Chapter 4

Effects of Disasters on Intra ASEAN Trade of Agriproducts

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CHAPTER 4

Effects of Disasters on International Trade of Agricultural Products and Food Security in Southeast Asia: Empirical Evidence from Thailand, Indonesia, and Viet Nam

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4.1 The Theory of International Trade

The theory of international trade suggests that the more a country participates in international trade, the more likely it is to benefit from an open economy, thereby improving its prospects of rapid socio-economic expansion at home (Smith, 1776; Ricardo, 1817). Trade liberalisation opens export markets and eases access to the import of capital goods and intermediate products (United Nations Conference on Trade and Development, 2016). However, as developing countries turned their attention to achieving rapid economic growth after the Second World War, almost all nations in the early 1950s rejected the notion that they might grow through reliance on comparative advantage. Instead, they opted for policies of 'import substitution'[1] (Niroomand and Nissan, 1997: 167).

Tariffs are not the only intervention by which international trade might be restricted. Nontariff trade barriers include restrictive licenses, quotas, outright prohibitions, impediments to foreign exchange transactions (including required advance deposits for such transactions), customs valuation impediments, and many more. Quantifying the effects of such restrictions on a common scale is even more difficult. The welfare cost of tariff rates and other impediments to trade depends on general equilibrium effects and market structure (Dornbusch, 1992). Across regions, some of the fastest-growing countries in Asia and the oil-rich Gulf states have restrictive policies in services, whereas some of the poorest countries are remarkably open. Across sectors, professional and transportation services are amongst the most protected industries in both industrial and developing countries, whereas retail,

[1] Import substitution is a government strategy that emphasises the replacement of some agricultural or industrial imports to encourage local production for local consumption, rather than producing for export markets. Import substitutes are meant to generate employment; reduce foreign exchange demand; stimulate innovation; and make the country self-reliant in critical areas such as food, defence, and advanced technology.

telecommunications, and even finance tend to be more open (Borchert, Gootiiz, and Mattoo, 2014).

Multilateral trade arrangements for tariff reduction and fair trade must integrate enabling conditions with arrangements for earnings capacity to increase national income and reduce tariffs. The margins of import tariffs applied by high-income and least-developed members of the World Trade Organization (WTO) are vastly different and significant, and the marginal propensity to import is significantly dependent on output for the high-income members of the WTO (Warburton, 2010). Successful reduction of import tariffs in the least-developed countries is ultimately contingent on how trade policies are integrated with development capacity (including the minimisation of corruption) beyond multilateral agreements which are intended to foster longer transition periods and enabling conditions under international trade law (Warburton, 2010).

In the midst of trade restrictions through tariff and non-tariff barriers, natural disasters have adversely affected the domestic and international trade of agricultural products and food security in the world; and Southeast Asia is not an exception (De Haen and Hemrich, 2007; Skees, 2000; Gassebner, Keck, and Teh, 2006). The objective of this study is twofold: (i) to examine the effect of natural disasters on the international trade of agricultural products in selected countries of Southeast Asia (i.e. Thailand, Indonesia, and Viet Nam); and (ii) to assess the effect of natural disasters on food security indicators in these countries.

4.2 International Trade Policies in Thailand, Indonesia, and Viet Nam

4.2.1 Thailand

The general thrust of Thailand's trade and investment policy has remained liberal, and new efforts have been made to improve market access and facilitate trade. Such efforts have been particularly noticeable in customs valuation and foreign direct investment. The tariff is rather complex because of the multiplicity of rates applicable to each of the 5,505 tariff lines. It remains one of the main instruments of trade policy, however, and affords a relatively high level of protection with a simple average applied most favoured nation rate of 14.7% in 2003. Moreover, about a quarter of all tariff lines are unbound, and bound rates often considerably exceed applied most favoured nation rates. This affords authorities considerable scope to raise (or lower) tariffs at any time, by means of royal decrees or ministerial regulations and notifications, with cabinet approval. Import licensing on various items remains opaque and appears in some cases to correspond to quantitative restriction. Most of the import licensing requirements are for national security and health and environment reasons. A number of other non-tariff border measures remain for economic reasons, such as infant industry protection; the effectiveness of these measures is questionable. Thailand has not acceded to the Agreement on Government Procurement.[2] Government procurement continues to be used as an instrument of economic policy, with preference being accorded to domestic suppliers. The authorities recognise a need to remove impediments to investment rather than relying on tax-based incentives, which have been widely used. Thus, various subsidies tied to exports have been removed and investment incentives have been streamlined. On the other hand, the government appears to be taking a more proactive approach to industrial policy and the pursuit of competitiveness, with measures apparently targeted at industries such as agri-industry, automobiles, textiles, electronics, and high-value services. Most local-content and export-performance requirements, including those attached to incentives for new investments, were abolished during the period under review. While privatisation seems behind schedule, considerable progress has been made to corporatise state-owned enterprises (SOEs) in preparation for their eventual privatisation. Since 1999, the number of Thai industrial standards based on international standards has increased. Thailand has also made various amendments to its laws related to quarantine requirements. Various laws have been enacted to strengthen the protection of intellectual property rights, and the government has taken actions to enforce such protection. The implementation of competition policy appears to be weak; the Office of Trade Competition Commission has made decisions on only three cases since its inauguration in 1999. The apparently weak enforcement of the competition legislation may be attributable to institutional, procedural, legal, or resource limitations. However, effective enforcement of the Trade Competition Act, 1999 could be envisaged through continuous institutional and human resources development as well as experience gained from international cooperation (WTO, 2009).

4.2.2 Indonesia

The Uruguay Round improved Indonesia's bound rate to 92% of its tariff items, a development that Japan welcomes. However, the bound tariff rates for the vast majority of items remain extraordinarily high, at levels of 30%–40%. Effective tariff rates are also high, at an average

[2] The Agreement on Government Procurement (GPA) consists of 19 parties covering 47 WTO members (counting the European Union and its 28 member states, all of which are covered by the GPA, as one party). Another 33 WTO members/observers and four international organisations participate in the GPA Committee as observers. Ten of these members with observer status are in the process of acceding to the GPA.

of 27.8% for textiles and textile products, 30.6% for transportation equipment, and 26.1% for electric equipment. In its 'Individual Action Plan' for Asia-Pacific Economic Cooperation (APEC), Indonesia made an explicit commitment to begin in 1995 to reduce effective tariffs of less than 20% to less than 5% by 2000, and those in excess of 20% to 20% by 1998 and to less than 10% by 2003. Description of the import and export system Indonesian foreign trade, both export and import, is conducted openly and liberally with some exceptions for specific reasons. Payment can be made under any terms which are normally applied to international trade. The trade system works because it is supported by the free foreign exchange system, which means that there are limits to obtaining and using foreign exchange for export and import purposes. The export and import system has four categories of regulations for products: (i) products which are traded freely; (ii) products which are prohibited from being traded; (iii) products which may be traded only by licensed exporters or importers (approved traders); and (iv) products with controlled trade (WTO, 1994).

Trade remains limited as a share of economic output, with merchandise exports accounting for 21.0%–26.0% of gross domestic product (GDP) and imports for 15.0%–18.5% of GDP. Indonesia continues to trade more energy-related products (fuels) than any other product category on both the import and export sides. A number of measures – including export restrictions and taxes on raw resources, tighter import licensing requirements, point-of-entry restrictions on imports, ownership limitations on banks, and certain divestment requirements for foreign mining companies – have recently raised concerns about the direction of trade and investment policymaking. The tariff has remained Indonesia's main trade policy instrument, albeit a relatively small source of tax revenue. Indonesia's revenues from taxes on international trade constitute about 4% of total tax revenues, which is considerably lower than the average for developing countries. Nearly half of Indonesia's trade taxes are levied on exports, mainly commodities, the main policy objectives being price stabilisation, development of downstream processing facilities, and reducing the rate of depletion in non-renewable resources. SOEs continue to play a key role in Indonesia's economy, estimated to account for about 40% of Indonesia's GDP. No significant privatisation activity took place during the review period. However, the government has partially divested itself of some of its ownership shares in various industries, including cement, telecommunications, mining, energy, pharmaceuticals, construction, highways, steel, manufacturing, airlines, and banks. An SOE monopoly on the importation of alcoholic beverages was terminated in 2010 (WTO, 2013).

Input trade liberalisation has contributed partially to poverty reduction in Indonesia by increasing the incomes of the poorest segment of the population. The effects of tariff liberalisation and increased competition in the regional output markets tended to increase poverty, while tariff reductions for inputs led to poverty reductions. This shows that the effects propagated through input markets could also be relevant role for a short-term analysis of the poverty effects of trade liberalisation. The driving mechanism behind these effects seems to be increasing firm competitiveness as a direct result of reductions in import tariffs on intermediate goods, which induced increased work participation for low- and medium-skilled labour as well as wage increases for medium-skilled labour (Kis-Katos and Sparrow, 2015).

Concept of Food Estate in Indonesia

The Merauke Integrated Food and Energy Estate (MIFEE) programme in West Papua, Indonesia was initiated in 2007 based on the Merauke district proposal on Merauke Integrated Rice Estate. The proposal was made a national programme because of the vast land potential. At its launch on 10 August 2010, Merauke had reserved 1.2 million hectares (ha) of 2.4 million ha of development land. The commodities to be produced under the MIFEE programme are rice, corn, soybeans, sugarcane, and cattle. The programme yielded high levels of crop productivity: 7 tons/ha for rice, 2 tons/ha for soybeans, 40 tons/ha for sugarcane, and 5 tons/ha for dried beans. The national government set up a grand design for large-scale food and energy development, and total investment in the MIFEE programme reached Rp50–60 trillion during 2011–2014. After 2014, production was targeted to reach 2 million tons of rice and maize, 0.2 million tons of soybeans, 2.5 million tons of sugarcane, and 64,000 tons of beef per year. The programme is making a real contribution to improving national food security. Its basic concept is the integration of agribusiness sectors and sub-sectors by using resources optimally and sustainably, supported by institutional and human capacity and environmentally friendly technology. Food estate is directed at a strongly rooted agribusiness system in rural areas based on the empowerment of local communities. Government policies regarding the development of food estate include the licensing of food crop cultivation, livestock, and plantation; strategic environmental studies; maximum foreign capital participation of 49%, business actors' legal entities; and ease of doing business for foreign investors. The scale of the food estate business is limited to a maximum of 20,000 ha per investor (Syaukat, 2010; Indonesia Agency for Agricultural Research and Development (IAARD), 2010; Santosa, 2014). The total population of Merauke is 175,000 people. Food estate development sites are located in the districts of Merauke, Semangga, and Tanah Miring to produce upland rice and maize; Malind, Kurik, and Animha districts are selected to produce sugarcane, beef, corn, and soybeans; and Likable and Jagebob districts for corn, soy, and livestock (IAARD, 2010).

4.2.3 Viet Nam

Viet Nam is an economy in transition, so policymaking is largely ministry-specific and unfocused. An excessive number of policy objectives exist for each policy instrument, many policy instruments are changed frequently for fine-tuning purposes, the language of legal documents remains unclear, and not all legal documents are systematically collected and published (McCarty, 1999).

Viet Nam's trade and investment policies can be characterised as 'export-led protectionism', whereby import substitution is encouraged through trade promotion and export industries are promoted by providing subsidies to countervail the high relative costs of intermediary products. Administrative rigidities and delays in the customs administration have continued to remain important non-tariff barriers. Rigidities and delays in customs procedures have given rise to the widespread use of unofficial customs fees, which are widely held to hurt private firms disproportionately by raising opportunity costs and making customs transactions more time-consuming and cumbersome (Thang, 2004).

Highly strict sanitary concerns also act as a non-tariff barrier. For instance, the European Union (EU) has adopted a policy of 'zero tolerance' for fishery products containing residue of the chloramphenicol antibiotic. The standards have been so strict that they have led to a radical reduction in shrimp exports to the EU from Viet Nam, affecting the livelihoods of thousands of rural exporters. The absence of strict food safety guidelines in exporting countries means that the standards of the richest importing markets – such as the EU, the United States, and Japan – are applied to imports from these countries (Tuan, 2003).

