Chapter 4

Tracking Climate Resiliency Actions in National Strategies: A Policy and Investment Framework and Application to Myanmar

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CHAPTER 4

Tracking Climate Resiliency Actions in National Strategies

A POLICY AND INVESTMENT FRAMEWORK AND APPLICATION TO MYANMAR

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ABSTRACT

The global development community is increasingly recognising the need to achieve climate resiliency with regard to food systems; yet, operationalising this goal within the existing policy systems remains a challenge at the national level. In this chapter, we develop a policy and investment framework that can help track climate resilience actions as part of the development of policies and strategies at the national level. We apply this framework to Myanmar's recently developed Agricultural Development Strategy, and argue that such frameworks are an essential part of developing local capacities to translate climate-resilience strategies into national action and investment plans. Finally, we demonstrate how a food systems approach can help identify a set of multidimensional drivers at the underlying, intermediate, and immediate levels for decision making and support the coordination of actions at various levels.

4.1 Introduction

Ending malnutrition is critical for both economic and human development (Shekar et al., 2017). Since the agricultural sector directly impacts the food and nutritional security of the population, any increase in the burden on this sector can result in decreased food security. The United Nations Food and Agriculture Organization (FAO) (2014) has predicted that the agricultural sector will face increasing pressure from population growth and climate change over the next 3 decades and beyond. The sector will also face a 30% increase in the global population, resulting in intensified competition for increasingly scarce land, water, and energy resources, a struggle made even more complex by the existential threat of climate change. To provide for a population that is projected to grow from 7.3 billion in 2014 to 9.3 billion by 2050, and to support changing dietary patterns, it is estimated that food production will need to increase from the current 8.4 billion tonnes to almost 13.5 billion tonnes per year. Achieving this level of production from an already seriously depleted natural resource base will be difficult without including disaster risk reduction and climate change adaptation (CCA) in developmental planning.

The Intergovernmental Panel on Climate Change (2014) has stated that the negative impact of global warming on the earth is indisputable. Further, is it highly likely that the increase in greenhouse gas (GHG) emissions from anthropogenic activities has caused global warming since the mid-20th century. In addition to an increase in average temperatures and precipitation, global warming also increases the frequency of floods, droughts, and heat waves, as well as the intensity of typhoons and hurricanes. GHG emissions from agricultural fields account for approximately 10%–12% of global emissions (Intergovernmental Panel on Climate Change, 2014). When counting external factors such as deforestation, emissions from agriculture and other related activities are projected to increase by 32% (Balasubramanian, 2017). The impacts of climate change can be seen throughout the world in the form of rising sea levels, shrinking glaciers, the northward movement of plant habitats, changes in animal habitats, rising ocean temperatures, shorter winters, and the early arrival of spring.

Recent studies have found that more people than originally thought are vulnerable to and will be impacted by climate change in Asia and the Pacific (ADB, 2009). This includes the population that relies directly on agriculture (around 60% of the economically active population and their dependents). In the Greater Mekong Subregion alone, climate change is projected to drive up the price of rice by 37%, while rice yields in Asia and the Pacific are expected to decline by 14%–16% over the next 40 years due to water scarcity.

As a result, the number of malnourished children in Southeast Asia will increase by 16%. According to the World Bank (2017), the agricultural sector is responsible for a large share of the gross domestic product (GDP) of Association of Southeast Asian Nations countries (26.7% in Cambodia, 25.5% in Myanmar, and 18.1% in Viet Nam). Thus, the negative impacts of climate change may hinder the growth of all Asian countries. Further, of all the world's regions, Asia and the Pacific are the most prone to natural disasters. A lack of capacity to adapt to climate change, inadequate infrastructure, and the inability to prepare for natural disasters can magnify this impact.

In this chapter, we explain how food systems must change to accommodate the impacts of climate change. By reviewing the literature, we can diagnose the weaknesses of the current food system from a climate change perspective. This is a crucial step since it identifies gaps in the policies and strategies currently being implemented. Next, we develop an operational framework to analyse gaps, identify priority investment areas, and track progress (AIT), which can be used to adapt food systems to become climate-resilient. We apply this framework to Myanmar's Agriculture Development Strategy (ADS), which was developed by the Ministry of Agriculture, Livestock, and Irrigation (MOALI), and analyse gaps that must be addressed to make the ADS climate-resilient, while listing priority investment areas and providing a tracking system to monitor the progress of these investments.

4.2 Climate Change Adaptation for Improved Food Security

The negative impact of climate change on crop production is already evident in several regions around the world (Porter et al., 2014). Changing weather patterns are adversely affecting marginal and smallholder farmers in developing countries, while the negative impacts of climate change on the agricultural sector are amplifying the challenges created by population growth. To address this issue, the concept of climate-smart agriculture (CSA) emerged in 2009 with the aim of providing globally applicable principles to encourage sustainable agricultural productivity to meet the demands of a growing population, despite climate change (Lipper and Zilberman, 2018). CSA refers to a bundle of agricultural interventions that aim to increase yields, place more carbon in soils, and achieve greater resilience to heat and drought (FAO, 2010). Such practices, including alternate wetting and drying (AWD), row cropping, the adoption of stress-tolerant and high-yield seed varieties, deep placement of urea, and aquaculture or floating agriculture, are being adopted in both developing and developed countries to decrease the negative impacts of climate change and GHG emissions while sustaining crop productivity and profitability.

