (1962) Flying Geese model should be the anchor to use. However, the model should be complemented with support from proactive federal and provincial governments from the regions involved. These entities should take into account the prevailing factor conditions that will drive sustainable agricultural development. The whole exercise should also be complemented with processing and service support in order to raise structural interdependence synergies. Thus, there should be policies supporting engineering, repair and maintenance, machinery modifications, and better planting and fallowing technologies as well as agro-processing, bamboo furniture, and textile manufacturing activities in the whole region.

6. Conclusions and Policy Implications

The study investigated the broader objective and some relevant points to open up the political space regarding the integration of Myanmar with its northern and western neighbors. Such integration will be based on a shared vision involving the promotion of sustainable agricultural development. The relevant schematic view of fundamental issues for the elaboration of a strategy to stimulate economic synergies through economic integration was justified through theoretical argument. We articulate the view that regional economic integration for stimulating agricultural development in Myanmar should be undertaken within the framework of the shared integration approach articulated by Rajaretnam (2006). In doing so, we presented detailed analysis of the existing and potential benefits that Myanmar will appropriate from the process.

Hence, policy makers of Myanmar, Bangladesh, Northeast India, and Southwest China must develop a common framework to engender the conditions that will allow them to take advantage of the opportunities that will emerge from economic integration. Given the endowments facing the border areas, agriculture should be the cornerstone of the integration process, and it would obviously invoke the sensitive issues related to border problems in the poorer regions of Northeast India, Bangladesh, Myanmar, and, in Southwest China, the province of Tibet. By far, infrastructure is the biggest obstacle to dynamic synergies but improvements in bureaucratic coordination to integrate regional physical capacities, such as transport networks and facilities and telecommunication networks, can go a long way towards achieving the synergies the potential offers. Conquering infrastructural deficiencies with applicable capacity-building in institutions must be vital to regional trade integration and the alleviation of poverty in these poorer regions (ADB 2005). Functional infrastructure provides many benefits for the poor, especially in the context of agricultural liberalization. Transport and information networks connect rural farmers to markets and ports (Holst 2006).

Although Myanmar and Bangladesh have embarked on industrialization initiatives with significant expansion in garments manufacturing, the focus should be on rural industrialization. The ADB should work with the Food and Agricultural Organization (FAO) and the United Nations Industrial Development Organization (UNIDO) to enhance the productivity of agricultural products. While it will be the FAO's task to raise agricultural productivity through the introduction of better farming methods and seeds instead of existing ones, UNIDO should assist in raising value added by improving the sorting, processing, packaging, and distribution of the promoted products. The ADB should focus on infrastructure development in the region.

The states of Sichuan and Yunnan and the municipal city of Chongqing have strategic development plans in place and thus would not require any special recommendations. The rural and poor states of Guizhou and Tibet would require more focus, but the Chinese government is already working on them. The other regions and countries in the region require policy advice. Instead of reinventing the wheel, UNIDO's model for supporting rural development can be adapted to local conditions (see appendix 4). Institutional reinvigoration and creation should be targeted at macro instruments and meso-organizations that are connected and coordinated with microlevel units. The meso-organizations should play a key role in supporting macro-micro interactions. The three broad activities recommended are (1) enabling the business environment for industrial policy support; (2) promoting clustering and business linkages; and (3) promoting the participation of rural and female members of society.

To provide a business environment that can make industrial policy work, Myanmar should pay attention to investment laws (for local and foreign investors) and procedures, incentives and grants, and the setting up and strengthening of infrastructure facilities. The key products identified for promotion should then be matched to the most suitable areas of concentration where they will be clustered for processing, for maintenance work, and for the establishment of development and demonstration centers. The existing and missing components required for the development of integrated clusters focusing on the selected products should be mapped. The provinces in China enjoy good infrastructure. The states of Sichuan and Yunnan and the municipal city of Chongqing are highly developed and could lead the way in driving the integration process. There should be programs to involve and empower the rural population (with special emphasis on women and the youth) and which should include coordination and training. The final institutional mechanism that must be initiated is a committee to evaluate *ex ante* and monitors and appraises *ex post* the rural development strategies to ensure that these are effectively implemented and are always upgraded to meet the changing needs of the population.

Sustainable approaches to the use of renewable forest products should be adopted across the region to complement agricultural development. These products should include bamboo cultivation and its development throughout the value chain to include bamboo shoots for food, fiber and fabric manufacturing, and furniture manufacturing. The bamboo development center located in Guwahati could be replicated in Myanmar and Bangladesh. China has a sophisticated bamboo-product development center in Hangchow; it can have its own subcenter in Yunnan.

Once the economic integration modalities are underway, the governments of Myanmar, China, India, and Bangladesh should work on dynamic strategies to spearhead a coherent strategy that will stimulate technological and value-added upgrading to ensure the sustainable provision of employment and income-generating opportunities for the people. The focus should be on the four systemic pillars shown in appendix 1. The strategies to stimulate agro-business in the region—R&D, prefarming, farming, and processing—should adapt the framework UNIDO uses to promote rural industrialization in the LDCs (see appendix 2).

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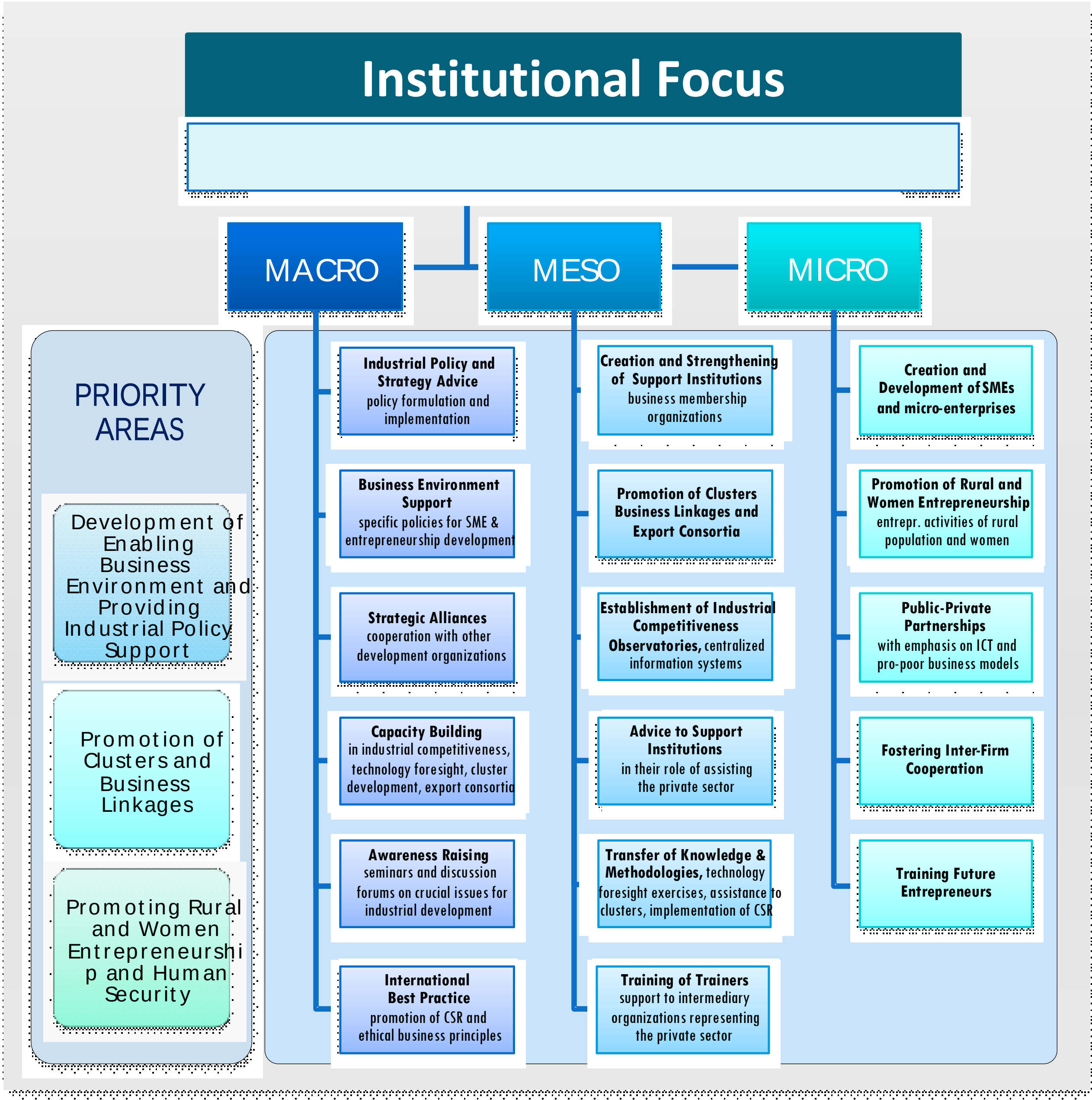
Appendix 1. Policy directions for cross-border agricultural development, Myanmar, Northeast India, and Bangladesh



Source: UNIDO (2009, 18)

Chapter 15

Toward A New Approach and Expanded Cooperation in Agricultural Research and Development in Developing East Asia Plus

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CHAPTER 15

Toward A New Approach and Expanded Cooperation in Agricultural Research and Development in Developing East Asia Plus[1]

Mercedita A. Sombilla

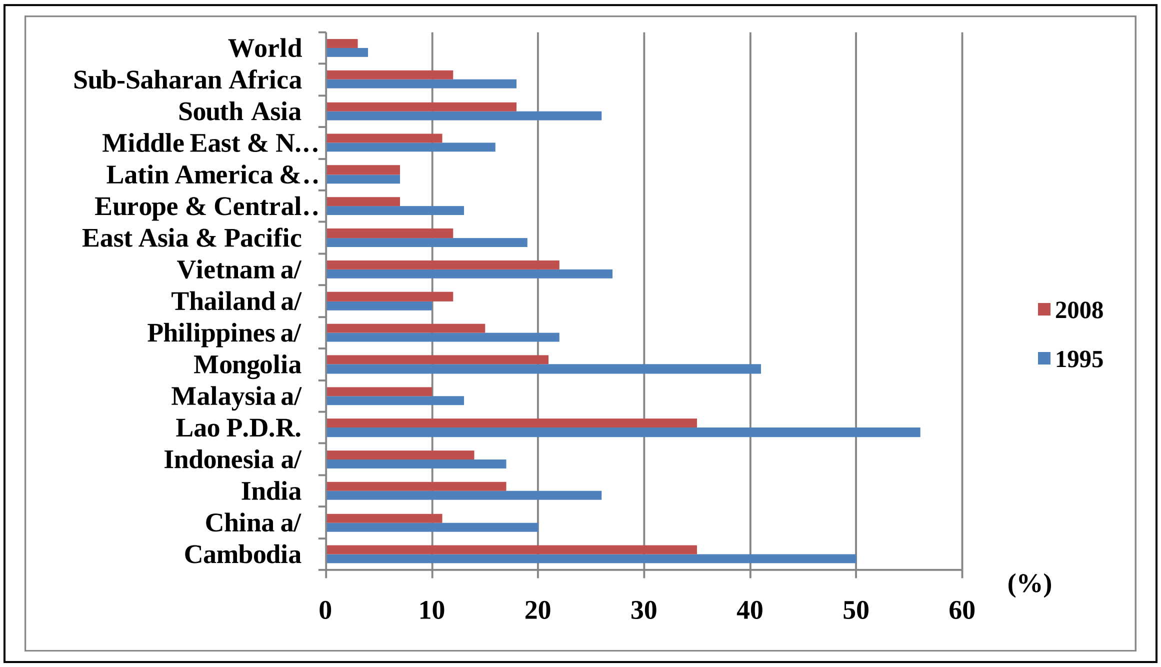
SEARCA

1. Introduction

Developing East Asia plus (DEAsia+), while it has exhibited significant economic growth, still faces tremendous challenges inimproving food security and reducing poverty. The agricultural sector thus continues to be of key importance as its relative contribution to the economies in the subregion (in terms of Gross Domestic Product [GDP]) is still high compared to the rest of the world (**figure 1**). Agricultural growth has been a key driver of development and much of this growth is attributable to agricultural research investments (Suphannachart and Warr 2010; Timmer 2009; Evenson and Rosegrant 2003).