Viet Nam's non-tariff barriers may be summarised as follows: (i) para-tariff measures – customs surcharges, additional taxes, and charges; special sales tax; value-added tax; and decreed customs valuations; (ii) price control measures – administrative pricing of import prices (minimum export prices); (iii) anti-dumping measures (currently being contemplated); (iv) countervailing measures (currently being contemplated); (v) finance measures – advance payment requirements and restrictive official foreign exchange allocation surrender requirements; (vi) quantity control measures – non-automatic licensing, quotas (global quotas, seasonal quotas as rice exports, and quotas linked to local production capacity as 'strategic products'), export prohibitions, and restraint arrangements (export restraint arrangements on textiles outside the multifibre arrangement (MFA), mostly from the EU); (vii) enterprise-specific restrictions; (viii) monopolistic measures – a single or limited number of channels for imports; (ix) technical measures – technical regulations, customs formalities, special formalities (stamping), and customs efficiency corruption; and (x) others such as export-related measures and distribution restrictions (McCarty, 1999; Vo, Nguyen, and Tran, 2016).

4.3 Natural Disasters and Trade

4.3.1 Introduction

A disaster can be defined as a serious disruption in the functioning of a community or society causing widespread material, economic, social, or environmental losses which surpass the ability of the affected society to cope with using its own resources (Dayton-Johnson, 2006). A disaster is the consequence of a combination of hazard, vulnerability, and insufficient measures to lessen the potential likelihood of risk.

Different types of natural disasters include geophysical, meteorological, hydrological, climatological, and biological disasters (Guha-Sapir et al., 2010). Geophysical natural disasters originate from solid earth (e.g. earthquakes, volcanos, and mass movements). Meteorological natural disasters are the result of events caused by short-lived/small to meso scale atmospheric processes (e.g. storms). Hydrological natural disasters are a result of deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up (floods, mass movements (wet)). Climatological natural disasters are caused by long-lived/meso to macro scale processes (in the spectrum from intra-seasonal to multi-decadal climate variability) (Guha-Sapir et al., 2010), e.g. extreme temperatures, droughts, and wildfires. Biological disasters are caused by the exposure of living organisms to germs and toxic substances (e.g. epidemics, insect infestations, and animal stampedes).

A rise in climatic disasters can reduce or increase trade. Beginning with channels reducing trade, disasters can destroy human and physical capital (e.g. kill people; destroy plants; and damage storage, transportation, energy, and communications infrastructure). As a result of the fall in production, income may decline, which reduces private spending and investments, and tax revenues may decline, which reduces public spending. The decline in aggregate demand and supply may reduce trade flows since domestic importers and exporters may not be able to absorb or produce the pre-disaster levels. Second, disasters may increase the cost of trade. For example, traders may need to use longer routes or other ports and airports to reach markets, increasing the costs of distribution and transportation. Insurance premiums may rise, as insurers seek to cover the increased risk. Disasters may also lead to new regulations, requiring goods to be less vulnerable to disasters through design changes or sturdier packaging. As a result, production and distribution technologies may require redesign, which increases costs. A rise in costs may raise the price of goods, causing a decrease in the total quantity demanded. Third, economic activity is partly driven by waves of optimism. Disasters can exhaust people and reduce their willingness to engage in normal economic activities such as consumption, production, and investment. Since disasters destroy sources of livelihood and homes, people may not be able to pay for goods. As a result, trade markets may collapse. In this vein, the Organisation for Economic Co-operation and Development (OECD, 2004) suggests that governments should focus on restoring confidence in the aftermath of disasters so that economic agents resume their normal routines. Consider next the possibility that disasters promote trade. First, a country hit by a disaster may lose production capacity. Other nations may enter the local market, motivated by humanitarian or other reasons (e.g. to increase market share or influence leaders). In doing so, they may grant aid or reduce their export prices, enabling their partners to buy more of their exports. Second, countries hit by disasters may choose policies aimed at increasing their bilateral trade flows. For example, the reconstruction efforts of damaged infrastructure in the affected countries may rely on imports of materials, technology, and skills. External aid may intensify this effect by providing foreign currency. Seeking to rebuild areas hit by a disaster, the government may increase exports to gain foreign currency. Seeking to intensify these effects, the government may also liberalise its export and import markets, which will likely further promote its trade flows. Third, the price of traded goods may rise as the result of a climatic disaster, as traders may seek to cover the higher costs and risks associated with doing business in this case. The quantity of traded goods may decrease because of a disaster. If the price increase is larger than the decrease in the quantity, the trade value will rise. Finally, whereas risk-averse traders are likely to exit markets hit by a disaster, risk-loving traders or speculators may view the situation as an opportunity to make super-normal profits. If the number of speculators and traders entering a market hit by a climatic disaster is larger than the number of traders exiting the market, the value of the bilateral trade may rise (Oh and Reuveny, 2010).

Trade concessions to disaster-hit countries may facilitate their recovery and be conducive to long-term growth, for several reasons. First, trade concessions may mitigate macroeconomic uncertainty in the aftermath of natural disasters, which have been shown to impede growth. The research finds that indirect effects from increased uncertainty after natural disasters hinder growth as much as the direct first effects of natural disasters. A promise or prospect of trade concessions in the near future could be helpful in mitigating post-disaster uncertainty (Baker and Bloom, 2013; Cheong, Won Kwak, and Yuan, 2017; Benali, Abdelkafi, and Feki, 2016; Marin and Modica, 2017). Natural disasters adversely affect foreign direct investment to countries (Anuchitworawong and Thampanishvong, 2015).

4.3.2 Disaster and Trade in Asia

Earthquakes and floods are the natural hazards with the highest potential of impacting small and medium-sized enterprises (SMEs) in Asia (Asian Disaster Reduction Center, 2011). The cases of the East Japan earthquake of 2011 and the Thai floods of 2011 are examples. SMEs in both economies are in a dominant positioning, comprising more than 99% of all enterprises. The impact was not restricted to the region but had a far-reaching impact globally. The two countries have taken up various good practices since the disasters. This learning is used to identify critical areas of action that support building the resilience of SMEs (Chatterjee, Ismail, and Shaw, 2016; Ye and Abe, 2012).

Noy and Vu (2010) revealed that disasters tend to lower output for Viet Nam, but costlier disasters appear to boost the economy in the short run. This is because of the degree of access to reconstruction funds from both the private sector and the central government, where richer and less remote regions exhibit faster growth following a disaster.

Countries with higher literacy rates, better institutions, higher per capita incomes, larger governments, and a higher degree of openness to trade appear to be better able to withstand the initial disaster shock and prevent its effects spilling deeper into the macroeconomy. Financial conditions also seem to matter. Countries with less open capital accounts, more foreign exchange reserves, and higher levels of domestic credit appear more robust and able to endure natural disasters with less spillover to GDP growth rates (Noy, 2009).

The less democratic and the smaller a country, the more its trade flows reduced when struck by a disaster. We are also able to distinguish between the effect of a disaster on an importing country and an exporting country. The impact of a large disaster on international trade can be transmitted either directly or indirectly. Direct impacts on exports can occur because of human losses and injuries (affecting companies' human resources) and the destruction and damage of physical capital and equipment in the export sector. Damage to public infrastructure, such as roads, bridges, railways, and telecommunication systems, can cause disruption to the export supply chain (Gassebner, Keck, and Teh, 2006).

Using the simple gravity model, da Silva and Cernat (2012) revealed that natural disasters impact negatively on the exports of small developing countries. The negative effects of natural disasters on the export performance of small developing countries last for about 3 years. Small developing countries seem to be at higher risk of having their exports negatively affected by natural disasters. Such countries could be the focus of measures dedicated to reducing their export vulnerability to disasters in the first place or minimising the negative export impact of disasters when they occur.

If an economy has access to international markets, imports surge after a disaster. When capacity is restored, imports decline again, but exports have to rise so that the economy may meet the interim budget constraint. After a natural disaster, the economy should have a higher degree of openness (exports plus imports over GDP) than before. Further, considering the interaction between financial remoteness and natural calamities, we expect the positive effect of disasters on imports to be reduced if a country is less integrated financially (Felbermayr and Gröschl, 2013).

Floods have a negative impact on humans, crops, agricultural inputs, livestock, poultry, fish, and other assets such as land and infrastructure – impacting the socio-economic condition of a country. Most of the damages are irreplaceable, leaving humanity in distress. Floods are recurrent and cannot be avoided, hence preparedness would lessen the impact (Dewan, 2015).

Hayakawa, Matsuura, and Okubo (2015) examined the economic impact of natural disasters at the firm level. They explored the economic impact of the 2011 flooding in Thailand, focusing on the impact of flooding on procurement patterns at Japanese affiliates in Thailand, to examine how natural disasters affect production networks in multinational enterprises. The findings show that (i) small firms are more likely to lower their local procurement share, especially their share of procurement from other Japanese-owned firms in Thailand; (ii) young firms are more likely to increase their share of imports from Japan, whereas old firms are more likely to look to China; and (iii) there is no impact on imports from ASEAN and other countries. These findings are useful for uncovering how multinationals adjust their production networks before and after natural disasters.

4.4 The ASEAN Framework on Free Trade and its Integration into the Sendai Framework and ASEAN Socio-Cultural Community

4.4.1 ASEAN Framework on Free Trade

The ASEAN Free Trade Area (AFTA) is a trade bloc agreement initially signed by six members of ASEAN, encompassing Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, and Thailand on 28 January 1992 in Singapore. The primary goal of the agreement is to increase the region's competitive advantage as a production base in the global market by eliminating tariffs and non-tariff barriers amongst members and attracting more foreign direct investment to the region (ASEAN, 2012).

The ASEAN Trade in Goods Agreement (ATIGA) was signed in February 2009 to replace the AFTA. The ATIGA aims at establishing an integrated single market to achieve the free flow of goods, deepen economic linkages amongst members, reduce business costs, and enhance economies of scale for businesses (ASEAN, 2009a). The ASEAN Economic Community was officially launched in late 2015.

4.4.2 ASEAN Cooperation on Disaster Risk Reduction

Southeast Asia is one of the most disaster-prone regions of the world. It has been exposed to all types of hazards, including typhoons, earthquakes, tsunamis, floods, volcanic eruptions, landslides, forest fires, and droughts. These disasters have caused severe sociocultural and economic impacts to the region (ASEAN, 2009b).

Anbumozhi (2017) developed an integrated approach and cooperative model for a sustainable and resilient ASEAN for scaling up activities to achieve resiliency and sustainability. The power of finance and public–private partnerships to drive change, where technological innovations and integrated policies and programmes are being adopted and scaled up as a result of policy innovations, are critical. Given the complexity of numerous challenges, three forms of cooperation between ASEAN and the international community could be valuable through an effective information system, capacity building, and innovative financing (Anbumozhi, 2017).

4.4.3 The Sendai Framework for Disaster Risk Reduction

The Sendai Framework relates to the risk of small- and large-scale, frequent and infrequent, sudden and slow-onset disasters, caused by natural or man-made hazards as well as related environmental, technological, and biological hazards and risks. It aims to guide the multi-hazard management of disaster risk in development at all levels as well as within and across all sectors. The expected outcome is the substantial reduction of disaster risk and losses in lives, livelihoods, and health and in the economic, physical, social, cultural, and environmental assets of persons, businesses, communities, and countries. The framework aims to prevent new and reduce existing disaster risks through the implementation of integrated and inclusive economic, structural, legal, social, health, cultural, educational, environmental, technological, political, and institutional measures that prevent and reduce hazard exposure and vulnerability to disaster, increase preparedness for response and recovery, and thus strengthen resilience. The framework specified seven targets: (i) reduce global disaster mortality, (ii) reduce the number of affected people, (iii) reduce direct disaster economic loss in relation to global GDP, (iv) reduce disaster damage to critical infrastructure and disruption of basic services (health and educational facilities), (v) increase the number of countries with national and local disaster risk reduction strategies, (vi) enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this framework and (vii) increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments. It also specified four priorities for action to prevent new and reduce existing disaster risk: (i) understanding disaster risk, (ii) strengthening disaster risk governance to manage disaster risk, (iii) investing in disaster reduction for resilience, and (iv) enhancing disaster preparedness for an effective response and to 'Build Back Better' in recovery, rehabilitation, and reconstruction (United Nations Office for Disaster Risk Reduction, 2015).