It is estimated that, given the current rate of population growth around the world, food production will need to increase by 60% by 2050 (FAO, 2014). Climate change is amplifying the challenges currently facing the agricultural sector, and farmers need to adapt quickly to changing natural environments to increase agricultural productivity while lessening damage to the environment through implementing sustainable solutions (Babu and Blom, 2014). Countries are facing several challenges in adopting sustainable agricultural policies and practices. Targeted capacity-building programmes can play an influential role in preparing a country's agricultural sector to deal with the growing threat of climate change. The concept of CSA encompasses the challenges mentioned above, providing a more holistic perspective on issues in agriculture. Patra and Babu (2017) provide a conceptual framework for helping a country transition from climate-vulnerable to climate-smart agriculture. They also provide a guide for database creation and the development of a district-level database on emissions from agriculture in India. This methodology can be used in other developing countries to mitigate the risks posed by climate change.

4.3 Diagnostic Review of the Agriculture Development Strategy

In this section, we diagnose the vulnerability of Myanmar's food system to climate change impacts. To do so, we completed an extensive desk review to build a policy, legal, and institutional matrix of multi-stakeholder actors, including ministries, agencies, and private sector players, who contribute to the food system. This is important because it enables us to identify how to develop climate-resilient policies and strategies. Using this information, we outlined the policy-making process in Myanmar. In the second step of the diagnostic review, we identified the level of climate-resilience as well as any gaps in current policy outcomes. For the purposes of this chapter, we used the ADS as an example and identified analytical needs, data requirements, and gaps to be addressed to make the ADS climate-resilient. The results of this diagnostic review are presented below.

4.3.1 | Country Context

Myanmar, with its fertile lands and low population density, is the largest country in mainland Southeast Asia with significant potential to increase agricultural production, yield, and profits. Due to its geographic location at the intersection of China and India,

two of the world's most dynamic economies, it is well positioned to be a regional trading hub and key supplier of minerals, natural gas, and agricultural produce. Since its transition in 2011, Myanmar's economy has been growing at an average annual rate of 6.3% (World Bank, 2017). The key driver of Myanmar's economic growth has been the export of natural gas; however, this decreased by seven% in 2015–2016 due to heavy floods, which slowed new investment flows and created a more challenging external environment. Flooding in July 2015 affected some of the poorest and most vulnerable population centres in the country and created inflationary pressures.

Myanmar has a tropical climate with three seasons: a cool winter from November to February, a hot summer in March and April, and a rainy season dominated by the southwest monsoon from May to October. The Central Dry Zone has the lowest mean annual rainfall (500–1,000 millimetres per year) compared to the hilly regions in the east and north, and coastal regions in the south and in Rakhine state (2,500–5,500 millimetres/year) (Egashira and Aye, 2006).

Myanmar's current economic condition and structure are reflective of a low-income economy (World Bank, 2014). During 2009–2017, Myanmar's agricultural sector grew at an average annual rate of 2.5% (World Bank, 2017), approximately half the rate of its neighbouring countries, which are at a comparable development level. Despite a decrease in employment in agriculture, this sector accounts for 25% of the country's GDP, and employs 25% of the total labour force (World Bank, 2016). In 2012, agriculture employed more than half the workforce and accounted for 36.4% of GDP, compared to 37.3% for services and 26.3% for industry (World Bank, 2014).

Temperatures are projected to change by 1.7–8.4 degrees Celsius each year during 2045–2065. Since a large portion of Myanmar's population is dependent on agriculture, it is crucial to take steps to minimise the negative impacts of climate change. Impacts on the agricultural sector will further diminish the nutritional security of the country's population. According to the Demographic Health Survey of Myanmar 2015–2016 led by the Ministry of Health and Sports, 29.2% of all children suffer from stunting. Moreover, 7% of the total population suffers from wasting, while women aged 15–49 and children under the age of 5 showed a high prevalence of anaemia (Ministry of Health and Sports and International Coach Federation, 2017).

4.3.2 | Policy Process and Institutional Environment for Climate-Resilient Food Systems in Myanmar

To understand the policy process and institutional environment, it is important to ensure that CCA is included in development planning. At present, Myanmar's policy and institutional landscape has not been studied in depth and is quite nascent in terms of multi-sectoral and inter-sectoral discussions from the perspective of the food system. While several public policy institutions in Myanmar have had a direct effect on its food system, the MOALI has had the most far-reaching and wide-ranging impact on food systems through its 15 divisions. Other key players include the ministries of natural resources and environmental conservation, commerce, health, finance and planning, education, and social welfare and resettlement. An analysis of the policies and strategies of these sectors from a food-system perspective can lead to a better understanding of the policy process and their contribution to climate policy objectives.