[1] Developing East Asia Plus in this paper refers to the developing countries in Southeast and East Asia plus India. Southeast Asia includes (as per IMF grouping) Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Thailand, Timor Leste, and Vietnam. The East Asian countries covered in this report are Chinaand Mongolia. This country grouping is referred to here as Developing East Asia plus or DEAsia+. Unless further qualified, the word "region" in this paper would refer to DEAsia+.

Figure 1. Share of agriculture in Gross Domestic Product (GDP), 1995 and 2008



Source: 2010 World Development Indicators

Note: a/ Components are at producer prices

However, agricultural research lost some of its footing following the success of the Green Revolution. Almost everyone felt that the problem of food supply availability was already solved and that the remaining challenges posed by hunger and malnutrition were largely due to inadequacies in distribution and marketing. To date, a significant number of people in the region continue to lead lives marked by hunger and malnutrition. Even more ominously, the percentage of hungry and malnourished people has increased in the past years due to rising food prices.

Indeed, the recent food crisis sparked growing concerns that the available food supply can still become insufficient, after all. It is evident that the growth in crop yields has plateaued since the late 1980s while the emerging threats to the expansion of food production have increased. These threats include the increasing scarcity of land, labor, and water for agriculture due to the diversion of these resources to nonagricultural activities; the likely impact of trade liberalization; global climate change; rise in fuel prices; and biofuel development. There are also misguided government policies that often hurt rather than promote sustained growth in agriculture and the economy as a whole (Sombilla et al. 2010; David 2003).

The emerging economic scenarios intensify the call for more agricultural research and development (R&D) to effect higher production growth and strengthen the resilience of the agriculture sector against imminent threats like climate change. New fields of research such as genomics and nanotechnology, which could have a dramatic impact on agriculture, indicate that there will be ample opportunities to develop sustainable food production strategies capable of satisfying the needs of growing populations without placing undue stress on the environment and natural resources. These new technologies must find their way to the least developed countries (LDCs), such as those in DEAsia+, where most of the poor live. Making them work in these countries will require a paradigm shift that involves more effective institutional arrangements and strong collaboration and teamwork not only among individuals and institutions within the country but also with those outside.

Objective and Structure of the Study

The paper presents an agricultural R&D agenda for DEAsia+ that would reinvigorate the region's agriculture sector and promote its sustainable growth as well as the growth of the economy as a whole. It describes a paradigm shift in the conduct of research—the kind of research that pushes for stronger and expanded regional cooperation—to ensure that new and appropriate technologies are disseminated and adopted by the beneficiaries that need them the most (primarily the smallholder producers, including women) and in order to improve incomes and well-being, reduce poverty, and achieve greater food security.

The study analyzed information from existing literature, most of which are results of the ongoing discussion by various stakeholders on the future agenda of agricultural R&D. This paper starts with a short description of agricultural development in the DEAsia+, followed by a recounting of the huge amount of agricultural research that contributed to this growth. It then identifies the challenges that slow down agricultural development, threaten food security, and worsen poverty and hunger. Section IV identifies the gaps in past research efforts and identifies priority research areas to fill up these gaps and weaknesses and overcome the challenges. The last section presents a new paradigm for designing future research agenda in DEAsia+ and rationalizes the need for an expanded and more committed collaboration among stakeholders in agricultural research. The paper concludes by stressing that networking and cooperation can be a win-win path for DEAsia+, considering the countries' differences not only in terms of economic progress but also progress in science and technology.

2. Agricultural Growth, Food Security, and Poverty

DEAsia+ countries are still primarily agricultural. Despite having limited arable land that average 0.2 hectare per person, countries in the region have successfully staged rapid agricultural growth, enabling them to be become key suppliers of food not only for their 3 billion people but also for the rest of world. Moreover, the agricultural sector benefits slightly more than 1.8 billion people in the rural areas who derive their livelihood and income from farming, fishing, and other related activities. Livestock raising is a primary source of livelihood for about 300 million poor people in region, some 200 million in South Asia and another 100 million in Southeast Asia and China. Fisheries and aquaculture also play an essential role in the livelihoods of about 37.3 million fishers and fish farmers in Asia (FAO 2009). China has 8.1 million fishers and 4.5 million fish farmers. Other countries with a significant number of fishers and fish farmers are India, Indonesia, the Philippines, and Viet Nam. Most fishers and fish farmers are small-scale, artisanal fishers, operating on coastal and inland fishery resources

Growth in agriculture and in both the industrial and service sectors resulted in a relatively rapid rise of per capita GDP between 2000 and 2009 (**appendix table 1**). This plus the long-term decline in the commodity prices, particularly of the major staples, benefited numerous people, primarily the poor. The food security status of countries improved and the number of undernourished people was almost halved.

Growth in Agricultural Production

Agricultural production in the DEAsia+ countries exhibited quite impressive growth as indicated by the indices in **table 1**. Countries like Cambodia, China, Lao PDR, Myanmar, and Viet Nam posted food production gains of more than 50 percent from their output levels in 1990—92. Myanmar has been most prolific, almost doubling its food output levels over the two reference periods. The rest of the countries in the region (e.g., India, Indonesia, Malaysia, the Philippines, and Thailand) exhibited much more moderate increases. These countries were early adopters of the Green Revolution technology and may have exhausted potentially bigger increases in yield.

Growth in Cereal Production

Cereal production in DEAsia+ tripled, reaching an average of nearly a billion tons in 2008 (average between 2007 and 2009) as shown in **table 2**. Rice production grew at an average rate of 2.31 percent per annum between 1968 and 2008, maize at 4.3 percent, and wheat at 3.7 percent. Much of this production growth was accrued through yield improvement—a clear impact of technology research being conducted primarily to enhance agricultural production. The rate of expansion in cultivated areas was nil in rice starting from the late 1990s and declined in wheat but expanded in maize, possibly due to the increased demand for the commodity for bioethanol production.

Table 1. Agricultural Production Indices, 1999—2001=100.

Country	Food Production Index (1999—2001=100)		Crop Production Index (1999—2001=100)		Livestock Production Index (1999—2001=100)	
	1990--92	**2005--07**	**1990--92**	**2005--07**	**1990--92**	**2005--07**
Developing East Asia+						
Cambodia	82.7	139.0	82.7	145.3	82.3	104.0
China	66.3	117.7	75.7	116.0	54.7	116.3
India	91.0	101.7	95.0	100.3	83.3	112.3
Indonesia	95.3	121.3	93.7	120.3	99.3	132.3
Lao P.D.R.	73.0	115.7	77.0	117.7	74.3	109.3
Malaysia	88.0	114.7	92.7	116.7	100.3	114.3
Myanmar	71.0	139.7	68.7	133.3	66.0	180.3
Philippines	95.3	108.0	103.7	109.7	74.7	105.3
Thailand	92.0	109.0	89.7	110.0	94.7	103.0
Viet Nam	71.3	114.3	69.7	116.0	60.0	113.3
World	**78.8**	**114.3**	**82.0**	**114.7**	**83.7**	**112.2**

Source**:** 2010 World Development Indicators

Rice accounts for more than 50 percent of cereal production in the region and maize, less than a fourth. Wheat accounts for about 20 percent, most of which comes from China and India. The other two wheat-producing countries in the region are Myanmar and Mongolia (data not shown), the combined production of which totaled close to 400,000 tons in 2008. In terms of the region's contribution to the cereal production of the whole of Asia, the figure is 82 percent and to the world, 38 percent (see **table 3**). Rice share to the total of Asia's is 86 percent, maize's is 93 percent, and wheat's is only 66 percent.

Yield trends of the cereal commodities are also exhibited in **table 2**. Average rice yield reached in DEAsia+ is slightly higher than that of Asia as a whole. This is especially true for China whose average yield reached 6.5 tons per hectare in 2008, followed by Vietnam with an average yield of 5.2 tons per hectare. China likewise demonstrated the highest average yield levels in wheat and maize. Malaysia's maize yield of 5.2 tons per hectare ranks second and Lao PDR's, third. The variability of cereal yields across the countries in DEAsia+, and in the whole of Asia for that matter, is quite telling of the great potentials of further technology development to enhance production through yield improvements.

Table 2. Cereal Production in DEAsia+ countries, 1969—2008

Rice, paddy	Area Harvested (1000 ha)					Yield (tons/ha)					Production (1000 tons)					Growth Rates, % (1968-2008)		
	1969	1979	1989	1999	2008	1969	1979	1989	1999	2008	1969	1979	1989	1999	2008	Area	Yield	Production
Developing East Asia+	100,548	108,833	112,248	118,324	120,798	2.22	2.72	3.58	3.99	4.34	223,493	295,873	401,918	471,759	524,151	0.49	1.84	2.31
Cambodia	2,222	1,071	1,847	1,982	2,618	1.43	0.96	1.38	1.95	2.73	3,189	1,085	2,557	3,859	7,163	0.29	1.70	2.00
China	31,655	34,739	33,051	31,170	29,535	3.25	4.12	5.50	6.32	6.52	102,939	143,249	181,847	196,930	192,670	-0.10	1.82	1.72
India	37,413	40,016	42,196	44,891	43,957	1.64	1.87	2.59	2.90	3.22	61,208	74,799	109,399	130,339	141,368	0.44	1.86	2.30
Indonesia	8,056	8,913	10,391	11,829	12,447	2.25	3.05	4.22	4.28	4.87	18,171	27,235	43,860	50,667	60,602	1.08	2.09	3.19
Lao PDR	662	667	590	685	826	1.29	1.32	2.19	2.90	3.54	857	881	1,300	1,993	2,927	0.58	2.80	3.39
Malaysia	683	679	672	688	667	2.29	2.75	2.64	2.96	3.62	1,569	1,879	1,775	2,041	2,413	-0.02	1.26	1.25
Myanmar	4,748	4,751	4,673	5,991	8,200	1.70	2.41	2.92	3.25	3.76	8,057	11,431	13,648	19,509	30,975	1.37	2.00	3.39
Philippines	3,241	3,552	3,403	3,736	4,422	1.60	2.12	2.78	2.90	3.72	5,162	7,514	9,438	10,910	16,441	0.73	2.63	3.38
Thailand	7,018	8,930	9,526	9,791	10,772	1.89	1.89	2.06	2.50	2.95	13,223	16,865	19,686	24,489	31,738	1.08	1.27	2.37
Vietnam	4,849	5,516	5,898	7,561	7,354	1.88	1.98	3.12	4.10	5.15	9,118	10,933	18,407	31,023	37,854	1.04	2.83	3.91
Asia	119,513	128,243	131,755	138,330	141,703	2.30	2.74	3.52	3.93	4.31	274,963	351,557	463,656	544,278	611,023	0.47	1.69	2.17
Maize																		
Developing East Asia+	28,115	33,988	35,779	39,562	47,662	1.54	2.25	3.08	3.92	4.47	43,344	76,406	110,202	154,962	213,128	1.32	2.64	4.26
Cambodia	101	80	48	52	173	1.37	1.05	1.29	1.85	3.92	136	84	61	100	686	0.92	2.57	3.51
China	15,960	20,172	20,563	24,769	29,953	1.89	2.96	4.11	4.94	5.36	30,225	59,637	84,749	122,554	160,523	1.57	2.83	4.45
India	5,810	5,828	5,905	6,412	8,272	1.08	1.07	1.51	1.80	2.26	6,287	6,253	8,947	11,567	18,662	0.94	2.19	3.15
Indonesia	2,864	2,784	3,169	3,597	3,931	0.96	1.39	2.06	2.69	3.99	2,761	3,875	6,526	9,684	15,747	0.55	3.62	4.19
Lao PDR	14	28	35	45	167	1.77	1.06	1.53	2.37	4.80	25	30	54	108	805	6.78	2.56	9.51
Malaysia	9	8	19	27	6	1.86	1.13	1.77	2.12	5.21	16	9	34	57	33	-0.83	2.96	2.11
Myanmar	73	109	123	199	345	0.72	1.11	1.56	1.70	3.23	52	123	191	339	1,114	3.65	3.71	7.49
Philippines	2,368	3,231	3,751	2,502	2,664	0.81	0.96	1.23	1.72	2.59	1,918	3,099	4,601	4,306	6,900	0.41	3.10	3.53
Thailand	678	1,361	1,680	1,267	1,046	2.43	2.12	2.53	3.52	4.06	1,661	2,884	4,263	4,457	4,252	1.37	1.56	2.94
Vietnam	238	385	484	691	1,103	1.11	1.07	1.60	2.59	3.99	263	411	775	1,790	4,405	3.95	3.30	7.39
Asia	31,089	37,206	39,190	43,491	52,001	1.55	2.23	3.05	3.79	4.43	48,351	83,092	119,609	164,849	230,218	1.29	2.85	4.18
Wheat																		
Developing East Asia+	41,001	51,407	53,476	55,757	52,092	1.13	1.76	2.65	3.21	3.66	46,450	90,367	141,672	179,183	190,748	0.65	3.16	3.73
China	25,072	29,232	29,794	28,428	23,849	1.12	1.96	3.07	3.79	4.71	27,985	57,263	91,492	107,747	112,237	-0.11	3.70	3.59
India	15,861	22,090	23,558	27,235	28,144	1.16	1.49	2.12	2.62	2.78	18,428	33,029	50,043	71,334	78,352	1.58	2.36	3.97
Myanmar	68	85	124	94	98	0.53	0.88	1.11	1.08	1.61	37	75	137	101	158	0.25	2.61	2.86
Asia	67,345	79,578	83,682	99,359	99,817	1.10	1.64	2.31	2.58	2.88	74,023	130,574	193,390	256,617	287,725	0.99	2.42	3.43