4.5 Methodology

4.5.1 Data

This study used annual data over 1980–2013 for the disaster and trade investigation and annual data over 1990–2013 for the disaster food security analysis. The data on disasters were obtained from the International Disaster Database (EM-DAT); and the following data set was obtained from the Food and Agriculture Organization of the United Nations Statistics Division (FAOSTAT): gross domestic, exchange rate, population, inflation rate, production, import quantities, export quantities, and food security indicators.

4.5.2 The Gravity Model of International Trade

The gravity model was used to explain the relationship of trade activities between countries. The key assumption of the gravity model in relation to trade is that the volume of trade between any two trading partners is an increasing function of their national incomes and a decreasing function of the distance between them (Head and Mayer, 2013). The gravity model has its genesis in Newton's law of universal gravitation (Anderson, 2016):

$$F_{ij} = \frac{G * MM_{ij}}{D_{ij}} \quad (1)$$

Where F_{ij} is the attractive force, M_i and M_j are the masses, D_{ij} is the distance between the two objects, and G is a gravitational constant (Kuratani, 2004; Head, 2003). Numerous studies have applied the gravity model (e.g. Antonucci and Manzocchi, 2006; Lewer and Van den Berg, 2008; Chakravarty and Chakrabarty, 2014; Hatab, Romstad, and Huo, 2010; Bruno and Improta, 2008; Filippini and Molini, 2003; Sartori et al., 2016; Avorgbedor, 2016). The gravity model is applied in this paper to examine the effect of disasters on the international trade of agricultural products. The augmented gravity equations employed in this study are expressed as follows:

$$EQ_t = \alpha_0 + \alpha_1 EXR_t + \alpha_2 DV_t + \alpha_3 GDP_t + \alpha_4 I_t + \alpha_5 P_t + \alpha_6 Q_t \quad (2)$$

$$IQ_t = \rho_0 + \rho_1 EXR_t + \rho_2 DV_t + \rho_3 GDP_t + \rho_4 I_t + \rho_5 P_t + \rho_6 Q_t \quad (3)$$

Where EQ_t and IQ_t denote export quantity and import quantity, respectively; EXR_t, DV_t, GDP_t, I_t, P_t, and Q_t denote exchange rate, disaster variable, GDP, inflation, population, and quantity produced, respectively; and α_i and ρ_i are parameters to be estimated. Numerous studies have revealed that these variables influence the international trade of products amongst nations (e.g. Avorgbedor, 2016). International trade (exports and imports) of four food security commodities (i.e. rice, cassava, potato, and banana) were examined in this study for each of the three countries (Thailand, Indonesia, and Viet Nam) where appropriate.

4.5.3 Disaster and Food Security Analysis

The disaster and food security analysis was also performed using regression models. Here, this study investigates the effects of floods, storms, and earthquake on food security indicators for each of the countries: Thailand, Indonesia, and Viet Nam. The regression model for the effect of disasters on food security is generally expressed as:

$$FS_{i,t} = \beta_0 + \beta_i\, DV_{i,t} + \delta_i Q_{i,t} \quad (4)$$

Where $FS_{i,t}$ denotes the food security indicator over time; $DV_{i,t}$ denotes the relevant disaster variables for a specific country over time; and $Q_{i,t}$ denotes the quantity of production of specific food security crops over time. This study assessed the effects of disasters on food security along the following four dimensions: *availability, access, stability, and utilisation*. The indicators of *availability* used are the average dietary energy supply adequacy; the average value of food production; the share of dietary energy supply derived from cereals, roots, and tubers; and the protein supply. The indicators of *access* are the number of people undernourished; the prevalence of undernourishment; the depth of the food deficit; and the prevalence of food inadequacy. The indicators of *stability* are the cereal import dependency ratio; the political stability and absence of violence/terrorism; per capita food production variability; and per capita food supply variability. The indicators of *utilisation* are the prevalence of anaemia amongst 5-year old children and pregnant women.

4.5.4 Econometric Considerations

The data sets were examined for stationarity. For each data set analysed in this study, the series were not stationary at the same order of integration. Thus, some series were stationary at levels while others were integrated at order one, [I(1)], and other time series were stationary at level two, [I(2)]. The time series observations of the disaster variables of particular interest in this study are dummy variables. Therefore, the application of cointegration analysis and the vector error correction model would not be appropriate in this case, as the vector error correction model presents the results in first differences, and using the first differences of dummy variables would generate zeros, hence the overall coefficients would not make much sense. The use of the autoregressive distributed lag model would not be appropriate either, as some of the time series in each set of analysis are integrated at the level two, [I(2)].[3] As a consequence, this study employed an augmented version of Box-Jenkins time series methodology for the analysis by differencing each of the series to be stationary for a specific estimation and applying the relevant autoregressive terms to the regression as appropriate, without differencing the disaster variables as they are dummy and would yield zeros after differencing.

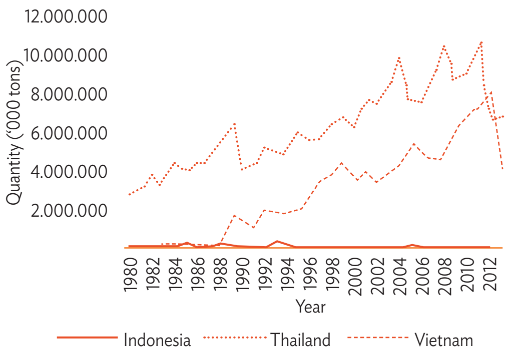
4.6 Overview of Trends in International Trade in Selected Agricultural Products and Food Security Indicators in Thailand, Indonesia, and Viet Nam

4.6.1 Trends in International Trade in Selected Agricultural Products

Thailand and Viet Nam's rice exports show increasing trends over the years, whereas those of Indonesia were minimal and stable over 1980–2013 (Figure 4.1). Indonesia's banana export quantity was stable over 1980–1992 before surging to a peak during 1993–2000, then decreasing in 2001 and remaining at that level until 2013. Thailand and Viet Nam's banana exports were stable over 1980–2001, exhibiting a positive trend thereafter, with some fluctuations in 2003, 2005, and 2012 (Figure 4.2).

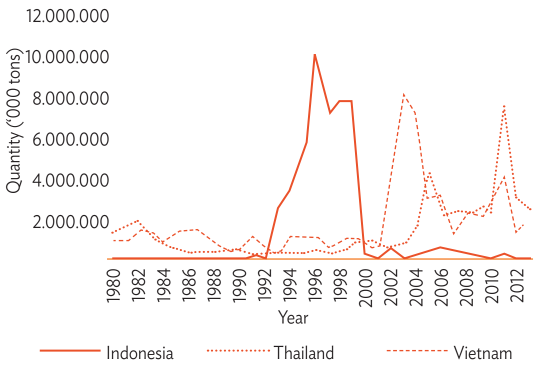
[3] For the autoregressive distributed lag modelling, the data sets have to be I(0) or I(1) or a mixture of these two.

Figure 4.1: Export Quantities of Rice from Indonesia, Thailand, and Viet Nam



Source: Author, 2017.

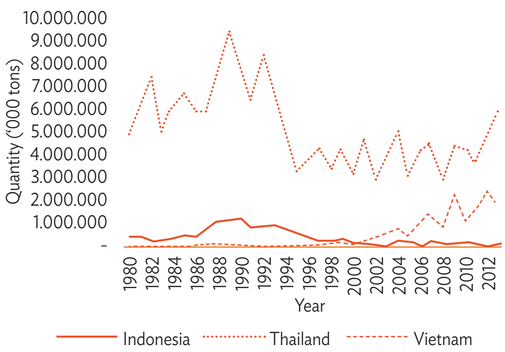
Figure 4.2: Export Quantities of Banana from Indonesia, Thailand, and Viet Nam



Source: Author, 2017.

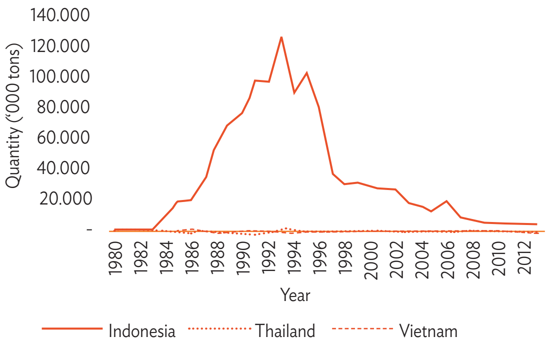
Thailand shows a steady increase in the quantity of cassava exported, although exports fell over 1992–1995 before showing a positive trend thereafter. Indonesia and Viet Nam exported lesser than Thailand (Figure 4.3). In terms of exporting potato, Indonesia increased its export in the 1980s up to 1992 and reached the peak in the 1993. However, start from 1995, the export decreased drastically and continued to decline until the period of 2000. Thailand and Viet Nam exported less than Indonesia in the period 1980–2012. (Figure 4.4).

Figure 4.3: Export Quantities of Cassava from Indonesia, Thailand, and Viet Nam



Source: Author, 2017.

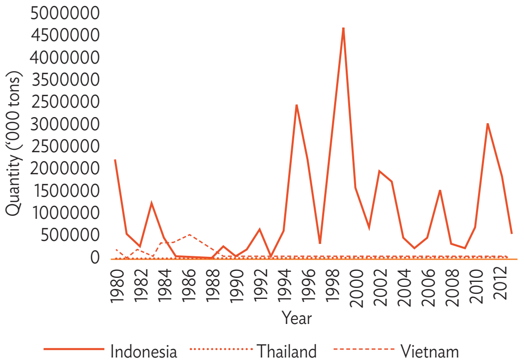
Figure 4.4: Export Quantities of Potato from Indonesia, Thailand, and Viet Nam



Source: Author, 2017.

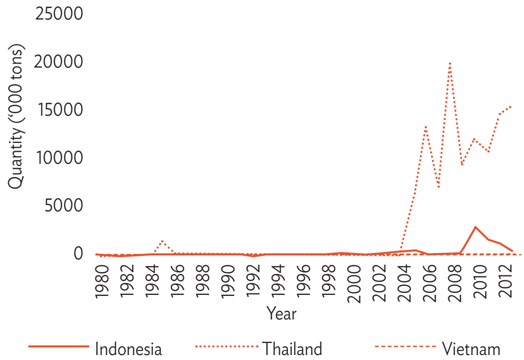
The quantity of rice imports fluctuated, peaking in Indonesia in 1999. Thailand had zero imports of rice from 1980 to 1994 and imported small quantities from 1995 onwards. Viet Nam also imported small quantities of rice, fluctuating from year to year (Figure 4.5). Thailand had zero banana imports over 1980–2002, increasing with some fluctuations after 2004. Indonesia had zero imports from 1980 to 1993 and some imports thereafter. Viet Nam did not import bananas over 1980–2013 (Figure 4.6).

Figure 4.5: Import Quantities of Rice by Indonesia, Thailand, and Viet Nam



Source: Author, 2017.

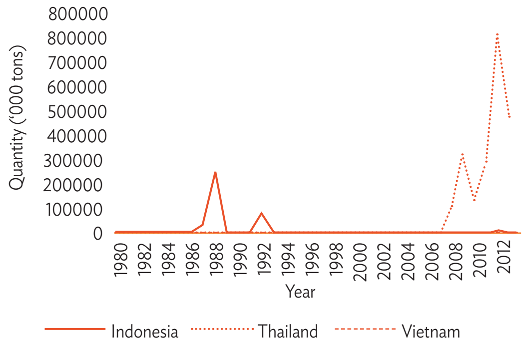
Figure 4.6: Import Quantities of Banana by Indonesia, Thailand, and Viet Nam



Source: Author, 2017.