Climate change is impacting different regions in Myanmar differently. For example, Ayeyarwaddy, Bago, Mon, and Takhine were afflicted by heavy rains and flooding in 2011, Sagaing region was severely impacted by flooding in 2012, and the Central Dry Zone was impacted by both flooding and landslides in 2015.

4.3.3 | Diagnoses of the Agriculture Development Strategy

The objective of the ADS is to accelerate growth through the strategic pillars of governance, productivity, and competitiveness. The ADS was developed to achieve an 'inclusive, competitive, food and nutrition secured and sustainable agricultural system contributing to the socio-economic well-being of farmers and rural people and further development of the national economy' (MOALI, 2018). It aims to develop the governance, physical and institutional infrastructure, and human resource capacities necessary to generate a more productive, sustainable, inclusive, and competitive agricultural and food sector capable of providing Myanmar's people with food and nutritional security. The strategy is expected to spur growth and shift millions out of poverty by boosting rural incomes and savings; generating jobs; and stimulating investments in farms, rural small and medium-sized enterprises, and people (MOALI, 2018).

This diagnostic review of the ADS discusses current plans to achieve specific outcomes, reviews analytical and data needs to implement the ADS effectively, and identifies gaps that must be addressed to achieve targeted ADS outcomes. The three main pillars of the ADS are governance, productivity, and competitiveness. Each pillar has its own objective and eight outcomes (MOALI, 2018). Table 4.1 shows each ADS pillar, objectives, and outcomes.

Table 4.1: Agriculture Development Strategy Pillars, Objectives, and Outcomes

Pillar 1: Governance	Pillar 2: Productivity	Pillar 3: Competitiveness
Objectives		
Enhanced governance and capacity of institutions responsible for agricultural development	Increased productivity and farmer incomes	Improved market linkages and competitiveness
Outcomes		
Planning. Effective integrated planning based on participatory processes at both the union and state or regional levels	**Agricultural research.** Improved research system for crop, livestock, and fisheries; and improved research-extension coordination systems with the participation of farmers and the private sector	**Business environment.** Improved business environment, information, and investment along the agri-food supply chain
Policy capacity. Improved capacity for policy formulation and analysis	**Agricultural extension.** Transformed public–private agricultural extension system delivering improved products (crops, livestock, fisheries) and technology for adoption and adaptation, better linked to agricultural research	**Intellectual property rights.** Protected intellectual property rights for the agricultural and food sectors
Monitoring and evaluation. Timely and effective monitoring and evaluation processes that inform a web-based management information system	**Education and training.** Develop (or revive) effective education and training to build 'human capital' in the agricultural and food sectors in response to the evolving needs of farmers and the private sector in rural areas	**Quality.** Develop reliable quality system that helps farmers and food processors get higher prices for higher quality goods
Statistics. Sound statistical systems for evidence-based decisions	**Irrigation and water management.** More responsive and reliable irrigation and drainage services, and more efficient and sustainable water management systems	**Rural development planning.** Enhanced framework for gender-equitable and participatory planning and implementation of rural development programmes institutionalised
Associations. Strong farmer and industry associations and federations, and triangular action of the Government of Myanmar, farmers and entrepreneurs, and millers for agribusiness development	**Crop inputs.** Increased use of improved farm production inputs and technologies by crop growers	**Rural infrastructure.** Rural infrastructure improves agricultural efficiency and profitability for smallholders

continued next page

Table 4.1: ***Continued***

Pillar 1: Governance	Pillar 2: Productivity	Pillar 3: Competitiveness
Land. Strengthened farmers' land rights and enhanced capacity of institutions involved in agricultural land	**Mechanisation.** Increased application of appropriate mechanisation in the agricultural value chain	**Value chains.** Increased competitiveness and stakeholder participation in agricultural value chains engaged with prioritised commodities
Coordination. MOALI capacity for ADS coordination and implementation enhanced and guided by democratically appointed, gender-equitable civil society representation	**Livestock and fish.** Increased use of improved livestock and fish breeding, health, and husbandry services and technologies by livestock and fish producers	**Food safety.** Enhanced food quality and safety
Food and nutritional security. Improved food and nutritional security for the majority of the population	**Sustainable practices.** Sustainable farming, good agricultural practices, good animal husbandry practices, good aquaculture practices, and organic practices	**Financial services.** Improved access to a range of financial services for farmers and agribusiness enterprises

ADS = Agriculture Development Strategy; MOALI = Ministry of Agriculture, Livestock and Irrigation.

Source: Ministry of Agriculture, Livestock and Irrigation of Myanmar (2018), *Agriculture Development Strategy – Draft*. Nay Pyi Taw: Ministry of Agriculture, Livestock and Irrigation.