***Source*:** FAOStat (accessed 2010).

Note**:** Figures are three-year averages centered in the year shown.

Production of Other Food Crops, Fruits, and Vegetables

Table 3 shows the production performance of DEAsia+ in other food crops like fruits and vegetables. The growth performance in these commodities was equally remarkable. From the period 1989 to 2008, fruit production almost tripled. The 2008 production level was reported at 225 million tons. Expansion of vegetable production in DEAsia+ more than tripled; the latest production figure available was 576 million tons in 2008. Table 3 also shows the relatively high share of the output of DEAsia+ of these commodities vis-a-vis world production—39 percent for fruits and 62 percent for vegetables. These shares have increased by almost 20 percent from the reported shares in 1989. While production is dominated by China and India, other countries like Indonesia, the Philippines, Thailand, and Viet Nam have closely followed behind.

Table 3. Production of Other Food Commodities (000 tons)

Countries	Cereals		Fruits		Vegetables		Meat		Milk		Fish a/	
	1988-1990	2007-2009	1988-1990	2007-2009	1988-1990	2007-2009	1988-1990	2007-2009	1988-1990	2007-2009	1988-1990	2007-2009
Developing East Asia+	694715	956381	72113	224838	191320	576256	37627	92641	59219	151064	20623	53608
Cambodia	2618	7849	231	307	472	487	117	213	17	24	87	469
China	374625	473849	20184	108728	126179	455030	28421	74381	6668	40186	8599	28336
India	192400	258094	25808	65974	47985	89279	3533	4353	51162	107440	3212	6519
Indonesia	50386	76350	5560	16578	4269	8789	1341	2549	562	1055	2566	5519
Lao PDR	1353	3733	120	206	93	896	42	113	5	7	28	105
Malaysia	1809	2446	1104	1410	321	630	560	1269	38	47	712	1275
Myanmar	14110	32267	940	1880	2073	4087	271	1434	570	1216	720	2779
Philippines	14040	23341	8750	15228	4171	5349	1023	2727	22	14	1774	2843
Thailand	24192	36192	6237	8804	2529	3717	1277	2220	116	785	2109	2664
Vietnam	19182	42261	3178	5721	3228	7991	1042	3382	59	290	815	3099
World	1850328	2454551	349502	576222	453476	928908	175012	276735	535867	689983	85245	107913
% to World	**38%**	**39%**	**21%**	**39%**	**42%**	**62%**	**21%**	**33%**	**11%**	**22%**	**24%**	**50%**

***Source*:**FAOStat (accessed 2010).

***Note*:** a/ includesDiadromous, Freshwater, and Marine Fishes

Growth of the Livestock Subsector

The livestock production indices in table 1 clearly show how this subsector has significantly expanded in the last two decades from 1990—92 to 2007—09. Myanmar's livestock production increased by 275 percent during this period as did China's livestock sector at slightly more than 200 percent. Production increases in other countries were not bad, ranging from 8 percent in Thailand to 88 percent in Viet Nam. This trend is in response to the so-called "livestock revolution" that has been taking place in the region because of the greater consumption of meat and dairy products. This shift, however, is not advantageous all the time. It could raise a number of new concerns. One example of such a concern involves the necessity of balancing crop output between that intended for food against that intended to be used as livestock feed. Another concern has to do with the increasing incidence of obesity and other illnesses resulting from the excessive consumption of livestock products.

Meat and milk production in DEAsia+ more than doubled from 1989 to 2008. The share of the meat output of DEAsia+ vis-à-vis the world's meat production increased from 22 percent to 34 percent while that of milk increased from 11 percent to 22 percent. China accounted for most of the meat produced in the country group. India, on the other hand, has been the milk production center of the region. It should be pointed out that milk production in DEAsia+ has grown more rapidly than anywhere else in the world, primarily due to the performance of India and China.

Fisheries and Aquaculture Subsector

Marine and inland capture fish as well as aquaculture production in DEAsia+ is estimated to have averaged 54 million tons in 2008 (**table 3**). This was about 50 percent of the world's total,which averaged 108 million tons. China leads all other countries in the region in the production and supply of fish from all three types of sources (i.e., marine, inland, and aquaculture) with its share of 28 million tons. DEAsian+ countries that are among the top ten producers of capture and aquaculture fish include Indonesia, India, Viet Nam, and the Philippines. These countries' combined fish catch accounted for about 17.8 million tons in 2007—09. Myanmar and Thailand followed with a combined fish catch of about 5.3 million tons in the same period.

Aquaculture is the fastest-growing of the three fishery subsectors. It has helped safeguard food and nutrition security as a supplementary source of protein, especially in remote areas. Aquaculture compensated for the production slowdown in capture fishery to adequately meet the increasing demand for fish in the region and the world. China, India, Viet Nam, Thailand, Indonesia, and the Philippines were among the top producers of aquaculture fish in 2006,contributing 42.5 million tons or about 82 percent of the world's total production (FAO 2009). China's aquaculture output increased at an average annual rate of 11.2 percent between 1970 and 2006. However, this growth rate recently declined to 5.8 percent from 17.3 percent in the 1980s and 14.3 percent in the 1990s.

DEAsia+ Countries as Major Suppliers of Food

The impressive production performances exhibited by the DEAsia+ countries enabled the region to become huge suppliers of food and other agricultural products.**Table 4** shows the net position of the countries in the trade of agricultural products. Except for milk and milk products, the region is a net exporter of other key food items like cereals (primarily rice), fruits and vegetables, and meat and fish.

Table 4. Net Trade Value in Agricultural Products (US$1000)

Countries	Cereals		Fruits + Vegetables		Meat		Milk		Fish		Total Agricultural Products	
	1999	2008	1999	2008	1999	2008	1999	2008	1999	2007	1999	2008
Developing East Asia+	(32,876)	4,149,475	4,917,075	13,250,924	949,150	1,292,439	(1,283,938)	(2,750,355)	3,224,020	6,209,294	7,754,520	16,891,048
Cambodia	(17,099)	17,036	(6,168)	(26,763)	(64)	(3,515)	(9,898)	(32,343)	26,019	28,514	(289,427)	(712,347)
China	(77,278)	(1,690,437)	2,429,864	9,480,128	256,657	(676,572)	(282,990)	(677,806)	1,436,558	2,970,071	(1,087,414)	(36,687,600)
India	514,233	3,481,687	464,941	(452,679)	187,350	1,235,475	(17,935)	143,114	226,870	430,883	672,374	8,166,476
Indonesia	(1,868,753)	(2,411,079)	170,028	(152,771)	(26,232)	(126,314)	(200,874)	(563,795)	550,120	618,811	399,551	17,389,217
Lao PDR	(2,470)	3,763	(380)	(7,175)	-	-	(6,500)	(9,802)	(1,085)	(2,656)	(44,649)	(182,171)
Malaysia	(639,568)	(1,977,648)	(219,900)	(515,994)	(140,172)	(336,812)	(189,238)	(341,495)	(137,354)	(189,251)	3,386,056	13,303,426
Myanmar	(140)	7,794	180,015	473,962	(213)	(696)			69,686	183,176	(79,969)	4,925
Philippines	(686,804)	(1,570,149)	428,611	1,342,843	(148,366)	(353,408)	(279,751)	(644,744)	92,453	140,341	(1,287,408)	(2,890,921)
Thailand	1,821,599	5,874,313	1,303,462	2,109,318	707,475	1,848,787	(190,072)	(327,648)	715,082	900,141	4,837,414	16,533,420
Vietnam	923,404	2,414,195	166,602	1,000,055	112,715	(294,506)	(73,965)	(249,529)	245,671	1,129,264	1,247,992	1,966,623

***Source*:**FAOStat (accessed 2010).

Rice is major export commodity and a big foreign-exchange earner for Thailand, Viet Nam, and India. Many countries in the region are also net exporters of fruits and vegetables (e.g., Thailand, China, and the Philippines), meat (e.g., pork from China and chicken from Thailand) and fish (especially those from aquaculture production in China, Thailand, and Viet Nam). China exports tilapia to as far as Africa while Viet Nam exports catfish to the developed world, particularly to the United States. Malaysia and Indonesia export palm oil.

Among the countries in DEAsia+, China, the Philippines, and Cambodia are net importers of agricultural products. The Philippines is now a major importer of rice. China is a huge importer of soybean products, palm oil, rubber, cotton lint, and, more recently, maize.

Importance of Continued Agricultural Growth

As has been previously discussed, agriculture is still very much the backbone of the economies of many countries in Asia, including those in DEAsia+. Its share of GDP, which averages 20 percent, can increase when the forward and backward links to agriculture (extended agriculture) are added. About 43 percent of the total labor force is in the agriculture sector, working mostly in the rural areas as smallholder producers or as laborers either in farms or in farm-related activities. Their incomes need to be raised to further reduce the incidence of poverty and malnutrition,which is still widespread in these countries, especially in the rural areas (**appendix table 1**).

Strong evidence has shown that there is no greater engine for driving overall economic growth and reducing poverty and hunger than investing in agriculture. For China, aggregate growth originating in agriculture is estimated to have been 3.5 times more effective in reducing poverty than growth outside agriculture. In fact, rapid agricultural growth in China as well as in India and Viet Nam was the precursor to the rise of these countries' industrial sector, similar to the way agricultural revolutions predated the industrial revolutions that spread across the temperate world from England in the mid-

18th century to Japan in the late 19th century (World Bank 2008; Bairoch 1973). Christiaensen et al. (2005) likewise estimated that a 1 percent increase in agricultural growth can lead to a 1.6 percent decline in poverty incidence in all low-income countries, 1.44 percent in Southeast Asia, and 1.73 percent in South Asia. Using cross-country regressions per region and taking the US$2-a-day poverty index, Hasan and Quibriam (2004) found larger effects from agricultural growth on poverty reduction efforts in Sub-Saharan Africa and South Asia.