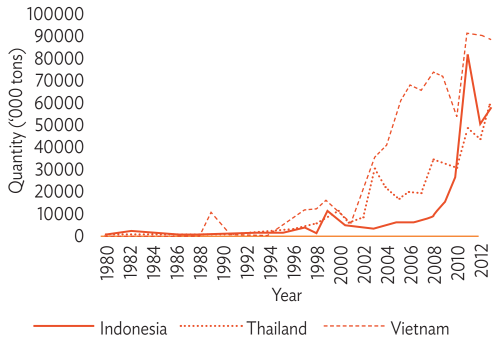
Thailand had no cassava imports from 1980 to 2001 and imported small quantities during 2003–2013. Indonesia imported some cassava, with peaks in 1988, 1992, and 2012. Viet Nam had zero cassava imports during 1980–2013 (Figure 4.7). Potato imports for the three countries showed an increasing trend over the period (Figure 4.8).

Figure 4.7: Import Quantities of Cassava by Indonesia, Thailand, and Viet Nam



Source: Author, 2017.

Figure 4.8: Import Quantities of Potato by Indonesia, Thailand, and Viet Nam

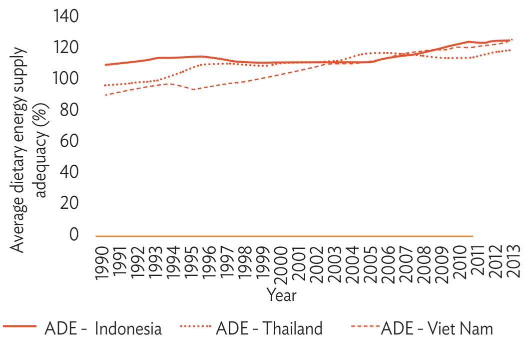


Source: Author, 2017.

4.6.2 Food Security Indicators

The average dietary energy supply adequacy (3-year average percentage) and the average value of food production in Indonesia, Thailand, and Viet Nam showed increasing trends (Figures 4.9 and 4.10). The share of dietary energy supply derived from cereals, roots, and tubers (3-year average percentage) in Indonesia, Thailand, and Viet Nam decreased over 1990–2013 (Figure 4.11). The average protein supply (3-year average grams/capita/day) in Indonesia, Thailand, and Viet Nam showed increasing trends (Figure 4.12) over the period of study.

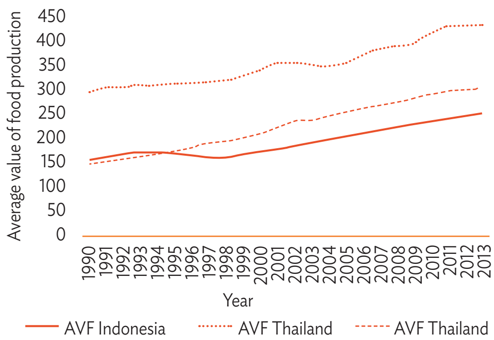
Figure 4.9: Average Dietary Energy Supply Adequacy (3-year average) in Indonesia, Thailand, and Viet Nam
(%)



ADE = average dietary energy.

Source: Author, 2017.

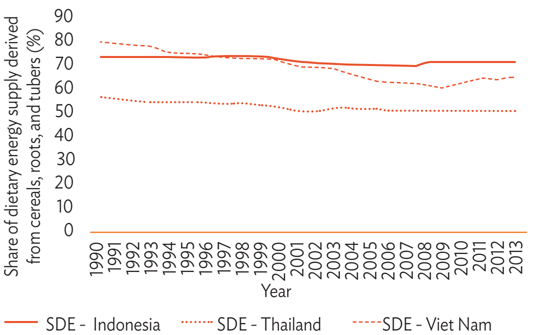
Figure 4.10: Average Value of Food Production (3-year average) in Indonesia, Thailand, and Viet Nam
(constant I$ per person)



AVF = average value of food.

Source: Author, 2017.

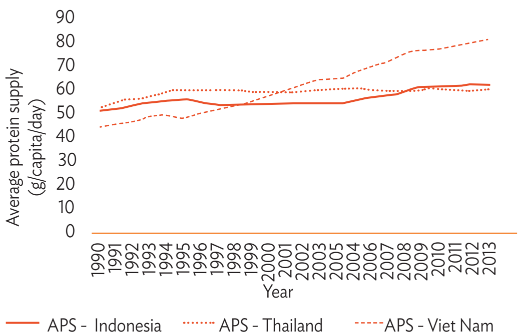
Figure 4.11: Share of Dietary Energy Supply Derived from Cereals, Roots, and Tubers (3-year average) in Indonesia, Thailand, and Viet Nam
(%)



SDE = share of dietary energy.

Source: Author, 2017.

Figure 4.12: Average Protein Supply (3-year average) in Indonesia, Thailand, and Viet Nam
(g/capita/day)

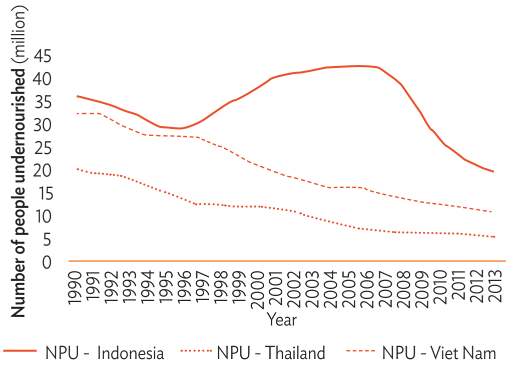


APS = average protein supply, g/capita/day = gram/capita/day.

Source: Author, 2017.

The following food security indicators – number of people undernourished; prevalence of undernourishment; depth of the food deficit; and prevalence of food inadequacy in Indonesia, Thailand, and Viet Nam – showed decreasing trends (Figures 4.13, 4.14, 4.15, and 4.16).

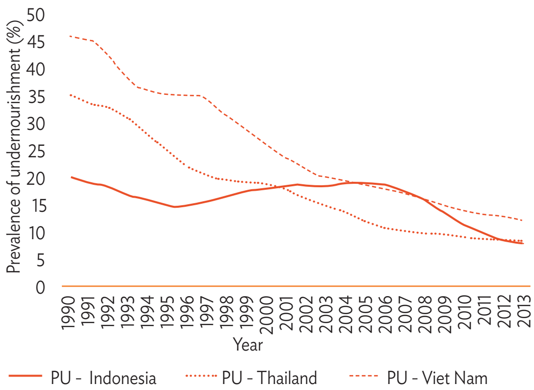
Figure 4.13: Number of People Undernourished (3-year average) in Indonesia, Thailand, and Viet Nam (million)



NPU = number of people undernourished.

Source: Author, 2017.

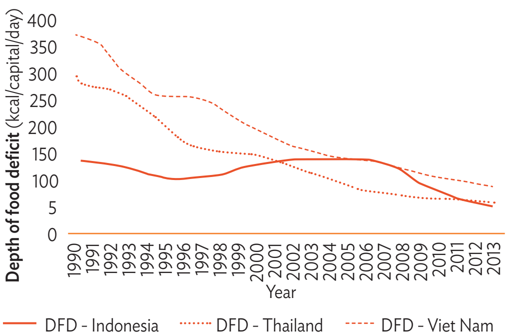
Figure 4.14: Prevalence of Undernourishment (3-year average) in Indonesia, Thailand, and Viet Nam (%)



PU = prevalence of undernourishment.

Source: Author, 2017.

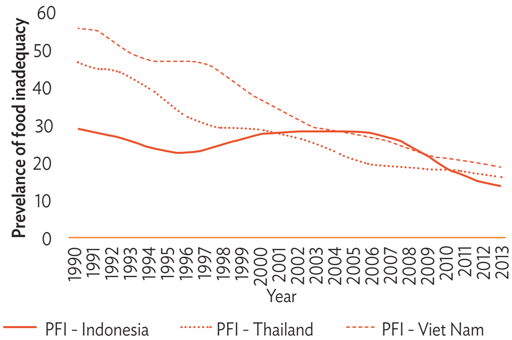
Figure 4.15: Depth of the Food Deficit (3-year average) in Indonesia, Thailand, and Viet Nam (kcal/capita/day)



DFD = depth of food deficit, kcal = kilocalorie.

Source: Author, 2017.

Figure 4.16: Prevalence of Food Inadequacy in Indonesia, Thailand, and Viet Nam (%)

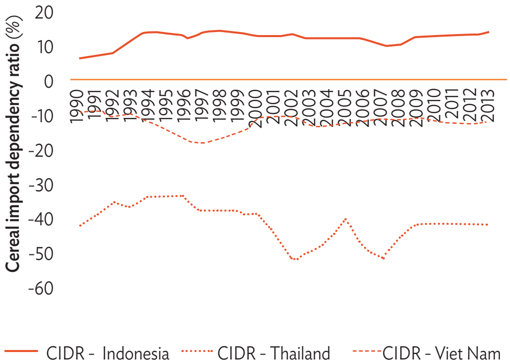


PFI = prevalence of food inadequacy.

Source: Author, 2017.

Figure 4.17 shows that Indonesia largely depended on cereal imports until 2013, whereas Thailand and Viet Nam did not. Amongst the three countries, per capita food production variability is highest in Thailand, followed by Indonesia and then Viet Nam (Figure 4.18). Nevertheless, the per capita food supply variability showed decreasing trends over the years for the three countries (Figure 4.19). In general, the prevalence of anaemia amongst 5-year old children and pregnant women decreased over 1990–2013. It is worth noting that the prevalence of anaemia amongst 5-year old children and pregnant women is highest in Indonesia, followed by Viet Nam and then Thailand. However, during 2011–2013, the prevalence of anaemia amongst pregnant women was at the same level for Indonesia and Thailand, with lower levels of prevalence in Viet Nam (Figures 4.20 and 4.21).

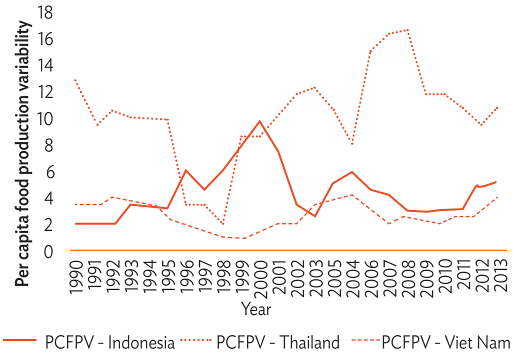
Figure 4.17: Cereal Import Dependency Ratio (3-year average) in Indonesia, Thailand, and Viet Nam (%)



CIDR = cereal import dependency ratio.

Source: Author, 2017.

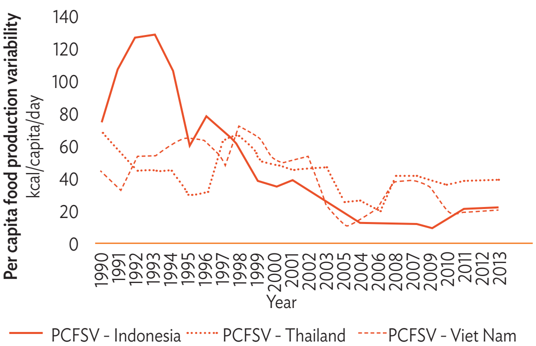
Figure 4.18: Per Capita Food Production Variability in Indonesia, Thailand, and Viet Nam (constant I$ per person, 2004-2006)



PCFPV = per capita food production variability.

Source: Author, 2017.