4.3.4 | Key Points from the Agriculture Development Strategy Diagnosis

This chapter identifies analytical and data needs and gaps that must be filled to achieve each of the ADS outcomes and create a climate-resilient food system. This section highlights the analytical and data needs for all three pillars, and highlights the gaps currently present in the outcomes. Annex 4.1 presents the analytical needs, data requirements, and gaps in the outcomes of all three pillars of the ADS; and the key points from the ADS diagnoses are outlined below.

Governance

The main objective of *governance* (Pillar 1 of the ADS) is to enhance the governance and capacity of the institutions responsible for agricultural development. This will improve the food and nutritional security of the population by enhancing institutional capacity to plan, develop, and implement policies and programmes to boost growth in the agricultural sector, resulting in increased production and farmer incomes.

At present, there is a lack of policy integration in existing climate risk management (CRM) plans and programmes, including the Myanmar Climate Change Strategy and Action Plan 2016–2030 and Myanmar Action Plan on Disaster Risk Reduction 2017. There is also a lack of understanding regarding the impact of climate change on agriculture amongst policymakers, practitioners, and farmers. To reduce the risk of climate change, all stakeholders need to understand how climate change impacts agriculture. Babu and Pinto (2017) have developed a comprehensive framework to assess the level of human, institutional, and policy capacity to achieve climate-resilient agriculture. Since weak human, institutional, and policy capacities are a major constraint on the building of climate resilience in developing countries, is it crucial to assess the country's current capacity in these areas.

Productivity

The second objective of the ADS is to increase productivity and farmer incomes (Pillar 2). To improve productivity, the efficiency of agricultural inputs such as land, water, seeds, and fertiliser must be improved, such as by developing and distributing drought-resistant seeds and regulating fertiliser use for soil conservation and carbon sequestration. Myanmar currently lacks the capacity to produce research on climate-resistant seeds and mitigation practices that can be adopted to reduce the impact of climate change.

Further, since rice production accounts for 32% of emissions from the agricultural sector (FAO, 2018), rice producers need to adopt climate-resilient techniques and practices. Excessive production of rice using irrigation is the top contributor of GHG emissions. Other major rice producers in the region, such as Bangladesh and Viet Nam, have adopted techniques like AWD to combat this issue. In Bangladesh, farmers using AWD achieved yields 9%–12% higher than those of farmers using conventional irrigation (de Pinto et al., 2017). Comparable results were seen in Viet Nam. Along with limiting GHG emissions, AWD adopters in Viet Nam saw a 20% decrease in production costs compared to farmers using conventional techniques (Quicho, 2013). This resulted in increased profits (Ha, 2014), mainly due to a decrease in irrigation and labour costs. Further, multiple studies have reported a decrease in GHG emissions of 6%–39% due to the adoption of AWD (Pandey et al., 2014; Narayan and Belova, 2013). However, as farmers' understanding of the importance of climate-resilience measures is limited, there is a need to increase farmer awareness of these techniques through agricultural extension and develop incentives for them to adopt these techniques and practices.

Competitiveness

The third objective of the ADS is to improve market linkages and competitiveness (Pillar 3). For example, promoting diversification of both on- and off-farm activities can increase income opportunities while decreasing GHG emissions. Improving rural infrastructure while using and promoting renewable sources of energy (such as hydropower, solar energy, biomass, and biogas) can also help mitigate the effects of climate change by reducing GHG emissions. Capacity building is also necessary to promote an inclusive, sustainable, and resilient renewable energy system. Lastly, there are no training programmes that focus on climate-resilient agricultural practices. Training agriculture extension agents on climate-resilient techniques will raise farmers' awareness of the impact of climate change on agriculture, resulting in increased competitiveness.

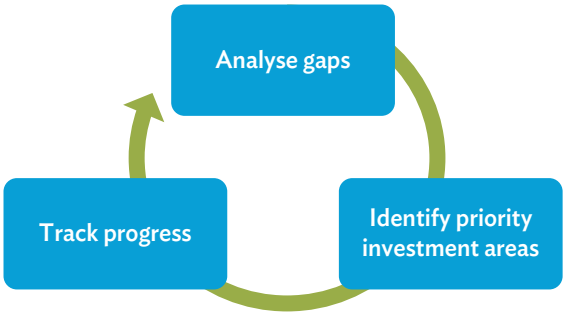
4.4 Operational Framework

This section presents the AIT operational framework that can be used to build a climate-resilient food system. This framework is broken down into the following three steps:

(i) analyse gaps in the policy currently being implemented;
(ii) identify priority investment areas (with the help of the strategy diagnoses [see Section 4.3]); and
(iii) track progress to ensure that the strategy being implemented is climate-resilient.