3. Agricultural Research: Its Impact on Agriculture and Rural Development

The most valuable portion of investment in agriculture is that which is channeled to agricultural research. In the developing countries, this kind of investment has primarily come from the public sector and has been directed mainly towards technology development to increase food production. The greatest proof of such an achievement was the Green Revolution technology in cereals that took place in many countries, but especially in DEAsia+. The Green Revolution technology accounted for the unprecedented success of food multiplication and lower prices; it made food more affordable, especially for the poor (Swaminathan 2000). Agricultural R&D has indeed paid handsomely, yielding high rates of return of up to 43 percent in the developing countries (Alston et al. 1996; Alston et al. 2000; Evenson2001; Evenson and Gollin2003). Alston et al. (1996) additionally found that not only are the rates of return on agricultural R&D high but also that these rates are less likely to be below acceptable levels. A meta-analytic cost-benefit analysis showed that the benefit-cost ratios of agricultural research investments of the International Agricultural Research Centers (IARCs) under the umbrella of the Consultative Group of International Agricultural Research (CGIAR) are more than one, ranging from 1.96 to 17.94.

More recent estimates of rates of return to investments in agricultural research are shown in **table 5**. These figures are taken from Alston et al. (2000), and they are shown according to the “commodity” orientation of the research being evaluated. A total of 1,772 rates of return are included. The mean is 81 percent per year, and the range is from -100 to 5,645 percent per year. The median—44 percent per year—might be more meaningful. Over half of these rates of return (916 estimates) are for crops research, for which the distribution of rates of return is similar to that for the entire sample (although within that group, the results for wheat show a lower mean and a narrower range). Suphannachart and Warr (2010) recently estimated a 30 percent rate of return on Thailand’s public investment in agricultural research, which is well above the opportunity cost of public funds.

Economic Gains from High-Yielding Rice and Other Grains

The Green Revolution has been one of the major success stories in scientific plant breeding, particularly with the development and widespread adoption of the short but sturdy high-yielding rice varieties (HYV) from the 1960s. Varietal development and improvement has continued since then not only for rice but also for other crops (**appendix table 2**). The relatively higher rates of varietal releases in rice, wheat, and maize are due to the research support of developed countries, which shared their technological backlog—both in germplasm and knowledge—to help expand grain yields and stave off the widespread hunger that almost happened in the 1960s and 1970s. The improved rice varieties were estimated to have accounted for as much as 50 percent of yield growth in the 1980s and 1990s compared with the 21 percent yield growth in the preceding two decades (i.e., 1960s and 1970s). Furthermore, the yield increases were estimated to have provided an annual economic benefit exceeding US$19.5 billion (Evenson and Gollin 2003). The adoption by farmers in Asia of the modern rice varieties developed by the International Rice Research Institute (IRRI) was estimated to have yielded an annual return of US$10.8 billion, nearly 150 times the combined annual investment in rice research by IRRI and the national systems.

Table 5. Estimates of Rates of Return of Investments in Agriculture Research per Year

Commodity	No.of Observations	Mean	Mode	Median	Min	Max
Multi commodity[a]	436	80.3 *(110.7)*	58.0	47.1	-1.0	1219.0
All agriculture	342	7.0 *(110.9)*	58.0	44.0	-1.0	1219.0
Crops and Livestock	80	106.3 *(115.5)*	45.0	59.0	17.0	562.0
Unspecified[b]	14	42.1 *(19.8)*	16.4	35.9	16.4	692.0
Field Crops[c]						
Maize	170	134.5 *(271.2)*	29.0	47.3	-100.1	1720.0
Wheat	155	50.4 *(39.4)*	23.0	40.0	-47.5	290.0
Rice	81	75.0 *(75.8)*	37.0	51.3	11.4	466.0
Livestock[d]	233	120.7 *(481.1)*	14.0	53.0	2.5	5645.0
Tree Crops[e]	108	87.1 *(216.4)*	20.0	33.3	1.4	1736.0
Resources[f]	78	37.6 *(65.0)*	7.0	16.5	0.0	457.0
Forestry	60	42.0 *(73.1)*	7.0	13.6	0.0	457.0
All studies (Total)	1772	81.2 *(216.1)*	46.0	44.0	-100.0	5645.0

Source**:** Alston et al.(2000).

Notes**:** Standard deviations are given in parentheses. Samples exclude two outliers and include returns to research only and combined research and extension.

[a] Includes research identified as “all agriculture” or “crops and livestock” as well as “unspecified”

[b] Includes estimates that did not explicitly identify the commodity focus of the research

[c] Includes all crops, barley, beans, cassava, sugarcane, groundnut, maize, millets, other crops, pigeon pea or chickpea, potato, rice,sorghum, and wheat

[d] Includes beef, swine, poultry, sheep or goats, dairy, other livestock

[e] Includes “other trees” and “fruits and nuts”

[f] Includes forestry and fishing

The enormous progress in raising the productivity of Asia’s rice farmers has ensured the availability of high-quality and safe rice at more affordable price levels. One simple but telling example of progress is the rise in rice consumption per capita in the poorestquintile of India’s rural households—arguably among Asia’s most food-insecure families—from 0.90 kilograms per week in 1983 (all of India) to 1.43 kilograms per week in 2004—05 (Timmer et al. 2010). Without the yield gains, world cereal prices would have been 18 percent to 21 percent higher in 2000, caloric availability per capita in developing countries would have been 4 percent to 7 percent lower, and 13 million to 15 million more children would have been classified as malnourished.

Another key impact of the significant yield improvement was the slowdown in the expansion of areas cultivated for rice into marginal and fragile areas. Again, IRRI rice research alone has spared 13 million hectares of natural ecosystems from being brought under cultivation, with attendant environmental benefits (Asia Society and IRRI 2010).

Other Technologies and Their Impact on Agricultural Growth

In addition to HYV development, many other technologies have been developed that successfully raised production. These include the farm-management practices that reduce production cost, promote more efficient use of inputs, and protect natural resources and the environment. The zero-tillage technology now used in the rice-wheat production systems of South Asia is an example of a technology that helps increase farm output while promoting the efficient use of inputs and protecting the environment. The technology has helped save water, fuel, and other inputs; facilitated timely planting; reduced tillage needs and burning of crop residues; and allowed farmers to diversify the cropping system (Hobbs et al. 2010, online). The wider adoption of zero tillage in a million-hectare area could save as much as 100 million cubic meters of water per year plus 60 million liters of diesel fuel. The use of zero tillage for wheat saves more than 50 liters of diesel per hectare, representing savings of 75 million liters of diesel fuel, which is worth more than US$40 million region-wide, and substantially reduces the emission of greenhouse gases. Other beneficial technologies developed and adopted are the alternate wetting and drying of rice farms, integrated crop and resource management, integrated pest management, and water-harvesting technologies that are not only environment friendly but are also efficient in terms of labor, water, energy, and nitrogen use.

On-farm conservation of coconut genetic resources has safeguarded the characteristics of local coconut varieties and, subsequently, the economic base of coconut farmers in the Philippines whoare primarily dependent on the coconut industry for their livelihood. The project,which was aimed at protecting the biodiversity of the commodity, also helped generate coconut-related technologies that doubled the incomes of poor farmers and reduced poverty in the project communities from 44 percent to 6 percent (Bioversity

Center 2005). A similar effort in vegetables led to the accession of indigenous vegetable cultivars, which are now kept in the World Vegetable Center.

Capacity Building, Networking, and Policy Advocacy

Almost all research projects have capacity building as a key component. Capacity building comes in many forms:training from short-term (knowledge transfer) to long-term (degree programs) in the form of bilateral scientific exchanges, networking and development of research consortia to facilitate technology dissemination, and community mobilization to create public awareness, among others.The capacity-building component enabled a huge number of local scientists to gain knowledge and expertise on a wide array of subjects and fields of critical concern to increasing production: applied genomics (marker development, phenotyping and genotyping, and data analysis); biotechnology tools; seed production technologies; new production management technologies, including integrated pest and nutrient management; and others. Quite a significant number of women were likewise trained as scientists and managers although empirical studies have repeatedly shown a disproportionately low number of them working in senior scientific positions (Beintema and Stads 2008).

Regional research institutions and networks, such as the Asia-Pacific Association of Agricultural Research Institutions (APAARI), Cereal and Legume Asian Network (CLAN), Consortium for Upland and Rainfed Environment (CURE), Council for Partnership on Rice Research in Asia (CORRA), Plant Genetic Resources Network, Rice-Wheat Consortium (RWC), and others like these that are organized as vital components in agricultural research have become key repositories of valuable data and information and are excellent venues forthe exchange of information. The returns to these networks are likely to be substantial considering the small investment cost incurred (Pray2006). These regional networks help disseminate technologies and inform partners on new developments in agriculture.

Another vital component of some research projects is policy advocacy to inform policy makers on research results. Science-based policy recommendations have helped guide and facilitate development activities to achieve inclusive and sustainable growth. A few key ones that country governments have responded to are the adoption of zero-tillage technology in India and other South Asian countries; the call for public-private partnership in the promotion of hybrid rice; the promotion of aquaculture to reduce dependence on capture fisheries; and the institution of more friendly trade reforms to strengthen the linkage of domestic to international markets.

Technologies Generated and Adopted by National Agricultural Research

There are also significant technologies developed by the national research institutions of DEAsia+ that similarly helped boost the performance of their respective agriculture sectors. Some of these are purely local initiatives while others received either financial or technical foreign assistance.

China's postrevolution reforms in research and technology resulted in ten major scientific and technological achievements by 1996. These technologies include the (1) development of high-yielding and high-quality multiresistant crop varieties, including the Hybrid and Super rice; (2) transgenic, insect-resistant cotton; (3) large-scale adoption of high-yield integrated crop technologies; (4) energy-saving solar greenhouses for vegetables, fruits, and flower production; (5) management of migratory bollworm, brown plant hopper, and pest forecast; (6) livestock and poultry breeding and disease management; (7) new feeds and additives; (8) information and communication development technology; (9) efficient use of water and fertilizer resources resulting in water conservation; and (10) large-scale use of regulation technology in fertilizer application (Yinlong 2009). The success of hybrid rice in China is so impressive that other nations have adopted the technology. China is now producing about 118 million tons of paddy rice from a total of 18 million hectares planted to hybrid rice. In comparison, India produces an equivalent amount from almost 42 million hectares.

Other successful technologies primarily produced by national research centers are shown in **table 6.** Gains from Thailand's baby corn technology and the Philippines's tilapia technology are briefly discussed in **box 1**.

Table 6. Some Successful Technologies Produced by the National Agricultural Research System (NARS)

Technologies	Country	Technologies	Country
Baby corn production	Thailand	Oilseeds	India
Tilapia farming	Philippines	Integrated pest management in rice	Indonesia
Hybrid rice	China	Bivalve mariculture	India
Dairying	India	Farming carrageenophytes	Philippines
Hybrid cotton	India	Resource conserving technologies in rice -wheat systems	Indo-Gangetic Plains
Palm oil industry	Malaysia	Newcastle disease in native chicken	Bangladesh
Cotton production	Pakistan	Classicla biological control of pests	India
Orchids	Thailand	Sustaining the Green Revolution	India
Wheat production	Iran	Rainbow trout culture	Nepal
Direct seeded rice	Malaysia	Bt Corn commercialization	Philippines
Groundnut	China	Bt cotton	India

***Source*:** APAARI

Box 1. *Some Successful NARS-led Research and Technology Development Efforts*

The Baby Corn Industry in Thailand. Behind the success of the baby corn industry in Thailand was the development of composite baby corn varietiescharacterized by high yield, yellow color, good row arrangement, and resistance to downy mildew,which affected the industry prior to 1976 when the breeding work started. The strong support of the Thai government for the breeding work led to the development of good hybrid and open-pollinated hybrid corn varieties, which are now widely used. The strong participation of the private sector in promoting the production, processing, and marketingof baby cornadded to the success of the industry. Indeed, the production of baby corn helped farmers diversify from rice and gain additional profitsamounting to US$273 per hectare. Baby corn has also become a major export commodity,bringing in significant foreign exchangefor Thailand.

Tilapia Technology in the Philippines. Breeding improvement and improved farming practices in the Philippines for tilapia are another success story for NARs-led research efforts. The adaptation of the sex-reversal technology on the Nile tilapia and its commercial production in floating cages made the country one of the top aquaculture producers in the region and the world. The extension of the technology to small farmers through solid government programs did not only provide additional income but also an inexpensive source of protein for communities. The engagement of the private/commercial sector, on the other hand, helped enhanced fish production, which, in turn,alleviated the shortfall from capture marine fisheries.