Figure 4.19: Per Capita Food Supply Variability in Indonesia, Thailand, and Viet Nam (kcal/capita/day)

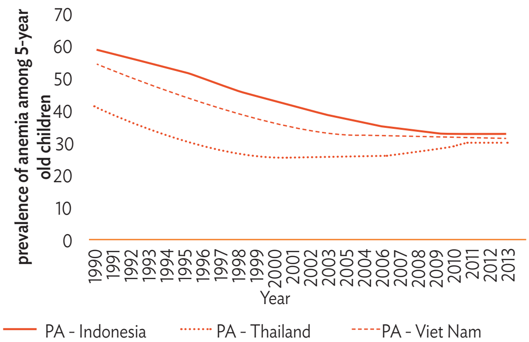


kcal = kilocalorie,

PCFSV = per capita food supply variability.

Source: Author, 2017.

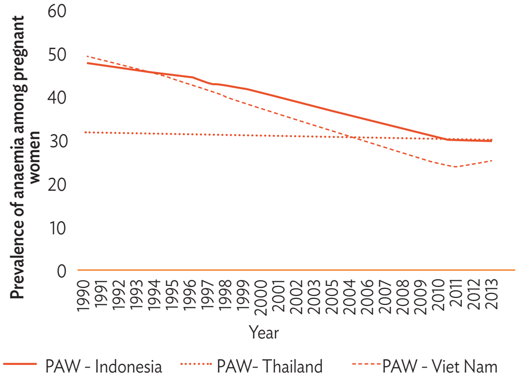
Figure 4.20: Prevalence of Anaemia amongst 5-years old Children in Indonesia, Thailand, and Viet Nam



PCFPV = per capita food production variability.

Source: Author, 2017.

Figure 4.21: Prevalence of Anaemia amongst Pregnant Women in Indonesia, Thailand, and Viet Nam



PAW = prevalence of anaemia amongst pregnant women.

Source: Author, 2017.

4.7 Conclusions and Recommendations

This study assessed the effect of disasters on the international trade of agricultural products and food security in Thailand, Indonesia, and Viet Nam. It employed the gravity model and the Box-Jenkins times methodology, using time series data that spanned 1980–2013 for the disaster-trade investigation and data from 1980 to 2013 for the analysis of the relationship between disasters and food security.

The empirical results regarding the disaster–international trade investigation revealed that floods negatively influenced Thailand’s rice exports, with and without trade restrictions, and Indonesia’s cassava exports. However, the disaster variables had no significant influence on Viet Nam’s international trade in agricultural products.

The disaster–food security analysis revealed that floods positively influenced the average dietary energy supply adequacy in Thailand. Storms negatively affected the number of people undernourished, the prevalence of undernourishment, the depth of the food deficit, and the prevalence of food inadequacy in Thailand. These results are contrary to expectations, but can be explained by food supplies from national and international organisations to areas affected by floods and storms, which increased dietary energy supplies, decreasing the number of people undernourished, the prevalence of undernourishment, the depth of the food deficit, and the prevalence of food inadequacy, at least in the short run. Storms negatively influenced the value of food imports over total merchandise exports in Thailand. This could imply that individuals, especially the poor, benefit from food donations from national, international, and non-governmental organisations in the event of floods. This decreases the overall food import quantity, thereby reducing the value of imports compared with exports. Storms negatively influenced the prevalence of anaemia amongst pregnant women in Thailand. This may imply that pregnant women are given priority in food distribution after a storm. For Indonesia, earthquakes negatively influenced political stability and the absence of violence/terrorism (an indicator of food stability) in Indonesia. Thus, potential political instability and violence resulting from the occurrence of earthquakes threatens food stability. Floods positively influenced the average value of food production (i.e. an indicator of food availability) in Indonesia. This could imply that floods destroy crops such that the harvested crops reduce to lower than expected levels. The lower output, with a given level of demand, would trigger price increases to relatively high levels, thereby increasing the value of food production. Furthermore, it is possible that the value of food exports would increase after a disaster, even with lower quantities, because of higher market prices. For Viet Nam, floods positively influenced per capita food supply variability.

These results have policy implications for the governments of these economies. Floods adversely affect Thailand's rice exports and Indonesia's cassava exports. Governments and related organisations should adopt strategies to minimise the impact of floods on the production and international trade of agricultural products, especially rice in Thailand and cassava in Indonesia. The Government of Viet Nam should put in place strategies to minimise the effect of floods and improve the food security situation in the country, as floods increase the per capita food supply variability. Furthermore, adequate preparation by the governments of these countries is imperative for recovery after natural disasters such as floods and storms. The role of non-governmental and international organisations is critical for swift recovery from these natural disasters. Such recovery comes in the form of the provision of new settlements, food, and clothing for people affected by the disasters, but this assistance should be coordinated and delivered in a timely manner to achieve the desired objectives. Disaster risk awareness campaigns, training exercises, and propagating self-sustainability sustainability through insurance are also steps in the right direction. The proactive roles of the ASEAN Socio-Cultural Community, ASEAN Economic Community, and ASEAN Political-Security Community regarding disaster management – to reduce losses and facilitate recovery from natural disasters at the regional and international levels in Southeast Asia – are critical. Finally, the global disaster risk reduction commitments and the Sendai Framework should be strengthened and promoted amongst these countries.

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Appendix

1 Empirical Results and Discussions

A Trade and Disaster

i *Thailand*

Floods negatively influenced Thailand 's rice exports, with and without trade restrictions ($p<0.01$), as shown in Tables 4.1 and 4.2. This means that floods decreased Thailand's rice exports, with and without trade restrictions. Floods cause the destruction of rice farms, which negatively impacts production, leading to lower export quantities. Storms negatively influenced Thailand's cassava and potato exports, but not significantly (Tables 4.3 and 4.4). Storms lead to the destruction of cassava and potato farms, which negatively impacts production, leading to lower exports of these commodities. Storms also negatively influenced Thailand's potato imports, but not significantly (Table 4.5).

Table 4.1: Effect of Storms and Floods on Thailand's Rice Exports, without Trade Restrictions

Variable	Coefficient	Std. error	*P*-value
Constant	-107,628.4	181,235.4	0.5587
Exchange rate	-23,759.40	281,474.1	0.9335
Storm	405,161.8	475,402.0	0.4033
Flood	**-1,206,194**	**615,323.2**	**0.0628**
Gross dome stic product	21.55342	39.64721	0.5922
Inflation rate	5,650,155	15,136,103	0.7125
Population	-1.172721	2.795566	0.6789
Quantity of production	0.291442	0.173836	0.1078
AR(1)	-0.775642	0.156172	0.0001

Regression diagnostics			
R-squared	0.552568	Mean dependent var	-21620.26
Adjusted R-squared	0.389866	S.D. dependent var	2125291.
S.E. of regression	1660088.	Akaike info criterion	31.72034
Sum squared resid	6.06E+13	Schwarz criterion	32.13666
Log likelihood	-482.6653	Hannan-Quinn criter.	31.85605
F-statistic	3.396190	Durbin-Watson stat	2.519482
Prob (F-statistic)	0.010860		

Source: Author, 2017.

Table 4.2: Effect of Storms and Floods on Thailand's Rice Exports, with Trade Restrictions*

Variable	Coefficient	Std. error	*P*-value
Constant	-117,684.9	201,976.6	0.5663
Exchange rate	-5,219.401	323,157.3	0.9873
Storm	419,965.5	503,025.0	0.4132
Flood	**-1,198,986**	**632,243.3**	**0.0717**
Gross domestic product	23.93072	44.62322	0.5974
Inflation	4,252,730	19,344,339	0.8281
Population	-1.189077	2.862165	0.6820
Quantity of production	0.293660	0.179155	0.1161
Restriction	81,102.07	652,491.9	0.9023
AR(1)	-0.776320	0.162913	0.0001
Regression diagnostics			
R-squared	0.552906	Mean dependent var	-21620.26
Adjusted R-squared	0.361294	S.D. dependent var	2125291.
S.E. of regression	1698513.	Akaike info criterion	31.78410
Sum squared resid	6.06E+13	Schwarz criterion	32.24668
Log likelihood	-482.6536	Hannan-Quinn criter.	31.93489
F-statistic	2.885551	Durbin-Watson stat	2.515075
Prob(F-statistic)	0.021785		

* During 1980–1985, the following restrictions were placed on rice exports from Thailand: (i) export premium (i.e. private traders pay premium for obtaining export licenses); (ii) export duty (i.e. rice exporters were levied by a 5% ad valorem export duty; and (iii) rice reserve requirement (see Xie and Napasintuwong, 2014).

Source: Author, 2017.

Table 4.3: Effects of Floods and Storms on Thailand's Cassava Exports

Variable	Coefficient	Std. error	*P*-value
Constant	-65,7456.9	745,629.2	0.3874
Exchange rate	62,8012.1	221,215.4	0.0096
Storm	-23,5028.0	446,060.5	0.6035
Flood	99,8481.7	765,605.3	0.2057
Gross domestic product	85.70636	34.92394	0.0225
Inflation	-38,722,752	13,645,482	0.0096
Population	2.229179	3.113818	0.4816
Quantity of production	0.158176	0.073806	0.0434
AR(1)	-0.558738	0.185868	0.0065
Regression diagnostics			
R-squared	0.641231	Mean dependent var	-11016.81
Adjusted R-squared	0.510769	S.D. dependent var	2225414.
S.E. of regression	1556567.	Akaike info criterion	31.59156
Sum squared resid	5.33E+13	Schwarz criterion	32.00788
Log likelihood	-480.6692	Hannan-Quinn criter.	31.72727
F-statistic	4.915091	Durbin-Watson stat	2.283075
Prob(F-statistic)	0.001402		

Source: Author, 2017.

Table 4.4: Effects of Floods and Storms on Thailand's Potato Exports

Variable	Coefficient	Std. error	*P*-value
Constant	99.32380	337.0555	0.7710
Exchange rate	67.69273	106.9831	0.5334
Storm	-228.1667	211.8637	0.2932
Flood	15.05800	338.3998	0.9649
Gross domestic product	0.003861	0.016802	0.8204
Inflation	-5,112.568	6,575.148	0.4451
Population	-0.001203	0.001444	0.4135
Quantity of production	0.000606	0.013499	0.9646
AR(1)	-0.638225	0.179399	0.0018

Regression diagnostics			
R-squared	0.419782	Mean dependent var	5.387097
Adjusted R-squared	0.208794	S.D. dependent var	846.0694
S.E. of regression	752.5768	Akaike info criterion	16.32258
Sum squared resid	12460180	Schwarz criterion	16.73890
Log likelihood	-244.0000	Hannan-Quinn criter.	16.45829
F-statistic	1.989600	Durbin-Watson stat	2.426356
Prob(F-statistic)	0.096356		

Source: Author, 2017.

Table 4.5: Effects of Floods and Storms on Thailand's Potato Imports

Variable	Coefficient	Std. error	*P*-value
Constant	9,404.571	6,312.353	0.1498
Exchange rate	-1,475.168	998.2575	0.1530
Storm	2,218.694	1,973.398	0.2725
Flood	-526.5992	2,898.155	0.8574
Gross domestic product	-0.174084	0.156244	0.2767
Inflation	30,610.24	51,177.01	0.5556
Population	-0.007792	0.004269	0.0810
Quantity of production	-0.363931	0.099727	0.0013
AR(1)	-0.303665	0.208624	0.1590
Regression diagnostics			
R-squared	0.518924	Mean dependent var	1833.875
Adjusted R-squared	0.351594	S.D. dependent var	6763.821
S.E. of regression	5446.477	Akaike info criterion	20.27558
Sum squared resid	6.82E+08	Schwarz criterion	20.68782
Log likelihood	-315.4093	Hannan-Quinn criter.	20.41223
F-statistic	3.101191	Durbin-Watson stat	2.222842
Prob(F-statistic)	0.015844		

Source: Author, 2017.

ii *Indonesia*[4]

Floods and earthquakes negatively influenced Indonesia's cassava exports by 5% and 10% levels of significance, respectively (Table 4.6). These natural disasters destroy cassava farms, impacting negatively on production and hence exports. The quantity of cassava production positively influenced cassava exports ($p<0.01$). Floods, storms, and earthquakes negatively influenced Indonesia's potato imports, but not significantly (Table 4.7). This result is contrary to expectations, as these natural disasters are expected to destroy potato farms and lead to low production, thereby necessitating higher amounts of imports.