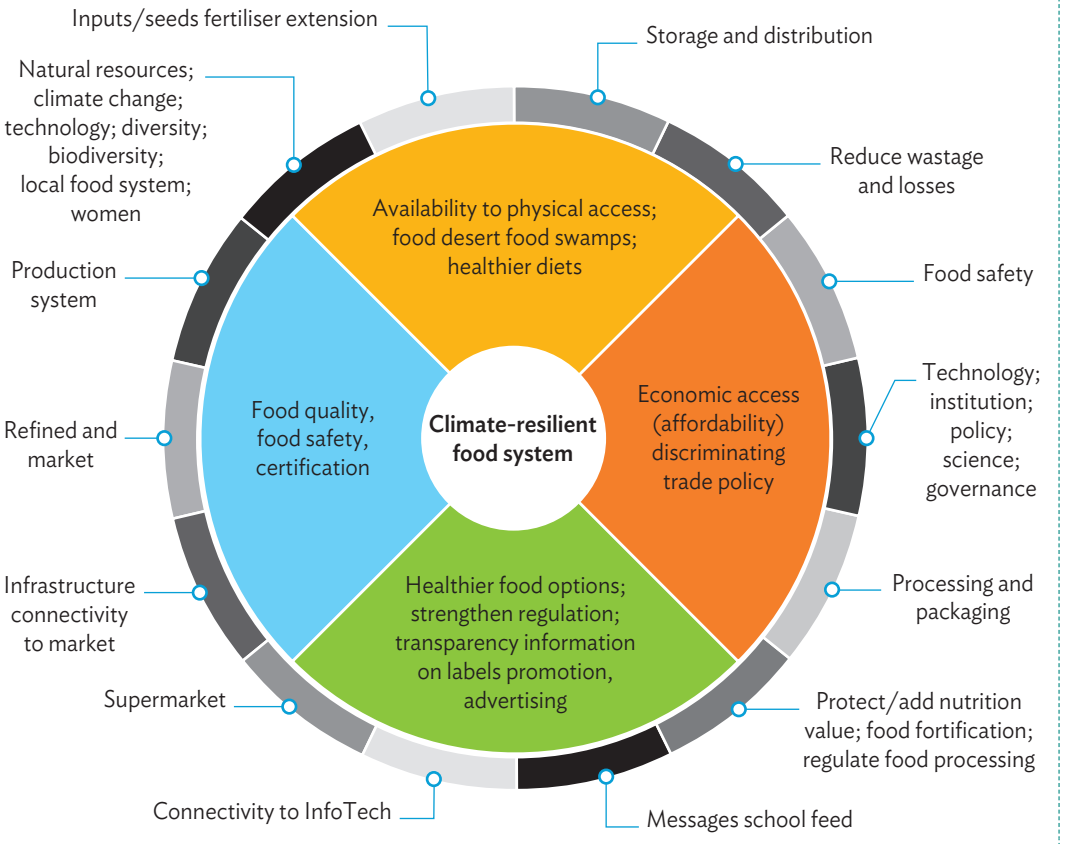
Repeating the AIT operational framework (see Figure 4.3) across different sectors and policies can help build a climate-resilient food system. Starting from the outer circle of Figure 4.2, which presents a climate-resilient food system, we can use the AIT framework to improve the climate sensitivity of the entire food system. In this chapter, we use this framework to assess the climate sensitivity of the ADS, identify priority investment areas for building a climate-resilient food system, and track the progress of the investments.

Figure 4.1: AIT Operational Framework



AIT = Analyse Gaps, Identify Priority Investment Areas, and Track Progress.
Source: Authors.

Figure 4.2: Food Systems Approach to Climate Resiliency



Source: Authors.

4.4.1 | Gap Analysis

Next, we consider the gaps that must be addressed to make ADS climate-resilient, based on the ADS diagnosis in Section 4.3 (for more information, see Annex 4.1). Despite an overall decrease in global poverty, Myanmar continues to suffer from high levels of poverty, hunger, and malnutrition. Based on the nutritional sensitivity review in the ADS, we highlight the steps that need to be adopted to promote a climate-resilient food system in Myanmar.

(i) To build a climate-resilient food system, specific policy and strategy goals resulting in climate-resilient agriculture need to be incorporated in all policy and strategy processes currently being implemented. This will involve further consultation and sensitisation amongst the stakeholders.

(ii) Furthermore, the outcomes of subsector policies should incorporate CCA into development planning. For example, to realise ADS outcomes such as improved crop production, inputs and technologies by crop growers could include the development and distribution of drought-resilient seeds and the regulation of fertiliser use for soil conservation.

(iii) Research on new technologies needs to be extended to include CCA and mitigation techniques. Also, research, extension, and education in agriculture need to be conceptualised in the context of more climate-resilient food systems. It is also necessary to improve the capacity to conduct research, as well as the flow of information amongst researchers, practioners, extension providers, and farmers.

(iv) Farmer land rights are currently vague and uncertain, hindering the implementation of long-term climate risk-mitigation measurements. There is also a lack of awareness regarding the impact of climate change on soil fertility.