***Source*:** APAARI Publications

Total research investment in DEAsia+ reached US$5.1 billion in 2002 from US$2.9 billion in 1991 (**table 7**). Half of the latest figure was spent in China and more than a quarter in India. Malaysia reported the third largest expenditure, followed by Indonesia, Pakistan (not shown in the table), the Philippines, and Bangladesh (also not shown in the table). The remaining five other countries in the sample surveyed (i.e., Laos, Nepal, Papua New Guinea, Sri Lanka, and Viet Nam) spent slightly more than US$100 million on public agricultural research in 2002. Despite the benefits gained, public investment in agriculture and agricultural research has slowed down in all countries in DEAsia+ except in China and India (**figure 2**).

The growth rate in public spending on agricultural research between 1991 and 2002 was 4.6 percent per year. Rapid growth started only in the late 1990s when China and India accelerated their spending on agricultural research. The 4.6 percent annual growth rate was primarily due to China, which more than doubled its spending on agricultural research as it pursued reforms to invigorate its economy through increased agricultural productivity. India's agricultural R&D expenditures likewise grew at 8.4 percent per year during the period 1996—2002, reflecting the Indian government's commitment to all fields of research, including the agricultural sector (Pal and Byerlee 2006). The financial resources of other countries in DEAsia+ for agricultural research were greatly affected by the Asian financial crisis in the late 1990s. In Indonesia, real agricultural R&D spending fell by one-third in 1997—98 alone and spending levels remained below precrisis levels in 2003. Laos suffered mass inflation in recent years,which greatly reduced spending on agricultural research. The strong increase in agricultural-research spending in Viet Nam, however, resulted from the national government's prioritization of agricultural and rural development.

Table 7. Public Agricultural Research Spending, 1991—2002

Countries	Total Spending (million 2005 international $)			Growth Rates (%)[a]		
	1991	1996	2002	1991-96	1996-2002	1991-2002
China	1,174	1,531	2,574	4.4	7.9	5.4
India	746	861	1,355	2.8	8.4	6.5
Indonesia	220	255	177	3.6	-7.9	-4.4
Laos[b]	*na*	*na*	13	*na*	-5.1	0.4
Malaysia	227	267	424	2.6	6.9	4.4
Philippines	80	121	141	9.2	0.7	4.4
Vietnam	8	22	56	18.8	19.6	19.1
12 Sample countries (includes China)	2,854	3,438	5.125	3.5	6.8	4.6

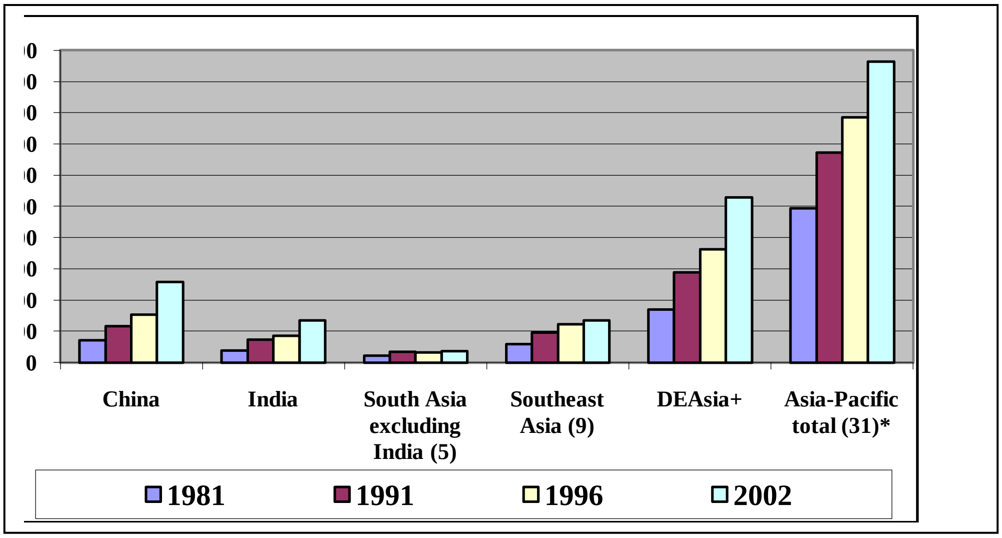
***Sources*:**Derived from table 7 of Beintema and Stads2008b; authors also compiled data from datasets underlying the ASTI country briefs and reports (ASTI 2005--08); revised PPP indices and GDP deflators from the World Bank (2007, 2008); data for China are from MOST (various years); 1991 research staff for India and Indonesia were estimated using ASTI data and information from Pal and Byerlee (2006) and Fuglie and Piggott (2006),respectively.

***Notes*:** The figures came from the responses of the 12 countries surveyed. The other countries included are Bangladesh, Nepal, Pakistan, Sri Lanka, and Papua New Guinea. *na* indicates not available.

a Annual growth rates werecalculated using the least-squares regression method, which takes into account all observations during a period;the resulting growth rates therefore reflect general trends that are not disproportionately influenced by exceptional values, especiallyat the end-point of a period.

b 1991--2002 growth rates for Nepal and Laos were based on estimated time-series data for 1991—95 and 1991—97, respectively.

Figure 2. National and regional trends in public spending on agricultural R&D, 1981—2002, in 2005 international dollars of total spending



***Source*:**Beintema and Stads(2008a)

***Notes*:** Asia-Pacific total includes those of the Pacific Islands and the OECD countries in the region (e.g., Japan, Brunei, Singapore, etc).

Decline in Investments in Agriculture and Research

Private-sector involvement in agriculture and agricultural research remains small in Cambodia, Lao PDR, and Viet Namgiven their weak funding incentives (Singh 2009). In Malaysia, private sector-led scientific research was mainly in the manufacturing sector. The limited involvement of the Malaysia's private sector in agricultural research (5 percent of total public and private spending in 2002) was focused on plantation crops (e.g., oil palm, coconut palm, sugarcane, and rubber) and much of this involvement was linked to the government. The promotion of private-sector involvement is gaining impetus, however, with the Malaysian government's increasing recognitionof the importance of agriculture in sustaining economic growth.

The involvement of the private sector in agricultural research is relatively high in India, the Philippines, and Indonesia compared to the rest of the developing world. This involvement has been primarily in biotechnology research. Private-sector involvement in Chinese agricultural research has also rapidly risen in recent years. Zhang, Fan, and Qian

(2006) estimated that about one-fifth of these agribusinesses are involved in agricultural research. As a result, the share of the private sector in total spending on agricultural R&D was 9 percent in 2003. Most of these agribusiness firms, however, were still at least partially state-owned but this is rapidly changing with the government's adoption of policies that encourage private-sector participation in agricultural research.

4. Emerging Issues and Challenges

The decline in investment in agricultural research has been creating great apprehension, considering the continuing challenges to be overcome and the emerging threats that have to be met head on.

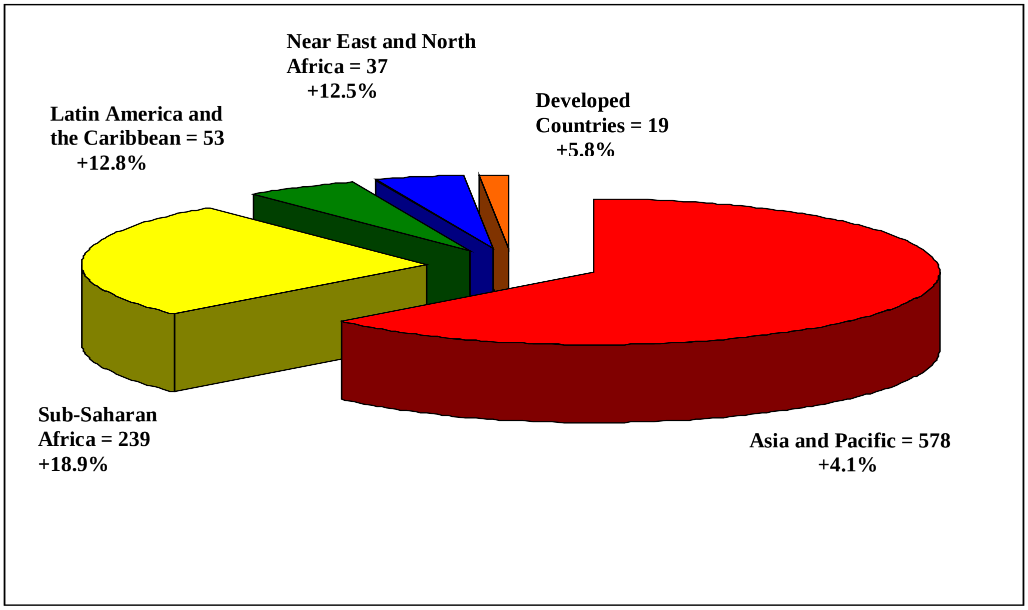
Continuing Challenges

Population growth and rapid urbanization continue to put pressure on agricultural production and its resources, especially in the light of the persistence of undernourishment and poverty in the region. The numbers have remained stubbornly high (appendix table 1) and even recently increased with the food crisis (von Braunet al. 2008).

Asia-Pacific, as a whole, is still the home of 578 million hungry people (**figure 3**).[2] The DEAsia+ countries account for most of them with the inclusion of the two most populous countries, China and India, as well as countries that continue to have relatively high population growth rate like the Philippines. China and India account for 42 percent of the

[2] This is smaller than the 2009 figure of 642 million people.

Figure 3. Estimated Regional Distribution of Hunger in 2010 (in millions) and Increase in Hunger Incidence from 2008 levels (in %)



***Source*:** State of Food Insecurity 2010, FAO.

world's hungry. India is home to 39 percent of the world's underweight children, the prevalence of which is twice as high as that found in Sub-Saharan Africa. China also accounts for 129 million of the region's undernourished people, majority of whom are in rural and landlocked provinces where productivity is relatively low. Other countries in the group have experienced rising incidence of poverty and malnutrition, which draw them farther from meeting the Millennium Development Goals (MDGs), especially Goal 1, which is to halve poverty and hunger by 2015.

In addition to increasing population and persistent poverty and hunger, agricultural productivity is slowing down due to several factors, including the (1) continued contraction of farmholdings; (2) exhaustion of the potentials of current technology to further increase yield levels; (3) degradation of land and water quality as well as forest cover due to unsustainable production practices; and (4) increasing competition overinputs such as land, water, and labor from nonagricultural sectors. The migration of men to the cities for more lucrative income opportunities has left the burden of farm work primarily to women.

Emerging Threats to Production and Agricultural Growth

There are a number of emerging threats to production and agricultural growth. The three most important threats are briefly discussed in this subsection. The first threat pertains to rapidly rising fuel prices that increase the cost of production (which, in turn, translates to lower net profits for farmers or higher food prices for consumers) and the competition for the same production resources resulting from the expansion of the biofuel subsector. The second threat relates to climate change. The third threat is the increasing globalization of markets, which has threatened the competitive stance of DEAsia+ countries and hindered small farmers from participating in world trade.

<u>Energy security and the expansion of the biofuel subsector</u>. The rise in fossil fuel prices has influenced the fluctuation in, and volatility of, food prices because of the heavy linkage of agricultural production to energy in terms of the inputs used (primarily fertilizers and fuel-run equipment and machinery). Increasing food production to meet higher demand equates to increased reliance on fossil fuels. The challenge in DEAsia+ (or anywhere else, for that matter) is to develop appropriate renewable-energy technologies that address broader socioeconomic and environmental issues.

While the current scope and nature of biofuels production and use in the DEAsia+ countries are still unlikely to have a negative impact on food security, there is a clamor to further increase biofuel production, and this may compound many of the problems that have rippled throughout the international food market. Further research on the potentials of biofuels is needed. At the same time, long-term R&D on increasing the energy yield of potential crops for feedstocks, an important determinant of future biofuel development, would (1) contribute greatly to productivity and control the land area used for energy cropsand (2) promote the use of wasteland or underutilized land to grow productive food and energy crops for biofuel feedstock through theapplication of intercropping techniques.