Table 4.6: Effect of Floods, Storms, and Earthquakes on Indonesia's Cassava Exports

Variable	Coefficient	Std. error	*P*-value
Constant	53,5012.7	219,080.2	0.0235
Exchange rate	-13.10864	46.86082	0.7824
Earthquake	**-191,610.1**	**108,069.4**	**0.0907**
Flood	**-386,595.6**	**168,730.1**	**0.0324**
Storm	197,379.1	94,870.95	0.0499
Gross domestic product	-0.247601	1.037085	0.8136
Inflation	192,151.7	265,727.7	0.4776
Population	0.814643	0.624071	0.2059
Quantity of production	**0.122263**	**0.025336**	**0.0001**
Regression diagnostics			
R-squared	0.609405	Mean dependent var	7992.613
Adjusted R-squared	0.442008	S.D. dependent var	210877.6
S.E. of regression	157523.2	Akaike info criterion	27.02823
Sum squared resid	5.21E+11	Schwarz criterion	27.49081
Log likelihood	-408.9376	Hannan-Quinn criter.	27.17902
F-statistic	3.640466	Durbin-Watson stat	3.209673
Prob(F-statistic)	0.007024		

Source: Author, 2017.

4 The analysis regarding rice imports has not been included for Indonesia, as in recent years the country has become self-sufficient in rice production due to pragmatic policies (including the food estate programme) being implemented by the government.

Table 4.7: Effect of Storms, Floods, and Earthquakes on Indonesia's Potato Imports

Variable	Coefficient	Std. error	*P*-value
Constant	-29,408.16	23,823.97	0.2301
Exchange rate	3.880784	2.395667	0.1195
Earthquake	-1,805.284	5,712.473	0.7550
Storm	-5,349.446	5,380.612	0.3309
Flood	-3,944.378	11,674.94	0.7387
Gross domestic product	0.152697	0.040914	0.0012
Inflation	-11699.40	16,586.33	0.4880
Population	0.010434	0.006905	0.1450
Quantity of production	-0.021173	0.018490	0.2645
Regression diagnostics			
R-squared	0.587061	Mean dependent var	1749.344
Adjusted R-squared	0.418131	S.D. dependent var	11755.95
S.E. of regression	8967.472	Akaike info criterion	21.29090
Sum squared resid	1.77E+09	Schwarz criterion	21.74894
Log likelihood	-330.6544	Hannan-Quinn criter.	21.44273
F-statistic	3.475182	Durbin-Watson stat	1.996104
Prob(F-statistic)	0.008220		

Source: Author, 2017.

iii *Viet Nam*

Storms negatively influenced Viet Nam's cassava exports, but not significantly. Nevertheless, the gross domestic product (GDP) and the quantity of cassava production positively influenced cassava exports ($p<0.05$), as shown in Table 4.8.

Table 4.8: Effects of Floods and Storms on Viet Nam's Cassava Exports

Variable	Coefficient	Std. error	*P*-value
Constant	-73,0422.8	797,627.8	0.3689
Exchange rate	-13.07205	22.12207	0.5601
Storm	-31,353.62	249,453.2	0.9010
Flood	15,515.58	82,807.46	0.8529

Variable	Coefficient	Std. error	*P*-value
Gross domestic product	**9.475686**	**1.714538**	**0.0000**
Inflation	-1,291,194.	1,004,672.	0.2110
Population	0.007687	0.015515	0.6248
Quantity of production	**0.097250**	**0.026457**	**0.0012**
AR(1)	-0.699856	0.178108	0.0006
Regression diagnostics			
R-squared	0.932208	Mean dependent var	468854.2
Adjusted R-squared	0.909611	S.D. dependent var	684958.6
S.E. of regression	205931.0	Akaike info criterion	27.53547
Sum squared resid	1.02E+12	Schwarz criterion	27.94361
Log likelihood	-445.3353	Hannan-Quinn criter.	27.67280
F-statistic	41.25325	Durbin-Watson stat	2.795232
Prob(F-statistic)	0.000000		

Source: Author, 2017.

Floods and storms negatively influenced Viet Nam's potato imports, but not significantly (Table 4.9). GDP positively influenced Viet Nam's potato imports ($p<0.01$). Thus, with an improved economy through higher GDP levels, the country can import more of the required potato for consumption. In addition, higher levels of cassava production increase exports.

Table 4.9: Effect of Floods, Storms, and Earthquakes on Indonesia's Cassava Exports

Variable	Coefficient	Std. error	*P*-value
Constant	-78,313.87	90,120.92	0.3935
Exchange rate	-1.114501	1.999246	0.5824
Storm	-785.4091	7,713.565	0.9197
Flood	-1,674.249	3,898.420	0.6714
Gross domestic product	**0.449080**	**0.118722**	**0.0009**
Inflation	76,759.15	3,6253.53	0.0448
Population	0.001244	0.001541	0.4275
Quantity of production	0.003002	0.029108	0.9187
AR(1)	0.550747	0.186230	0.0069

Regression diagnostics			
R-squared	0.948093	Mean dependent var	25073.82
Adjusted R-squared	0.930790	S.D. dependent var	31512.72
S.E. of regression	8290.273	Akaike info criterion	21.11055
Sum squared resid	1.65E+09	Schwarz criterion	21.51869
Log likelihood	-339.3241	Hannan-Quinn criter.	21.24788
F-statistic	54.79551	Durbin-Watson stat	2.122894
Prob(F-statistic)	0.000000		

Source: Author, 2017.

2 Disaster and Food Security

A Thailand

i *Food Availability*

Floods positively influenced average dietary energy supply adequacy (3-year average percentage) in Thailand ($p<0.05$). This result is not intuitive but can be explained by the food supplies from national and international organisations to areas affected by the floods, which increased people's dietary energy supplies. The quantity of cassava produced also positively influenced the average dietary energy supply adequacy ($p<0.05$) since cassava is a key food security crop in Thailand.

Table 4.10: Average Dietary Energy Supply Adequacy (3-year average) (%)

Variable	Coefficient	Std. error	*P*-value
Constant	-2.903369	1.547583	0.0852
Storm	-0.442857	0.784160	0.5826
Flood	**3.242449**	**1.252613**	**0.0237**
Quantity of banana	-1.94E-06	1.59E-06	0.2459
Quantity of potato	-5.15E-08	8.56E-08	0.5583
Quantity of cassava	**-1.56E-07**	**7.03E-08**	**0.0468**
Quantity of rice produce	-1.04E-07	2.35E-07	0.6647
Population	2.13E-06	1.82E-06	0.2658
AR(2)	0.470239	0.184489	0.0255

Regression diagnostics			
R-squared	0.529369	Mean dependent var	0.857143
Adjusted R-squared	0.215615	S.D. dependent var	1.236354
S.E. of regression	1.094983	Akaike info criterion	3.316882
Sum squared resid	14.38785	Schwarz criterion	3.764534
Log likelihood	-25.82726	Hannan-Quinn criter.	3.414034
F-statistic	1.687212	Durbin-Watson stat	1.611584
Prob(F-statistic)	0.199597		

Source: Author, 2017.

ii *Food Access*

Storms negatively influenced the number of people undernourished in Thailand ($p<0.1$). Floods also negatively influenced the number of people undernourished, but not significantly (Table 4.11). As explained previously, food supplies from national and international organisations to areas affected by these natural disasters decreased the number of people undernourished, at least in the short run.

Table 4.11: Number of People Undernourished (3-year average) in Thailand (million)

Variable	Coefficient	Std. error	*P*-value
Constant	0.022874	0.466916	0.9616
Storm	**-0.617263**	**0.290744**	**0.0508**
Flood	-0.525289	0.405306	0.2146
Quantity of banana produce	-4.81E-07	6.43E-07	0.4668
Quantity of cassava produce	-2.95E-09	3.33E-08	0.9306
Quantity of potato produce	6.70E-08	4.21E-08	0.1319
Quantity of rice produce	1.19E-07	9.82E-08	0.2459
Population	7.59E-08	6.17E-07	0.9038

Regression diagnostics			
R-squared	0.417431	Mean dependent var	-0.630435
Adjusted R-squared	0.145565	S.D. dependent var	0.524348
S.E. of regression	0.484684	Akaike info criterion	1.657571
Sum squared resid	3.523785	Schwarz criterion	2.052525
Log likelihood	-11.06206	Hannan-Quinn criter.	1.756901
F-statistic	1.535430	Durbin-Watson stat	1.154627
Prob(F-statistic)	0.229385		

Source: Author, 2017.

Storms negatively influenced the prevalence of undernourishment ($p<0.05$). Floods also negatively influenced the prevalence of undernourishment, but not significantly (Table 4.12). The explanation is the same as presented previously.

Table 4.12: Prevalence of Undernourishment (3-year average) in Thailand (%)

Variable	Coefficient	Std. error	*P*-value
Constant	0.033859	0.782596	0.9661
Storm	**-1.104271**	**0.487315**	**0.0387**
Flood	-0.866583	0.679333	0.2215
Quantity of banana produce	-1.09E-06	1.08E-06	0.3297
Quantity of cassava produce	6.38E-09	5.59E-08	0.9106
Quantity of potato produce	1.16E-07	7.05E-08	0.1214
Quantity of rice produce	2.22E-07	1.65E-07	0.1971
Population	-9.03E-08	1.03E-06	0.9316
Regression diagnostics			
R-squared	0.474967	Mean dependent var	-1.160870
Adjusted R-squared	0.229952	S.D. dependent var	0.925762
S.E. of regression	0.812378	Akaike info criterion	2.690507
Sum squared resid	9.899376	Schwarz criterion	3.085461
Log likelihood	-22.94083	Hannan-Quinn criter.	2.789837
F-statistic	1.938522	Durbin-Watson stat	0.998970
Prob(F-statistic)	0.133479		

Source: Author, 2017.

Storms negatively influenced the depth of the food deficit in Thailand ($p<0.05$), as shown in Table 4.13. Floods also negatively influenced the depth of the food deficit, but not significantly. As explained previously, this is as a result of food supplies from national and international organisations to areas affected by these natural disasters, which decreased the depth of the food deficit, at least in the short run.

Table 4.13: Depth of the Food Deficit in Thailand

Variable	Coefficient	Std. error	P-value
Constant	0.984546	6.734113	0.8857
Storm	**-9.848947**	**4.193267**	**0.0330**
Flood	-7.586811	5.845548	0.2139
Quantity of banana produce	-8.01E-06	9.28E-06	0.4019
Quantity of cassava produce	7.94E-08	4.81E-07	0.8711
Quantity of potato produce	1.01E-06	6.07E-07	0.1182
Quantity of rice produce	1.87E-06	1.42E-06	0.2073
Population	-7.85E-07	8.90E-06	0.9309
Regression diagnostics			
R-squared	0.486301	Mean dependent var	-9.695652
Adjusted R-squared	0.246574	S.D. dependent var	8.053428
S.E. of regression	6.990383	Akaike info criterion	6.995156
Sum squared resid	732.9818	Schwarz criterion	7.390110
Log likelihood	-72.44429	Hannan-Quinn criter.	7.094486
F-statistic	2.028567	Durbin-Watson stat	1.076175
Prob(F-statistic)	0.118497		

Source: Author, 2017.

Storms negatively influenced the prevalence of food inadequacy in Thailand ($p<0.1$). Floods also negatively influenced the prevalence of food inadequacy, but not significantly (Table 4.14).