(v) There is also a need to develop appropriate measures for water management and increase awareness of effective water systems to deal with diverse climate hazards such as droughts, cyclones, intense rain, floods, and saltwater intrusion.

(vi) To improve agricultural productivity and reduce risks due to climate change, it is necessary to adopt better crop production inputs through such activities as the promotion of soil demonstration and conversion techniques, more efficient fertiliser use, and the use of climate-resilient seeds.

4.4.1.1 Investment Priorities for Climate-Resilient Food Systems

This section identifies investment priorities for each outcome of the ADS to mainstream CCA for the implementation of the ADS. The investment priorities for each pillar under the ADS are summarised below, with detailed information available in Annex 4.2.

Governance

It is crucial to improve the governance and capacity of institutions responsible for agricultural development, and to strengthen capacity for advocacy, planning, and analysis across relevant ministries. The Government of Myanmar and the public sector play important roles in formulating policies, including the development of a comprehensive policy or strategy (such as the ADS). To build a climate-resilient food system, it is important to develop a multi-sectoral approach and recognise the need for combined actions across multiple sectors such as agriculture, education, and natural resource management. Moreover, it crucial to strengthen the capacity of local authorities, service providers, research institutions, and partners, especially investment in research on the risks associated with climate change. Linkages between CRM and agriculture, and climate-resilient practices should also be increased. Further, it is necessary to strengthen capacity for policy formulation and analysis relevant to CRM and agriculture, especially for MOALI (and Agriculture Policy Unit) staff. As there is currently no system to monitor and evaluate the impact of agricultural activities on climate change, investment is necessary to facilitate the collection and analysis of such data at the national and regional levels. Since not all regions are impacted in the same manner, this will help to develop region-specific strategies to mitigate the risks associated with climate change.

Productivity

To increase agricultural productivity and farmer incomes, it is important to invest in an agricultural research system especially focused on CRM, climate-resilient agricultural practices, and climate-resilient crop varieties. Further, transforming the agriculture extension systems (both public and private) can help mitigate the risks associated with climate change. Since awareness of the impacts of climate change on agriculture is limited amongst farmers, increasing this awareness through extension programmes is crucial. Moreover, boosting farmers' access to weather-related information (including early warning systems) can increase their resilience to climate change and disasters. There is a need for investment to increase the number of farmers with access to extension, and to include CRM in the current extension curricula and agriculture courses available at the university level. Finally, increased investment is needed in the development and distribution of climate-resilient crop varieties.

Competitiveness

To improve market linkages and competitiveness and to build a climate-resilient food system in Myanmar, it is crucial to transform the current agriculture extension system. For example, increased investment in rural infrastructure such as alternative power generation from renewable energy sources can decrease GHG emissions from the agricultural sector. Along with improving access to financial services for farmers and agribusiness enterprises, the number of agricultural insurance programmes for farmers should be expanded, resulting in fewer farmers being affected by climate change. Further, increasing investment in project intellectual property rights for climate-resilient seed varieties can boost research and development in this area, resulting in greater competitiveness amongst farmers.

4.4.1.2 Tracking System for a Nutrition-Sensitive Food System

After analysing gaps and identifying investment priority areas, it is essential to track the progress of these initiatives. Based on the priority investments mentioned above, the indicators that can be used to track the progress of these investments are summarised below (a complete list of indicators is in Annex 4.3).

Governance

In the drive to build a climate-resilient food system, improving government policy and strategy with a focus on CRM will result in effective and integrated planning at both the state and regional levels. Further, applying a multi-sector approach to policy advocacy, planning, and analysis with the aim of mainstreaming CCA into development planning across relevant ministries and sectors (i.e. agriculture, climate change, natural resource management, health, food safety, water and sanitation, education, and trade) will help build a climate-resilient food system. After investing to strengthen institutional capacity, it is important to track the number of integrated policies or strategies developed. The number of projects implemented by the MOALI on CRM and the agricultural sector should also be monitored periodically. There is currently no system to monitor and evaluate the impact of climate change on agricultural activities, and investment in this area should be followed by an increased number of periodic monitoring and evaluation reports on targeted CRM indicators by the Department of Planning, MOALI.

Productivity

Greater investment in agricultural research systems can directly boost agricultural productivity. To track the progress of such investments, it is necessary to monitor the increase in the number of researchers focusing on CRM. For example, research papers and

documents regarding CRM and the agricultural sector can be used to evaluate progress made in agricultural research systems. To track the effectiveness of the education and training provided, the number of agricultural programmes that include the impact of climate change should be monitored. Finally, the number of farmers with access to information regarding climate-resilient practices and early warning climate data can be used to evaluate the effectiveness of the agriculture extension system.