Impact of climate change. Increased intensity andfrequency of storms, droughts and floods, altered hydrological cycles, and precipitation variance have serious implications on future food production, particularly in DEAsia+ where many countries are hard hit by these disasters. According to the Intergovernmental Panel on Climate Change (IPCC), cereal production Asia as a whole is expected to suffer severely with climate change (IPCC2007). Rice production alone could decline by 3.8 percent by the end of the twenty-first century as a consequence of the combined influence of the fertilization effect and the accompanying thermal stress and water scarcity (Murdiyarso 2000).[3]

The challenge posed by climate change to food security is indeed considerable. Hence, the need to strengthen the natural foundations ofagriculture, such as water, land, and ecosystems, through sound management of natural resources in order to enhance the resilience of the sector to the impacts of climate change.

Trade liberalization and globalization of food markets. Trade liberalization opens up domestic markets so that more, and possibly cheaper,goods become available, which could then help ensure food security across countries (Sen 1997). While this can be beneficial to consumers, it puts pressure on local producers who will have to improve production efficiency to compete with cheaper imported goods. The key challenge that these countries face would be to improve production efficiency to lower cost and, at the same time, aim for the production of safe and high-quality food. Alongside improving production efficiency is the need to adopt the least trade-distortive policiesthat will open new trading opportunities but leave enough flexibility (i.e.,policy space) to allow interventions when market and economic circumstances change. Such policies should increasingly enable even the smallfarmers to take part in the globalized and commercialized agrifood systems.

[3] This is one of the projected climate-change scenarios based on those predicted by global circulation models.

5. The New Approach in Agricultural Research and Development(AR&D)

AR&D is needed to overcome the numerous constraints and challenges. However, more of the same will no longer be enough. AR&D should be refocused to address the weaknesses and gaps of past research efforts that have surfaced because of changes in the political, social, and economic frame conditions that are also affecting agriculture.

Past Research Focus

Table 8 shows the research focus of Southeast Asian countries by commodity. Crop research has the largest share followed by forestry, livestock, natural resources, and postharvest researches. **Appendix table 3**indicates that rice attracted the largest share in crops research in most Southeast Asian countries. Nonetheless, work has also been done on other commodities although on a limited scale. Malaysia focused on oil palm, for example. Vegetables, fruits, bananas and plantain, and corn each had a share in crop research intensity that ranged from 8.1 percent to 9.6 percent. Similarly, in India, crops (primarily rice) accounted for 58 percent of research studies (Beintema and Stads 2008b). The remaining 42 percent was devoted to livestock research (15 percent), forestry (7 percent), fishery (5 percent), postharvest (4 percent), natural resources (6 percent) and other areas (5 percent).

Table 8. Commodity Focus of Agricultural Researchers

	Indonesia	Laos	Malaysia	Myanmar	Philippines	Vietnam	Total	Share (%)
	in full time equivalent (FTE) researcher							
Crops	1,995.8	35.4	664.5	416.1	1,923.4	1,208.7	6,243.9	46.1
Livestock	452.2	15.8	131.6	111.1	376.9	398.3	1,485.9	11.0
Forestry	640.1	21.7	175.3	52.6	370.2	386.8	1,646.7	12.2
Fisheries	187.9	14.3	82.4	29.0	243.1	242.5	799.3	5.9
Postharvest	198.4	3.0	71.7	0.0	0.6	72.1	409.9	3.0
Natural Resources	491.1	24.7	37.6	6.9	123.1	264.4	947.8	7.0
Others	1,153.7	10.5	37.6	3.0	424.6	377.9	2,007.3	14.8
Total	5,119.3	125.4	1,200.7	618.7	3,525.8	2,950.8	13,540.7	100.0

***Source*:** ASTI database (shown as table 3.5 in Raitzer et al. 2009).

***Note*:** The reported number of full-time equivalent (FTE) researchers is often somewhat lower than the actual totals due to the fact that some agencies failed to complete the research focus section of the questionnaire. The data presented here represent all sectors, including the private sector.

Appendix table 4 shows the distribution of research activities related to livestock development. Beef cattle and poultry garnered the biggest number of research work followed by research on sheep and goats, dairy, and swine.

Research studies undertaken based on thematic area is shown in **table 9.** The major research themes identified in both national and international agricultural research were genetic improvement and natural resource management. National research institutions focused on pest and disease control and postharvest technologies while international research centers did significant work related to policy and institutional issues.

Table 9. Thematic Focus of Past Research Studies in Southeast Asia

Themes	National Agricultural Research Institutions (2002-2003)	International Agricultural Research Instituions (2008)
Crop genetic improvement	14.6	18.6
Livestock genetic improvement	4.4	
Crop pest and disease control	9.8	
Livestock pest and disease control	2.7	
Other crop	14.6	
Othe livestock	7	
Diversification and high value commodities		13.7
Soil, water, other natural resources/ Integrated natural resource mangement	16.3	28.6
Sustaining biodiversity		8.3
Post harvest technologies	4.7	
Policies and institutional innovations		22.8
Others	25.9	8.0
Total	**100**	**100**

***Source*:** ASTI database (as cited in Raitzer et al. 2009).

Jha and Kumar (2006) also revealed that nearly 35 percent of research resources in India were focused on germplasm improvement, 26 percent on agro-chemicals, and 21 percent on soil and water research. More than 55 percent were devoted to raising the productivity of natural resources. Material resources (such as agro-chemicals, power, and machinery) collectively claimed about one-third of research resources. The rest was spread across socioeconomics and other resources.

Filling the Gaps and Responding to the Challenges[4]

The bias on rice, especially in the conduct of basic research which is critical for scientific breakthrough, is clear from past research efforts. These efforts also dwelt on developing and promoting farm-management practices that boosted production but with less regard

[4] Discussion in this section is taken primarily from the e-consultation and face-to-face consultation with various stakeholders initiated by the Global Forum for Agricultural Research (GFAR) on the future focus of agricultural research; also from Singh 2009.

for the environmental consequences of such production. These biases have to change if agriculture in DEAsia+ has to respond to changing economic and environmental structures such as the shift in demand for more diverse diets that increasingly include fruits, vegetables, meat, dairy products, and fish; increased vulnerability to shocks; and globalization of markets. A research reorientation is required to build competitive advantage in high-value subsectors; design new production systems that are more well-aligned with the carrying capacity of the natural resources; broaden the growth base in rainfed and marginal areas; and adjust the price equations of production and technology decisions. The same reorientation will have to continue factoring in the needs of smallholders and marginal farmers not only in rice but also in other crops. Social science (policy analysis, policy interfacing, agricultural markets/trade/value chain analysis), natural resources management research (NRM), maintenance research, and human capital formation also need to be given greater priority in defining future research agenda.

Table 10 shows the translation of these challenges and gaps into the necessary research and development agenda for Southeast and South Asia. Examples of more specific research activities are listed in **appendix table 5**.

Basic Research for Technology Development

Intensified basic research on rice, wheat, and maize (the Green Revolution crops) must continue as these are the foundation of food security and livelihoods particularly of small and marginal farmers (Chand2009). However, the pitfalls of the Green Revolution that adversely affected natural resources (e.g.,loss of biodiversity, environmental pollution, land and water degradation, and enhanced pestilence) and which resulted from inappropriate/injudicious use of technology should be avoided. In addition, basic research on the development of the horticulture, livestock, and fisheries (aquaculture, in particular) subsectors needs to be enhanced. The demand for these high-value commodities is growing rapidly on the global market and, as such, these commodities have a great deal of potential to raise incomes, reduce poverty, hunger, and malnutrition.

Productivity and nutritional quality should also be enhanced through genetic improvement. Biotechnology, nanotechnology, and other related sciences can help address the various productivity challenges, especially in terms of preventing, avoiding, and diagnosing diseases of plants, animals, and marine life. These fields may also be able to offer new pathways to food and nutritional security and poverty alleviation. Developed countries should help the developing countries. The more developed countries in DEAsia+ (e.g., China, India, Indonesia, Malaysia, the Philippines, Thailand, and Viet Nam) that are making major investments in biotechnology should also lend technical assistance to their less-developed neighbors. Ongoing biotechnological programs that have previously been country- and commodity-specific have to be linked to one another as well as to programs that ensure biosafety and the conservation of biodiversity (and, therefore, biosecurity).

Table 10. Projected Agricultural Research Agenda in South and Southeast Asia

	South Asia	Southeast Asia
Increased Productivity		
Food Staples	Rice, wheat, local staple cereals, pulses	Rice
Diversified crops/livestock	Horticulture, fisheries, livestock	Vegetables, fruits, aquaculture
Thru science and technology	Germplasm conservation and improvement	Genetic improvement, management of biotic and abiotic stresses
Improved Value-Chain Development/Bioecosystem Research (weak links in the chain; food-feed-fuel-fiber nexus)		
Infrastructure: farmer-market links	Postharvest, agro-processing, Management; ICT Safety and Quality	Postharvest ICT Safety and Quality
Markets andnetworks/partnerships	Public-private-partnerships (PPPs); south-south cooperation	PPPs South-south cooperation
Increased Resilience		
Climate change management	Adaptation and mitigation	Adaptation and mitigation
Economicshocks	Rural and nonfarm jobs Risk management	Resilience to market volatility

***Source*:**Singh(2009).

Research on Natural Resources Management

Research on appropriate and sustainable production and management practices has to be enhanced and directed towards the development of farming systems that also help (1) conserve the use of natural resources, particularly land, water, and natural ecosystems and (2) improve the resilience and competitiveness of farmers, especially against climate change and various economic shocks. Work on improving rice-based systems has to continue while future research in the following areas—crop-livestock-farming systems based on integrated food-fodder-feed-breed-health and biosecurity management to reduce threats from transboundary animal diseases and epizoonotics—needs to be enhanced. Diversification of aquaculture will also have to be done through breeding and development of feeding and seeding technologies. There is a need to pursue agroecological and biodiversity-based farming technologies with great potential in meeting the region's food security, productivity, environmental, and social-sustainability goals.

Integrating Local/Indigenous Knowledge with Science.Farmers' indigenous knowledge and traditional technologies,especially those on conservation (e.g., plant propagation, seed storage, etc.), sustainable management and use of natural resources (e.g., schedules of field preparation and crop establishment, knowledge and use of forest plants and animals, selection of fodder and forage species for animal feeds, pest management and plant-protection methods), and the production systems that go with them (e.g., rice-based farming systems like rice cultivation-fish culture, rice cultivation-duck raising, etc.) should be strongly related to basic research.

Postharvest Handling, Processing, and Value Adding. R&D on postharvest handling to prevent losses and on efficient agro-processing interventions should be emphasized so as to add value and make locally grown or –raised products more attractive or appealing to local and international markets. The same R&D effort has to be done for fish processing and marketing to sustain the profitability of thesmall fishermen who derive income from coastal resources.

Climate Change and Bioenergy Research

Research on climate adaptation and mitigation is still quite inadequate in most countries. There is a need to identify more appropriate intervention measures in order to reduce the expected impacts of climate change. **Appendix table 6** shows the research studies on genetic and resource management that need to be undertaken to identify appropriate and sustainable measures that will strengthen the resilience of the agriculture sector against climate change and protect the small and vulnerable farmers. The recommended research activities include enhanced breeding work, improvement of farm/production practices, information dissemination and public awareness campaigns, and adoption of effective regulatory measures and policies to correct human- and industry-induced malpractices.

In the case of bioenergy development, research is important to develop alternative feedstocks for biofuel production. At the same time, more efficient and sustainable production processes have to be explored and experimented on. The key issue in biofuels development is minimizing the environmental footprintresulting from the biofuels production process. Public-private partnership in research and investment should be pursued in developing sustainable production technologies in biofuels.