Table 4.14: Prevalence of Food Inadequacy in Thailand

Variable	Coefficient	Std. error	*P*-value
Constant	0.082774	0.935685	0.9307
Storm	**-1.185284**	**0.582642**	**0.0600**
Flood	-1.067459	0.812221	0.2085
Quantity of banana produce	-9.66E-07	1.29E-06	0.4655
Quantity of cassava produce	1.81E-09	6.68E-08	0.9787
Quantity of potato produce	1.33E-07	8.43E-08	0.1363
Quantity of rice produce	2.82E-07	1.97E-07	0.1726
Population	-1.56E-07	1.24E-06	0.9012
Regression diagnostics			
R-squared	0.435897	Mean dependent var	-1.313043
Adjusted R-squared	0.172649	S.D. dependent var	1.067837
S.E. of regression	0.971293	Akaike info criterion	3.047830
Sum squared resid	14.15114	Schwarz criterion	3.442785
Log likelihood	-27.05005	Hannan-Quinn criter.	3.147160
F-statistic	1.655841	Durbin-Watson stat	0.946411
Prob(F-statistic)	0.194927		

Source: Author, 2017.

iii *Food Stability*

Storms negatively influenced the value of food imports over total merchandise exports (3-year average percentage) in Thailand ($p<0.1$), as shown in Table 4.15. This could imply that individuals, especially the poor, benefit from food donations by national, international, and non-governmental organisations in the event of floods. Therefore, the overall food import quantity decreases, thereby reducing the value of imports compared with exports.

Table 4.15: Value of Food Imports over Total Merchandise Exports (3-year average) in Thailand (%)

Variable	Coefficient	Std. error	*P*-value
Constant	0.186572	0.143337	0.2127
Storm	**-0.187294**	**0.089254**	**0.0532**
Flood	0.069486	0.124423	0.5848
Quantity of banana produce	-2.43E-07	1.98E-07	0.2372
Quantity of cassava produce	-4.25E-08	1.02E-08	0.0008
Quantity of potato produce	-1.38E-08	1.29E-08	0.3035
Quantity of rice produce	4.12E-08	3.01E-08	0.1917
Population	-1.93E-07	1.90E-07	0.3239
Regression diagnostics			
R-squared	0.652822	Mean dependent var	0.043478
Adjusted R-squared	0.490805	S.D. dependent var	0.208514
S.E. of regression	0.148791	Akaike info criterion	-0.704334
Sum squared resid	0.332083	Schwarz criterion	-0.309380
Log likelihood	16.09984	Hannan-Quinn criter.	-0.605004
F-statistic	4.029355	Durbin-Watson stat	2.342407
Prob(F-statistic)	0.011227		

Source: Author, 2017.

Storms negatively influenced per capita food production variability in Thailand, but not significantly (Table 4.16).

Table 4.16: Per Capita Food Production Variability (constant $ per person, 2004–2006)

Variable	Coefficient	Std. error	*P*-value
Constant	-1.124240	2.675070	0.6812
Storm	-1.768531	1.555532	0.2761
Flood	0.630646	2.468016	0.8023
Quantity of banana produce	7.28E-06	4.28E-06	0.1124
Quantity of cassava produce	2.25E-07	2.26E-07	0.3391
Quantity of potato produce	1.76E-07	3.03E-07	0.5711

Variable	Coefficient	Std. error	*P*-value
Quantity of rice produce	2.13E-08	7.37E-07	0.9773
Population	3.31E-06	2.91E-06	0.2759
AR(1)	-0.515249	0.246779	0.0571
Regression diagnostics			
R-squared	0.319280	Mean dependent var	0.059091
Adjusted R-squared	-0.099624	S.D. dependent var	2.950167
S.E. of regression	3.093632	Akaike info criterion	5.388658
Sum squared resid	124.4173	Schwarz criterion	5.834993
Log likelihood	-50.27523	Hannan-Quinn criter.	5.493801
F-statistic	0.762179	Durbin-Watson stat	1.780692
Prob(F-statistic)	0.640957		

Source: Author, 2017.

Floods and storms negatively influenced per capita food supply variability (kilocalories (kcal)/capita/day) in Thailand, but not significantly (Table 4.17).

Table 4.17: Per Capita Food Supply Variability in Thailand (kcal/capita/day)

Variable	Coefficient	Std. error	*P*-value
Constant	3.630886	10.54720	0.7366
Storm	-2.000275	7.165513	0.7849
Flood	-4.452650	10.65334	0.6834
Quantity of Banana Produce	2.47E-05	1.42E-05	0.1071
Quantity of Cassava Produce	2.03E-07	7.93E-07	0.8023
Quantity of Potato Produce	1.07E-06	8.84E-07	0.2514
Quantity of Rice Produce	2.42E-06	2.37E-06	0.3269
Population	-3.62E-06	1.14E-05	0.7573
AR(2)	-0.618246	0.243663	0.0261

Regression diagnostics			
R-squared	0.522482	Mean dependent var	-0.238095
Adjusted R-squared	0.204137	S.D. dependent var	11.81907
S.E. of regression	10.54393	Akaike info criterion	7.846505
Sum squared resid	1334.094	Schwarz criterion	8.294158
Log likelihood	-73.38831	Hannan-Quinn criter.	7.943657
F-statistic	1.641243	Durbin-Watson stat	1.574112
Prob(F-statistic)	0.211688		

Source: Author, 2017.

iv *Utilisation*

Floods and storms positively influenced the prevalence of anaemia amongst 5-year old children in Thailand, but not significantly (Table 4.18).

Table 4.18: Prevalence of Anaemia Amongst 5-year old Children in Thailand

Variable	Coefficient	Std. error	*P*-value
Constant	0.578986	1.128669	0.6166
Storm	0.033876	0.184304	0.8570
Flood	0.066962	0.172520	0.7042
Quantity of banana produce	1.21E-08	3.13E-07	0.9698
Quantity of cassava produce	-9.80E-10	1.35E-08	0.9434
Quantity of potato produce	3.50E-08	2.12E-08	0.1225
Quantity of rice produce	4.25E-08	4.71E-08	0.3832
Population	-2.69E-07	9.79E-07	0.7880
AR(1)	0.916454	0.066169	0.0000
Regression diagnostics			
R-squared	0.953484	Mean dependent var	-0.413636
Adjusted R-squared	0.924859	S.D. dependent var	1.070067
S.E. of regression	0.293326	Akaike info criterion	0.677024
Sum squared resid	1.118522	Schwarz criterion	1.123360
Log likelihood	1.552731	Hannan-Quinn criter.	0.782168
F-statistic	33.30914	Durbin-Watson stat	1.357398
Prob(F-statistic)	0.000000		

Source: Author, 2017.

Storms negatively influenced the prevalence of anaemia amongst pregnant women in Thailand ($p<0.1$), as shown in Table 19. This may imply that pregnant women are given priority in food distribution after a storm.

Table 4.19: Prevalence of Anaemia Amongst Pregnant Women in Thailand

Variable	Coefficient	Std. error	*P*-value
Constant	-0.158926	0.133141	0.2511
Storm	**-0.166391**	**0.082906**	**0.0631**
Flood	0.155135	0.115573	0.1995
Quantity of banana produce	-1.71E-07	1.83E-07	0.3650
Quantity of cassava produce	-3.42E-09	9.50E-09	0.7236
Quantity of potato produce	1.38E-08	1.20E-08	0.2668
Quantity of rice produce	-1.45E-08	2.80E-08	0.6132
Population	6.66E-08	1.76E-07	0.7105
Regression diagnostics			
R-squared	0.385259	Mean dependent var	-0.086957
Adjusted R-squared	0.098380	S.D. dependent var	0.145553
S.E. of regression	0.138208	Akaike info criterion	-0.851903
Sum squared resid	0.286523	Schwarz criterion	-0.456948
Log likelihood	17.79688	Hannan-Quinn criter.	-0.752573
F-statistic	1.342932	Durbin-Watson stat	1.060085
Prob(F-statistic)	0.297577		

Source: Author, 2017.

B Indonesia

i *Food Availability*

Storms and earthquakes negatively influenced average dietary energy supply adequacy in Indonesia, but not significantly (Table 4.20).

Table 4.20: **Average Dietary Energy Supply Adequacy (3-year average) in Indonesia (%)**

Variable	Coefficient	Std. error	*P*-value
Constant	-18.70440	6.497589	0.0121
Storm	-0.779275	0.881664	0.3917
Flood	1.615710	1.765595	0.3756
Earthquake	-0.799114	1.118996	0.4869
Quantity of banana produce	5.71E-07	7.11E-07	0.4350
Quantity of cassava produce	2.54E-07	3.16E-07	0.4347
Quantity of potato produce	-3.54E-07	2.48E-06	0.8888
Quantity of rice produce	-7.73E-11	4.95E-10	0.8782
Population	6.08E-06	2.16E-06	0.0136
Regression diagnostics			
R-squared	0.545286	Mean dependent var	0.652174
Adjusted R-squared	0.285449	S.D. dependent var	1.228772
S.E. of regression	1.038695	Akaike info criterion	3.199978
Sum squared resid	15.10441	Schwarz criterion	3.644302
Log likelihood	-27.79975	Hannan-Quinn criter.	3.311725
F-statistic	2.098573	Durbin-Watson stat	1.506933
Prob(F-statistic)	0.107568		

Source: Author, 2017.

Floods positively influenced the average value of food production (3-year average in constant International dollars (1$) per person) in Indonesia ($p<0.1$), as shown in Table 4.21. This could imply that floods destroy crops such that the harvested crops reduce to lower than expected levels. The lower output with a given level of demand would trigger price increases to relatively high levels, thereby increasing the value of food production. Storms also positively influenced average value of food production, but not significantly. However, earthquakes negatively influenced the average value of food production, but not significantly.

Table 4.21: Average Value of Food Production (3-year average) in Indonesia (constant $ per person)

Variable	Coefficient	Std. error	*P*-value
Constant	-20.37339	44.50642	0.6553
Storm	0.972053	1.199478	0.4335
Flood	**5.701917**	**2.672393**	**0.0542**
Earthquake	-2.522146	1.496360	0.1177
Quantity of banana produce	1.35E-06	9.80E-07	0.1920
Quantity of cassava produce	-2.62E-07	4.15E-07	0.5393
Quantity of potato produce	-2.54E-06	3.52E-06	0.4841
Quantity of rice produce	-4.68E-10	7.81E-10	0.5599
Population	7.11E-06	1.45E-05	0.6334
Regression diagnostics			
R-squared	0.831816	Mean dependent var	4.045455
Adjusted R-squared	0.705678	S.D. dependent var	3.387333
S.E. of regression	1.837678	Akaike info criterion	4.357838
Sum squared resid	40.52474	Schwarz criterion	4.853767
Log likelihood	-37.93622	Hannan-Quinn criter.	4.474664
F-statistic	6.594483	Durbin-Watson stat	1.565134
Prob(F-statistic)	0.001781		

Source: Author, 2017.

ii *Food Access*

Floods, storms, and earthquakes positively influenced the prevalence of undernourishment (3-year average percentage) in Indonesia, but not significantly (Table 4.22).

Table 4.22: Prevalence of Undernourishment (3-year average) in Indonesia (%)

Variable	Coefficient	Std. error	*P*-value
Constant	21.75911	4.398574	0.0002
Storm	0.639903	0.596847	0.3018
Flood	1.082259	1.195228	0.3805
Earthquake	0.056451	0.757510	0.9416
Quantity of Banana Produce	-4.65E-07	4.81E-07	0.3500
Quantity of Cassava Produce	-3.26E-07	2.14E-07	0.1503
Quantity of Potato Produce	-1.58E-06	1.68E-06	0.3627
Quantity of Rice Produce	-2.91E-10	3.35E-10	0.4004
Population	-7.64E-06	1.46E-06	0.0001
Regression diagnostics			
R-squared	0.700926	Mean dependent var	-0.526087
Adjusted R-squared	0.530027	S.D. dependent var	1.025678
S.E. of regression	0.703149	Akaike info criterion	2.419677
Sum squared resid	6.921865	Schwarz criterion	2.864001
Log likelihood	-18.82628	Hannan-Quinn criter.	2.531423
F-statistic	4.101401	Durbin-Watson stat	0.975281
Prob(F-statistic)	0.010399		

Source: Author, 2017.