Competitiveness

To improve market linkages, enhance competitiveness, and build a climate-resilient food system, it is essential to increase the number of on- and off-farm activities resulting in increased household income. A decrease in the number of farmers that depend on rain for agriculture can serve as an indicator of rural infrastructure development. Other such indicators include total irrigated area, number of water and distribution facilities (especially in high-risk areas), and decreased GHG emissions from the agricultural sector. Just as it is important to invest in increased access to agricultural insurance for farmers facing high risks due to climate change, monitoring the number of farmers with access to and using agricultural insurance is an important indicator of the success of such investment.

4.5 Conclusion

This chapter uses a food systems approach to understand different issues, challenges, and options with regard to mainstreaming climate change into development planning. First, we performed an extensive desk review to explain the country context and policy process, and identify key players. This information is valuable because it helps to identify policies and strategies related to climate change, as well as the actors responsible for implementing them. We then used a food systems approach to diagnose the ADS drafted by the MOALI to identify analytical needs, data requirements, and gaps that need to be addressed to meet the ADS outcomes. Next, we developed the AIT operation framework and applied it to the ADS by analysing the gaps that need to be addressed to make the ADS climate-resilient, identifying priority investment areas, and recommending a tracking system to monitor the progress of these investments. Replicating this framework across different sectors and policies will result in a climate-resilient food system. For example, this framework can be applied to such policies as the Myanmar Climate Change Strategy and Action Plan, Land Use Policy, and National Seed Law to ensure that these policies are climate-resilient. The framework developed here can be used for polices and strategies in different countries.

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Annex 4.1: Diagnosis for a Climate-Resilient Food System

Current Plans/ Evidence Needed	Analysis and Data for Effective Implementation of the Agriculture Development Strategy	Gaps
Pillar 1: Governance		
Outcome: Effective integrated planning based on participatory processes at both the union and state or regional levels		
• Integrate existing plans of different departments. • Establish targets and indicators that can be tracked and reported periodically.	• Data outcomes of existing programme and policies focusing on CRMs • Indicators, baselines and target of ADS impacts relevant to CRM	• Lack of policy integration in existing CRM plans and programmes (e.g. the MCCSAP 2016–2030 and MAPDRR 2017) • No indicators or targets suggested regarding climate change measurements (adaptation and mitigation)
Outcome: Improved capacity for policy formulation and analysis		
• Review existing CRM policies and programmes. • Commission policy studies. • Conduct regular independent policy reviews.	• Understanding of the linkage between agriculture and CRM • Policy studies focusing on the linkage between agriculture and CRM • Independent review of policies related to CRM	• Lack of policy integration in existing CRM plans and programmes (e.g. the MCCSAP 2016–2030 and MAPDRR 2017) • Lack of understanding of the linkage between agriculture and CRM
Outcome: Timely and effective monitoring and evaluation process		
• Strengthen the capacity of monitoring and evaluation units at the union. • Establish an appropriate methodology and system to carry out systematic ADS monitoring and evaluation.	• Implementation plan involved with the monitoring and evaluation of CRM outcomes in the agriculture sector • Indicators, baseline, and targets of ADS impacts relevant to CRM	• No standardised procedure to collect data in a reliable and timely way • No indicators or targets suggested regarding CRM
Outcome: Sound statistical systems for evidence-based decisions		
• Conduct an agriculture, livestock, and fisheries census. • Improve current system of collecting agricultural statistics using information and communications technology. • Conduct annual surveys on key issues identified by policy division.	• Collect data beyond production, especially related to the effects of climate change on the agriculture, livestock, and fisheries sectors. • Statistic data about the current situation and the readiness or awareness of rural households regarding climate change risk in the census and annual survey	• No standard procedure to collect and confirm data in a reliable and timely manner • No clear procedure to collect household-level data focusing on CRM

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Annex 4.1: ***Continued***

Current Plans/ Evidence Needed	Analysis and Data for Effective Implementation of the Agriculture Development Strategy	Gaps
Outcome: Strong farmer and industry association and federation		
• Promote the formation of farmer associations and their federations to empower farmers in marketing and resource use as well as boost engagement on government policy and regulatory issues. • Conduct annual meetings of the MOALI with farmer organisations at the state or regional and union levels.	• Climate adaptation issues raised to empower farmer associations, especially in the case of communities in at-risk regions (e.g. deltas, coastal areas, and the Central Dry Zone) • Include discussions about CRM in the agricultural sector in the annual meeting of the MOALI and farmer organisation.	• Lack of communication focusing on CRM between governments, farmer associations, and the private sector
Outcome: Strengthened farmers' land rights and enhanced capacity of institutions involved in agricultural land		
• Remove restrictions that condition securing tenure through land titling over land held by smallholders. • Secure the holding and use of agricultural land of smallholders once these have been titled. • Prioritise the enforcement of the Vacant, Fallow, and Virgin Land Law. • Develop an agro-ecological zoning system for the country based on the principle of global agro-ecological zones. • Clarify land use rights by livestock farmers, fishers, and crop farmers, and establish clear rules for the use and management of grazing land.	• (Sound and clear) land tenure arrangement with climate change-mitigation instruments • Regulation and monitoring system for appropriate land use to prevent deforestation, encroachment, soil erosion, and reduction of the 'carbon sink' effect • Agro-ecological measurements with diverse inputs and conditions for resilience to climate change	• Vague and uncertain land rights system hinders the implementation of long-term climate risk mitigation measurements. • Lack of awareness of the impact of climate change on land use • Limited capacity of research and data analysis • Discordance between the CRM measurements and agriculture expansion
Outcome: MOALI capacity for ADS coordination and implementation enhanced and guided by MOALI professional expertise and democratically appointed, gender-equitable civil society representatives		
• Establish a coordination unit for the implementation of the ADS under the Department of Planning.	• Better understanding of the linkage between agriculture and CRM for staff working in the new coordination unit	• Limited understanding of the linkage between agriculture and CRM amongst MOALI staff