Socioeconomic Research

The importance of socioeconomic research will have to be intensified to quickly analyze and understand issues critical to formulating policy and provide information to decision makers. Policy- and decision makers need to balance food supply and demand in a way that will benefit all stakeholders. At the same time, they face conflicting views on the environmental consequences of increasing productivity, controlling growth in demand, the environmental and human health impacts of transgenic crops, the consequences of bioenergy development on the environment and on the long-term availability and price offood, and the implications of climate change on agricultural production. Socioeconomic research includes impact assessment, risk evaluation, market and trade analysis, and similar efforts that provide science-based information for policy formulation and decision making. Of critical importance is the analysis of high-value markets that are increasingly organized in retail chains and which are becoming threats to small-scale producers because of the possibility of them (small-scale producers) being marginalized. Analysis of the commodity value chains can provide opportunities for upgrading small-scale production through value-added activities, organization of small farmers into cooperatives, acquisition of necessary capital andtechnology, development of management skills, and overcoming problems in relation to scale requirements, including certification.

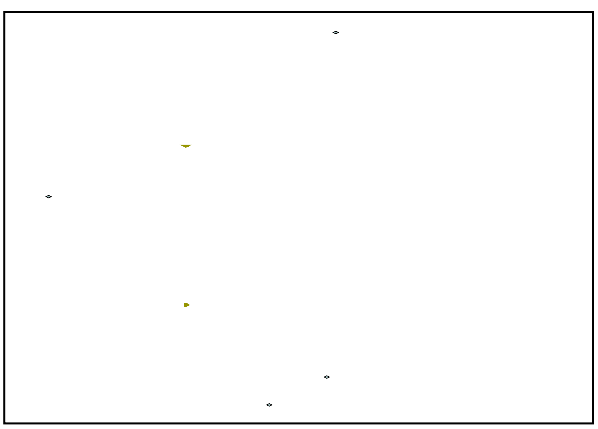
6. A Holistic Approach to Agriculture Research and the Need for Expanded Cooperation

Unlike in the past when research activities could be done by individual scientists working in isolation, the complex challenges that confront the achievement of more equitable and sustainable development require that agricultural research be now conducted in a holistic manner involving a pool of multidisciplinary experts and the cooperation of institutions within and outside the country.

A Holistic ResearchApproach

Figure 4 shows a holistic approach to the development of an agricultural research framework with four dimensions: the socioeconomic, science/knowledge, institutional, and global dimensions. The dimensions are shown as a continuum with cross-linkages to indicate the need to consider all four dimensions in the design of research projects.

Figure 4. A Holistic Approach to Agricultural Research



***Source*:** Chaparro (1999).

The socioeconomic landscape has seen many rapid changes. On the supply side, these changes include the exhaustion and degradation of natural resources combined with the threat of climate change. On the demand side, there is continued population growth, rapid urbanization, undernutrition, and micronutrient deficiencies, among others. These changes are putting a great deal of pressure on food production. Small and marginal producers, for example, are under pressure not only to raise agricultural productivity in order to enhance food supply but also to produce the right crops to help the populace consume more nutritious food. Socioeconomic factors have likewise made it a challenge to strike an appropriate balance between food supply and demand that benefits both producers and consumers.

There are new areas in science and technology that offer additional potential to increase current capacity to respond not only to technical issues in food production but also to social and economic challenges. The use of such technologies, however, should be carefully weighed against the conventional tools of plant breeding and on-farm research experimentation primarily in terms of cost efficiency and the capacity of stakeholders to adopt them. Biotechnology and nanotechnology, for example, often carry with them proprietary tags that may be too expensive for developing countries to use. The globalization dimension can be included in the research framework to overcome these proprietary issues and to ensure that the capacities of scientists and researchers in thedeveloping countries (including some countries in DEAsia+) are strengthened to enable them to understand and apply the tools.

The institutional dimension of the research framework ensures that the necessary measures and processes are in place to help overcome proprietary issues and ensure the smooth flow of knowledge and exchange of technology. This will strengthen the capacities to learn, adopt, and use new technologies, especially among small producers who are the ultimate users. Technological innovations are now seldom generated by individual research institutions or firms. They are increasingly the product of transnational research networks, or networks of learning, that play a central role in the process of knowledge generation and knowledge dissemination and applications (Powell et al. 1996). The institutional dimension helps establish strategic alliances and partnershipsthatare essential for new science and technology to work increasingly for small farmers and achieve more inclusive growth.

The Need for an Expanded South-South Research Collaboration

DEAsia+, and developing countries as whole, have greatly benefitted from the North-South research collaboration that came about as early as the 1960s with the development and spread of technologies such as the Green Revolution. The knowledge flow (e.g.,new research tools) and technology transfer from advanced research institutes and the private sector (mostly in developed countries) to the national research institutes of developing countries helped increase food supply and, at the same time, benefitted small farmers. Furthermore, the collaboration helped improve the relevance, quality, and efficiency of research as clients' needs and the potential "market" for products werebetter understood and partners with greater knowledge and skillsor usable products or servicesassisted in the conduct of research at lower cost.

While the North-South research collaboration continues, the South–South research collaboration is expected to heighten asthe scientific hierarchy in the developing countries creates classes of leaders and followers,enabling some of them to "give" and others to "gain" through scientific collaboration (Osama 2008). Countries like China, India, the Philippines, and Indonesia, for example, have relatively more advanced scientific and technical knowledge (e.g., in biotechnology) that they are extending tobuild the capacities of their neighboring countries in new research tools and technologies. Moreover, therapid economic growth in some developing countries (e.g., China and India) has spurred more investments in research; thus, creatingmore opportunities and impetus for greater collaboration.

South-South research collaboration among the DEAsia+ countries in particular needs to be expanded and strengthened:

a) To enable countries to work together on shared problems,especially those countries that share social or geographical environments andhave similar socioeconomic circumstances and scientific standing. Examples of such collaboration would be on tropical plant pests and diseases; transboundary animal diseases; threats from challenges like climate change, rapid population growth, food insecurity, and others.

b) To broaden opportunities for researchers working in developing countries and to open avenues for professional advancement, especially for those countries with poor international relations and limited resources.

c) To encourage countries to help one another develop their indigenous capacity to generate, manage, and use science and technology to address their needs; attune research to their particular needs; and create a critical mass of scientists either on a sectoral or regional level with the necessary momentum to solve challenging problems.

d) To ensure greater participation of small producers in the region and to enhance their competitiveness so that they will thrive in the more commercialized markets that used to be the domain of large and export-oriented producers.

e) To increase the impact of research by drawing on the experience of partners and bringing in more technical or cultural knowledge to the investigation process.

Public-Private Sector Partnership

The new agriculture that is characterized by far-reaching technologies and innovations and dynamic markets in extensive value chains clearly suggest the importance of private sector involvement in AR&D. Private-public sector alliance has to be promoted by putting in place appropriate policies, institutions, and investments to enable them to work on areas where they have comparative advantage so that they can help strengthen agriculture (primarily the agribusiness sector) and support the greater inclusion of smallholders and rural workers. Public-private sector partnership will work best in areas where the interests of both are matched, such as in the: (1) acquisition, exchange, distribution, and improvement of genetic stocks of crops, forest species, livestock, and fish using conventional and biotechnology applications; (2) production and distribution of improved seed and livestock; (3) production of fertilizers and development of more efficient managementpractices to optimize crop production; (4) development of diagnostics to detect diseases in crops, animals, and fish; (5) production of pesticides and pesticide application within the context of chemical control or integrated pest management; (6) development of strategies to ensure responsible deployment of resistance genes in crops that will optimize the durability of genes; (7) development and production of vaccines and other disease-control agents for animal diseases; (8) processing, storage, and use of food and feed products, including control of postharvest losses; and (9) global strategic planning and policy analysis aimed at developing commercial agriculture-based products to meet global needs.

Institutional Modalities for the Expanded DEAsia+ Research Collaboration

Getting the right institutional mix in place is one instrument that can be used to help achieve the move towards an expanded DEAsia+ research collaboration. Such institutional modality need not be developed from scratch but could be built or patterned on existing successful ones. The organization and institutional mechanism can be patterned after APAARI, and the core members can be the DEAsia+ countries. Other suitable partners would be the private sector and some relevant institutions from developed countries.

Othersmaller but more focused networks that can find complementarities or align strategies can be pursued. There are a number of successful networks/consortia of this nature such as the CURE, the RWC, the Asian Maize Biotechnology Network (AMBIONET), and the Collaborative Vegetable Research Network in Cambodia, Lao PDR, and Viet Nam (CLVNet), to name a few.

Considering the differences of DEAsia+ countries in terms of economic and technical development, expanded collaboration in DEAsia+ can definitely facilitate exchange and access of research tools and knowledge within the region. The nurturing principle where the more developed and technically advanced countries teach their weaker neighbors could work here. China, India, and the Philippines can share their capacities in biotechnology with Cambodia, Lao PDR, Myanmar, and Viet Nam to facilitate interactive learning between stakeholders that result in joint analysis, planning, and collective action on issues and problems. Countries that are relatively more advanced in other technologies could do the same for their country neighbors. It should always be remembered that support for expanded South–South research collaboration or stronger public-private sector alliance should be always based on a clear understanding of the reasons and the validity for collaboration. The objective should be the development of a solid, evidence-based research arrangement that ensures maximum usefulness, benefits, and sustainability.

7. Concluding Section

The emerging challenges that threaten agricultural growth, food security and worsen poverty and hunger will have impacts that will transcend national and even regional boundaries. The right balance between food supply and food demand has to be achieved for the benefit of all stakeholders from both the socioeconomic and nutritional aspects. This is one key reason for countries to support one other, including in the conduct of AR&D to meet the challenges of further improving food security.

Expanded research collaborationis a win-win solution and is becoming more effective than traditional “aid” programs, especially now that funds from development partners and donors are becoming scarce. The impressive economic growth performance of a number of countries in DEAsia+ can make expanded collaboration in agricultural research work in the region.

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Appendix

Appendix Table A.1. Economic and Welfare Improvement

Countries	Growth Rates (%)				GDP Per Capita (PPP)*		Per Capita GDP Growth Rates (%)	Proportion of population living below $2 PPP per day	Gini Coefficient (%)	Undernourishment		
	Real GDP	Agriculture	Industry	Services						(no. in millions)	Proportion to total population (%)	Progress in prevalence towards MDG
	2000-2009	2000-2009	2000-2009	2000-2009	2000	2009	2000-09			2005-07	2005-07	target = 0.5
Developing East Asia+												
Cambodia	8.1	4.6	14.6	9.9	1,010	1,735	6.6	58 (2007)	0.44 (2007)	3	22	0.6
China	10.3	4.0	11.2	11.2	2,667	6,200	9.6	36 (2005)	0.42 (2005)	130.4	10	0.5
India	7.3	2.4	7.9	8.8	1,776	2,970	5.6	76 (2005)	0.37 (2005)	237.7	21	1.1
Indonesia	5.1	3.4	4.2	6.7	2,727	3,813	3.8	55 (2007)	0.38 (2007)	29.9	13	0.8
Lao P.D.R.	7.0	3.0	9.7	9.4	1,327	2,048	4.8	77 (2002)	0.33 (2002)	1.4	23	0.7
Malaysia	4.8	3.3	3.5	6.2	10,271	12,678	2.6	8 (2004)	0.38 (2004)	ns	-	na
Myanmar	12.4	8.9	21.5	13.6	na	na	10.3	na	na	7.8	16	0.3
Philippines	4.4	3.4	3.5	5.5	2,587	3,216	2.3	45 (2006)	0.44 (2006)	13.2	15	0.6
Thailand	4.1	2.9	4.8	3.6	5,568	7,258	3.2	12 (2004)	0.42 (2004)	10.8a/	16	0.6
Vietnam	7.3	3.8	9.3	7.1	1,597	2,681	6.1	48 (2006)	0.38 (2006)	9.6	11	0.4
World										847.5	13	0.8

Source: SOFI-FAO 2010; WDI 2010

***Note*:**na = Data not available; ns = not statistically significant; *constant 2005 international $; **a/** Maybe overstated (personal discussion with the project leader of the Asean Food Security Information System(AFSIS) project based in Bangkok, Thailand (Nov 2010).