Floods, storms, and earthquakes positively influenced the prevalence of food inadequacy in Indonesia, but not significantly (Table 4.23).

Table 4.23: Prevalence of Food Inadequacy in Indonesia

Variable	Coefficient	Std. error	*P*-value
Constant	27.54194	5.512515	0.0002
Storm	0.674373	0.747998	0.3825
Flood	1.215659	1.497920	0.4306
Earthquake	0.080893	0.949350	0.9333
Quantity of banana produce	-6.41E-07	6.03E-07	0.3056
Quantity of cassava produce	-4.18E-07	2.68E-07	0.1410
Quantity of potato produce	-1.58E-06	2.11E-06	0.4651

Variable	Coefficient	Std. error	*P*-value
Quantity of rice produce	-3.07E-10	4.20E-10	0.4776
Population	-9.62E-06	1.83E-06	0.0001
Regression diagnostics			
R-squared	0.700976	Mean dependent var	-0.652174
Adjusted R-squared	0.530105	S.D. dependent var	1.285538
S.E. of regression	0.881222	Akaike info criterion	2.871158
Sum squared resid	10.87174	Schwarz criterion	3.315482
Log likelihood	-24.01832	Hannan-Quinn criter.	2.982904
F-statistic	4.102371	Durbin-Watson stat	0.941758
Prob(F-statistic)	0.010389		

Source: Author, 2017.

iii *Food Stability*

Earthquakes negatively influenced political stability and the absence of violence/terrorism in Indonesia (p<0.1). Storms also negatively influenced political stability and the absence of violence/terrorism, but not significantly (Table 4.24).

Table 4.24: Political Stability and Absence of Violence/Terrorism in Indonesia (p<0.1)

Variable	Coefficient	Std. error	*P*-value
Constant	2.086879	6.094725	0.7371
Storm	-0.055660	0.826999	0.9473
Flood	0.056144	1.656125	0.9734
Earthquake	**-2.010102**	**1.049616**	**0.0761**
Quantity of banana produce	9.19E-07	6.66E-07	0.1895
Quantity of cassava produce	2.26E-07	2.96E-07	0.4585
Quantity of potato produce	-1.11E-06	2.33E-06	0.6419
Quantity of rice produce	2.32E-10	4.64E-10	0.6251
Population	-1.23E-07	2.02E-06	0.9522

Regression diagnostics			
R-squared	0.317938	Mean dependent var	0.051304
Adjusted R-squared	-0.071811	S.D. dependent var	0.941089
S.E. of regression	0.974293	Akaike info criterion	3.071963
Sum squared resid	13.28946	Schwarz criterion	3.516287
Log likelihood	-26.32758	Hannan-Quinn criter.	3.183709
F-statistic	0.815751	Durbin-Watson stat	2.975106
Prob(F-statistic)	0.601244		

Source: Author, 2017.

Floods, storms, and earthquakes positively influenced per capita food supply variability (kcal/capita/day) in Indonesia, but not significantly (Table 4.25).

Table 4.25: Per Capita Food Supply Variability in Indonesia (kcal/capita/day)

Variable	Coefficient	Std. error	*P*-value
Constant	-23.97088	24.61501	0.3479
Storm	1.188640	10.02268	0.9074
Flood	22.60340	21.95266	0.3220
Earthquake	1.022984	13.91128	0.9425
Quantity of banana produce	-1.59E-05	8.06E-06	0.0708
Quantity of cassava produce	8.40E-07	3.55E-06	0.8168
Quantity of potato produce	-2.99E-05	3.15E-05	0.3608
Quantity of rice produce	-7.73E-09	6.04E-09	0.2228
AR(1)	0.292704	0.253946	0.2698
Regression diagnostics			
R-squared	0.477081	Mean dependent var	-3.954545
Adjusted R-squared	0.155284	S.D. dependent var	13.72338
S.E. of regression	12.61294	Akaike info criterion	8.199413
Sum squared resid	2068.123	Schwarz criterion	8.645749
Log likelihood	-81.19354	Hannan-Quinn criter.	8.304556
F-statistic	1.482553	Durbin-Watson stat	2.190485
Prob(F-statistic)	0.253538		

Source: Author, 2017.

iv *Utilisation*

Floods, storms, and earthquakes positively influenced the prevalence of anaemia amongst 5-year old children in Indonesia, but not significantly (Table 4.26).

Table 4.26: Prevalence of Anaemia Amongst 5-year old Children in Indonesia

Variable	Coefficient	Std. error	*P*-value
Constant	-13.84480	2.577682	0.0001
Storm	0.256411	0.349768	0.4756
Flood	0.407245	0.700436	0.5702
Earthquake	0.610981	0.443921	0.1903
Quantity of banana produce	2.25E-07	2.82E-07	0.4373
Quantity of cassava produce	9.12E-08	1.25E-07	0.4790
Quantity of potato produce	-9.51E-07	9.85E-07	0.3510
Quantity of rice produce	-1.04E-10	1.96E-10	0.6054
Population	3.84E-06	8.55E-07	0.0005
Regression diagnostics			
R-squared	0.682714	Mean dependent var	-1.134783
Adjusted R-squared	0.501408	S.D. dependent var	0.583569
S.E. of regression	0.412064	Akaike info criterion	1.350897
Sum squared resid	2.377158	Schwarz criterion	1.795221
Log likelihood	-6.535319	Hannan-Quinn criter.	1.462644
F-statistic	3.765537	Durbin-Watson stat	0.787257
Prob(F-statistic)	0.014748		

Source: Author, 2017.

B Viet Nam[5]

i *Food Availability*

Floods negatively influenced the average dietary energy supply adequacy in Viet Nam, but not significantly (Table 4.27).

[5] Floods are the disaster variable used for Viet Nam with respect to food security indicators because earthquakes did not occur in Viet Nam during the 1990–2013 study period (for the disaster–food security linkage). In addition, floods and storms generally occurred in the same years, and using both variables in the regression equations resulted in a near singular matrix because of the high level of Tetrachoric correlation among them.

Table 4.27: Effect of Floods on Average Dietary Energy Supply Adequacy (3-year average) in Viet Nam (%)

Variable	Coefficient	Std. error	*P*-value
Constant	1.466681	0.891131	0.1206
Flood	-0.471471	0.852235	0.5883
Quantity of banana produce	3.91E-06	4.33E-06	0.3808
Quantity of rice produce	1.88E-07	2.44E-07	0.4532
Quantity of cassava produce	1.42E-07	4.29E-07	0.7446
Quantity of potato produce	4.36E-06	5.59E-06	0.4467
AR(1)	0.476170	0.229587	0.0557
Constant	1.466681	0.891131	0.1206
Flood	-0.471471	0.852235	0.5883
Regression diagnostics			
R-squared	0.258469	Mean dependent var	1.409091
Adjusted R-squared	-0.038143	S.D. dependent var	1.140555
S.E. of regression	1.162103	Akaike info criterion	3.391712
Sum squared resid	20.25727	Schwarz criterion	3.738862
Log likelihood	-30.30883	Hannan-Quinn criter.	3.473490
F-statistic	0.871405	Durbin-Watson stat	1.548080
Prob(F-statistic)	0.538025		

Source: Author, 2017.

ii *Food Access*

Floods positively influenced the number of people undernourished and the depth of the food deficit in Viet Nam, but not significantly (Tables 4.28 and 4.29).

Table 4.28: Number of People Undernourished (3-year average) in Viet Nam (million)

Variable	Coefficient	Std. error	*P*-value
Constant	-0.925997	0.578866	0.1305
Flood	0.073245	0.524082	0.8907
Quantity of banana produce	-1.03E-06	2.89E-06	0.7261

Variable	Coefficient	Std. error	*P*-value
Quantity of rice produce	-1.50E-07	1.46E-07	0.3222
Quantity of cassava produce	1.55E-07	2.67E-07	0.5703
Quantity of potato produce	-6.81E-07	3.22E-06	0.8354
AR(1)	0.579716	0.229142	0.0231
Regression diagnostics			
R-squared	0.357396	Mean dependent var	-0.968182
Adjusted R-squared	0.100354	S.D. dependent var	0.740904
S.E. of regression	0.702745	Akaike info criterion	2.385727
Sum squared resid	7.407765	Schwarz criterion	2.732877
Log likelihood	-19.24300	Hannan-Quinn criter.	2.467505
F-statistic	1.390420	Durbin-Watson stat	0.803515
Prob(F-statistic)	0.281181		

Source: Author, 2017.

Table 4.29: Depth of the Food Deficit (3-year average) in Viet Nam (kcal/capita/day)

Variable	Coefficient	Std. error	*P*-value
Constant	197.4523	63.16536	0.0062
Flood	1.307627	66.29186	0.9845
Quantity of cassava produce	-3.73E-05	2.77E-05	0.1962
Quantity of banana produce	-0.000311	0.000267	0.2595
Quantity of potato produce	-0.000354	0.000415	0.4051
Quantity of rice produce	5.96E-06	1.85E-05	0.7513
Regression diagnostics			
R-squared	0.199595	Mean dependent var	184.6522
Adjusted R-squared	-0.035818	S.D. dependent var	77.19610
S.E. of regression	78.56645	Akaike info criterion	11.78522
Sum squared resid	104935.7	Schwarz criterion	12.08144
Log likelihood	-129.5301	Hannan-Quinn criter.	11.85972
F-statistic	0.847849	Durbin-Watson stat	0.389314
Prob(F-statistic)	0.534818		

Source: Author, 2017.

iii *Food Stability*

Floods positively influenced per capita food supply variability in Viet Nam ($p<0.1$), as shown in Table 4.30.

Table 4.30: Per Capita Food Supply Variability in Viet Nam (kcal/capita/day)

Variable	Coefficient	Std. error	*P*-value
Constant	-21.87605	9.439270	0.0332
Flood	**25.08057**	**9.906486**	**0.0215**
Quantity of cassava produce	-2.05E-06	4.15E-06	0.6274
Quantity of banana produce	-7.93E-05	3.99E-05	0.0630
Quantity of potato produce	3.49E-05	6.20E-05	0.5805
Quantity of rice produce	9.20E-07	2.76E-06	0.7433
Regression diagnostics			
R-squared	0.343400	Mean dependent var	-1.043478
Adjusted R-squared	0.150283	S.D. dependent var	12.73677
S.E. of regression	11.74077	Akaike info criterion	7.983470
Sum squared resid	2343.376	Schwarz criterion	8.279686
Log likelihood	-85.80990	Hannan-Quinn criter.	8.057967
F-statistic	1.778192	Durbin-Watson stat	2.029695
Prob(F-statistic)	0.171122		

Source: Author, 2017.

iv *Utilisation*

Floods positively influenced the prevalence of anaemia amongst 5-year old children in Viet Nam, but not significantly (Table 4.31).

Table 4.31 : Prevalence of Anaemia Amongst 5-Year Old Children in Viet Nam

Variable	Coefficient	Std. error	*P*-value
Constant	-1.237873	0.630041	0.0660
Flood	0.117847	0.661226	0.8607
Quantity of Cassava Produce	3.74E-07	2.77E-07	0.1938
Quantity of Banana Produce	4.43E-06	2.66E-06	0.1142
Quantity of Potato Produce	1.19E-06	4.14E-06	0.7766
Quantity of Rice Produce	-8.93E-08	1.85E-07	0.6345
Regression diagnostics			
R-squared	0.287812	Mean dependent var	-0.978261
Adjusted R-squared	0.078345	S.D. dependent var	0.816287
S.E. of regression	0.783659	Akaike info criterion	2.569772
Sum squared resid	10.44005	Schwarz criterion	2.865988
Log likelihood	-23.55237	Hannan-Quinn criter.	2.644269
F-statistic	1.374022	Durbin-Watson stat	0.564860
Prob(F-statistic)	0.282765		

Source: Author, 2017.