Appendix Table A.2. Average Annual Releases of Improved Varieties by Crop in Asia, 1965—1998

Crops/Region	YEAR							Varieties released with inputs from international agricultural research centers (1965-98)			
	1965-70	1971-75	1976-80	1981-85	1986-90	1991-95	1996-98	IX	IP	IA	IN
Wheat	40.8	54.2	58	75.6	81.2	79.3	79.3*	0.49	0.29	0.08	0.14
Rice	19.2	35.2	43.8	50.8	57.8	54.8	58.5	0.2	0.25	0.07	0.48
Maize	13.4	16.6	21.6	43.4	52.7	108.3	71.3	0.28	0.15	0.04	0.53
Sorghum	6.9	7.2	9.6	10.6	12.2	17.6	14.3	0.16	0.07	0.06	0.71
Millets	0.8	0.4	1.8	5	4.8	6	9.7	0.15	0.41	0.09	0.35
Barley	0	0	0	2.8	8.2	5.6	7.3	0.49	0.2	0.01	0.3
Lentils	0	0	0	1.8	1.8	3.9	3.98*	0.54	0.05	0.01	0.4
Beans	4	7	12	18.5	18	43	43*	0.72	0.05	0.01	0.19
Cassava	0	1	2	15.8	9.8	13.6	13.6*	0.53	0.15	0.01	0.31
Potatoes	2	10.4	13	15.9	18.9	19.6	19.6*	0.17	0.06	0.02	0.75
ASIA (All Crops)	27.2	59.6	66.8	86.3	76.7	81.2	79.9	0.18	0.29	0.1	0.43

***Source*:** Evenson online: http://www.google.com.ph/#q=evenson+and+gollin&hl=en&biw=1276&bih-851&prmd=b7ei=4jbeTK3XF8OycOz6jZcM&start=10&sa=N&fp=71dc2b26726ed4e2.

***Notes*:** * These are 1991--95 rates because of insufficient data.

** IX: Variety based on IARC Cross

IP: Variety based on NARS cross with at least one IARC parent

IA: Variety based on NARS cross with at least one non-IARCparent

IN: Variety based on NARS cross with no IARC ancestors

Appendix Table A.3. Focused Crop Research, 2002--2003

Crop	Indonesia	Laos	Malaysia	Myanmar	Philippines	Vietnam	Total	Share
	(FTE researchers)							(%)
Rice	299.1	15.8	63.1	96.1	532.6	333.3	1,340.0	21.5
Vegetables	172.6	4.5	55.8	75.6	175.8	114.6	598.9	9.6
Fruits	47.7	5.1	109.2	10.3	218.7	137.9	528.9	8.5
Bananas and plantains	78.4	0	5.2	0.5	422.1	12.6	518.9	8.3
Corn	150.5	4.2	4.8	50.6	178.9	119	508	8.1
Oil palm	125.1	0	264.2	67.3	2.4	5.2	464.3	7.4
Soybeans	155.4	2.8	0	2.5	8	53.4	222.1	3.6
Coconut palm	146.8	0	6.8	0	48.7	2.6	204.8	3.3
Sugarcane	92.5	0	6.7	11.1	53.3	40.1	203.6	3.3
Ornamentals	48.8	1.1	37.3	0	31	33.5	151.7	2.4
Cotton	41.2	0	0	52.3	8.5	47.3	149.3	2.4
Nuts	53	0	2.7	2.7	16.5	47.4	122.3	2
Tobacco	92.7	0	5.2	0	24.2	0.2	122.3	2
Coffee	17.6	1.1	3.7	0	12.7	52.2	87.2	1.4
Potatoes	23.4	0	0.8	1.8	26.6	28	80.5	1.3
Cocoa	39.7	0	22.9	0	0	15	77.6	1.2
Cassava	35	1.1	0.3	0	13.6	24	73.9	1.2
Tea	22.2	0	0	0	0	44.7	67	1.1
Wheat	14	0	0	0	0	7.1	21	0.3
Sorghum	8.8	0	0	0	2.6	7.6	18.9	0.3
Yam	0.6	0	0.3	0.3	10.5	2.9	14.5	0.2
Barley	2.4	0	0	0	0	4.5	6.8	0.1
Millet	1.5	0	0	0	0.3	4.3	6.1	0.1
Other crops	326.9	0	75.4	45.1	136.4	71.4	655.2	10.5
Total crops	1,995.80	35.4	664.5	416.1	1,923.40	1,208.70	6,243.90	100

***Source*:** Raitzer et al. 2009. Basic data came from a survey of 11 countries,excluding Thailand.

Appendix Table A.4. Focused Livestock Research

Crop	Indonesia	Laos	Malaysia	Myanmar	Philippines	Vietnam	Total	Share
	(FTE researchers)							(%)
Beef	121.7	2.1	30.9	21.9	127	43.4	347	23.4
Poultry	108.8	1.1	25	21.9	65	95.5	317.2	21.3
Sheep and goats	83.6	2.8	21.6	11	50.7	26.1	195.8	13.2
Dairy	42	0	15.3	21	17.1	67.9	163.3	11
Swine	13.1	1.7	1.4	21	37.2	58.8	133.3	9
Pastures & forages	33.4	4.2	2.1	0.9	30.5	32.5	103.5	7
Other	49.6	4	35.3	13.3	49.3	74.2	225.8	15.2
Total livestock	452.2	15.8	131.6	111.1	376.9	398.3	1485.9	100

***Source*:**Raitzer et al. 2009. Basic data came from a survey of 11 countries,excluding Thailand.

Appendix Table A.5. Research Priorities for Crops and Natural ResourcesManagement

Crops and Horticulture

- Crop varieties with the following characteristics: (a) tolerance to abiotic and biotic stresses; (b) can raise crop yield ceilings, particularly in irrigated areas; (c) better product quality, nutrition, value added, shelf life, and high suitability for processing; and (d) multipurpose use
- Other crops (e.g., legumes, vegetables, and flowers) to be incorporated in the cropping systems of short-duration, period-bound, high-yielding varieties of rice, wheat, and maize to enhance cropping intensity and resourceproductivity
- Diversifying production systems consistent with land, water, social, economic regimes, and market demand, particularly integrated management for off-season vegetables, flowers, and periurban cultivation
- Improving input-use efficiency (especially of fertilizers, nutrients, water, and energy) through ICM, IPM, INM, fertilization, precision farming, etc.
- Designing and improving cropping systems for higher yields, pest management, natural resource conservation, and integration with livestock and trees
- Sustainable production and distribution of quality seeds and planting materials and a technology-transfer system, including *in vitro* methods
- Small-farm mechanization and protected cultivation of vegetables and flowers.
- Postharvest handling and value addition through processing and storage
- Crop- and horticulture-based farming systems suited to distinct agro-eco-regions, such as arid, hilly and mountainous, coastal, and hot-humid zones

Livestock including poultry

- Improving nutrition through the quality of crops residues and the removal of antinutritional factors; strategic supplementation and improved varieties of fodder crops and feed balance and formulation; and reduction in methane emission

- Animal health enhanced by science-based capability in the epidemiology and diagnosis of, and vaccine production for, major diseases, disease-nutrition interactions and genetic resistance to major diseases, and overall capacity in the management of cross-border diseases and zoonotics
- Characterization and improvement of local breeds through selective breeding and evolution of a science-led policy on cattle breeding
- Market development, product processing, and biosafety of products with focus on smallholders
- Animal-waste management and socioeconomic and environmental impact of crop-livestock systems, including pastoral systems

Coastal Fisheries

- Sustainable integrated management of coastal systems and protected marine areas, including mangroves
- Sustainable management of marine shrimp farming (feed, nutrition, health, and seed distribution), including effluent management
- Management of reef fishery systems, crab culture, and ornamental fishes

Inland/Aquaculture Fisheries

- Genetic improvement for growth enhancement and disease resistance
- Aquaculture systems management, including deep-water rice-fish/freshwater prawn; integrated fish farming and open-water, culture-based fishery; and cold-water fish culture
- Fish-health management, particularly for the intensive culture of fish and crustaceans

Forestry

- Management of felling-cutting cycles in natural forest, timber utilization, second-growth forests, and forest health
- Inventory, evaluation, and development of forest resources and biodiversity
- Promotion and management of agro-forestry, landscape forestry, alley cropping, and carbon sequestration and trading
- Improvement of medicinal and aromatic plants and enhanced judicious extraction of nontimber and minor products and their marketing

Management of Natural Resources and Climate Change

- Conservation, characterization, evaluation, and utilization of genetic (crop, livestock, fish, and tree) resources for food, agriculture, energy, adaptation to climate change, and overall income and livelihood security
- Knowledge-based integrated management of the supply and demand sides of water and other nonrenewable resources under the regimes of worsening water crises, declining natural resources, and globalization
- Improving efficiency in the distribution and use of irrigation water, soil, nutrients/fertilizers (policy, technology, and institutional issues) through the enhancement of crop-animal-water-nutrient-implement synergy
- Technological, institutional, and policy options for rainwater harvesting, aquifer recharging, water pricing, watershed management, reclamation of degraded/sodic lands, control/management of saline and arsenic-contaminated water, and conjoint and multiple uses of water
- Sustainable integrated land use, organic recycling,soil fertility,water quantity and quality management to maintain crop-soil-water balance, particularly under changing climate regimes
- Developing drought, flood, and good weather codes, contingency and compensatory farming systems, and biotic stress management devices for adapting to abnormal meteorological (weather) and climate changes, duly

supported by credible early warning and information, communication, and technology (ICT) systems

Appendix Table A.6. Climate Change Adaptation Measures in the Agriculture Sector

	Adaptation Measures	**Agricultural Knowledge and Technology Challenges**
Agriculture cropping	*Choice of crop and cultivar:* Use of more heat- and drought-tolerant crop varieties in areas under water stress Use of more disease- and pest-tolerant crop varieties Use of salt-tolerant crop varieties Introduction of higher-yielding, earlier-maturing crop varieties in cold regions *Farm management* Altered application of nutrients/fertilizers Altered application of insecticides/pesticides Change planting date to effectively take advantage of the prolonged growing season and irrigation Develop adaptive farm-level management strategy	Identification of appropriate genes Lack of resources for the development of varieties Time-lag between development, field trial, farmers' acceptance, and onset of climate change Riseof new pests and diseases Needs extensive research on nutrients and fertilizer requirements of new crop varieties Changing planting date could have effect on yield. Resources and technology required at the grassroots level

Livestock production	Breeding livestock for greater tolerance and productivity Increase forage stocks for use during unfavorable time periods Improve the management of pastures and grazing,including grasslands Improve management of stocking rates and rotation of pastures Increase the quantity of forage used for grazing animals Plant native grassland species Increase plant coverage per hectare Provide local specific support in supplementary feed and veterinary service	Breeding less climate-sensitive livestock will be a formidable challenge Less climate-sensitive grass and pasture varieties need to be developed Many native grassland species are not nutritious for animals Need resources, advanced technologies for feed and veterinary service
Fishery	Breeding fish tolerant to high water temperatures Improved fisheries management capability to tackle challenges resulting from climate change	Cross-breeding with fishes from arid regions is a possibility but its effects on local varieties will be unknown for long time Technology and resources will be major obstacle
Development of agricultural biotechnologies	Development and distribution of more drought-, disease-, pest-, and salt-tolerant crop varieties Develop improved processing and conservation technologies in livestock production Improve crossbreeds of high-productivity animals	Will emerge as technological challenge for poor countries Faster technological transfer is required A new nexus between technology owners may emerge to take advantage of climate change

Improvement of agricultural infrastructure	Improve pasture water supply Improve irrigation systems and their efficiency Improve the use and storage of rain and snow water Improve the system for information exchange on new technologies at the national,regional, and international levels Improve sea defense and flood management Improve access of herders, fishers, and farmers to timely weather forecasts	Improved water storage, supply, and irrigation need new technologies and replacement of the old Dissemination of information on technology requires building institutional capacity and educating farmers Improved sea defense and flood management have potential but they have certain limits

***Source*:** IPCC 2007.