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Annex 4.1: ***Continued***

Current Plans/ Evidence Needed	Analysis and Data for Effective Implementation of the Agriculture Development Strategy	Gaps
Outcome: Improved food and nutritional security for the most disadvantaged groups		
• Coordinate with ongoing food and nutritional security and multi-sector initiatives on nutrition and poverty alleviation.	• Identify multi-sector approaches to tackle food and nutritional insecurity issues caused by climate change, especially in the case of at-risk regions (e.g. deltas, coastal areas, and the Central Dry Zone).	• Improve coordination and promote multi-sector initiatives on food and nutritional security and poverty alleviation.
Outcome: The MOALI restructured to integrate existing units better and become more responsive to farmers, enterprises, and civil society		
• Evaluate alternative options for MOALI restructuring.	• Better understanding of the linkage between agriculture and CRM throughout the MOALI	• Limited understanding of the linkage between agriculture and CRM
Pillar 2: Productivity		
Outcome: Improved agricultural research system for crops, livestock, and fisheries; and improved research-extension coordination systems with the participation of farmers and the private sector		
• Establish a National Agricultural Research Council to coordinate and provide overall guidance to research and establish the Myanmar Academy of Agriculture, Livestock, and Fisheries services to carry out policy affairs for the research council. • Develop a research master plan to establish research priorities and research programme.	• Research activities contribute to promote climate-resilient species and climate-smart agricultural practices. • Include CRM and its linkage to the agricultural sector in research priorities.	• More investment in human resources development for research in CRM and the agricultural sector • Budget allocation for CRM and agricultural research • Strategic emphasis on research about the climate risk adaptation and mitigation measures in the agricultural sector
Outcome: Transformed public–private agricultural extension system delivering improved products (crops, livestock, fisheries) and technology for adoption and adaptation, better linked to agricultural research		
• Review extension systems and formulate a national extension policy and strategy encompassing the functional mandate of the MOALI. • Provide training and mobility and connectivity amenities to build and strengthen the capacity of agricultural, livestock, and fisheries extension services, institutions, and staff.	• Include the impact of CRM on the agricultural sector in the extension policy and strategy. • Include content about CRM measurements in the extension programme to promote awareness and the adaptation capacity of at-risk farmers and stakeholders	• Lack of CRM-relevant contents in the extension programme • More investment in human resource development for proper extension services relating to CRM and the agricultural sector

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Annex 4.1: *Continued*

Current Plans/ Evidence Needed	Analysis and Data for Effective Implementation of the Agriculture Development Strategy	Gaps
• Strengthen the capacity of field extension staff. • Increase the number and capacity of subject matter specialists in those areas of greater interests to farmers. • Establish an information and knowledge system to provide advisory services to farmers.	• Capacity building programme for human resources (extension service staff, subject matter specialists, etc.) especially regarding CRM measurements	• Specific focus on the vulnerable, landless, women, and marginalised groups in climate-sensitive geographic areas
Outcome: Develop (or revive) effective education and training to build 'human capital' in the agricultural and food sector responding to the evolving needs of farmers and the private sector in rural areas		
• Upgrade the current Yezin Agriculture University campuses into a single consolidated university. • Establish or upgrade sectorial disciplines in Yezin and other universities. • Upgrade the 3-year diploma curricula of the state agricultural institutes in all states and regions.	• Include CRM content in university courses.	• Strengthen policy, institutional, and human capacity for CRM-sensitive agricultural interventions. • Emphasise the impact of climate risk on the agricultural sector. • Lack of CRM contents in higher education courses • Ensure that training curricula reaches all levels and covers critical and urgent issues regarding CRM.
Outcome: More responsive and reliable irrigation and drainage services, and more efficient and sustainable water management systems		
• Develop appropriate measures for water management in rainfed agriculture. • Establish a programme on groundwater development.	• Effective water management system dealing with diverse climate hazards (e.g. droughts, cyclones, intense rain, floods and storm surges, high temperatures, and saltwater intrusion)	• Lack of climate-resilient measures and technologies to manage climate hazards • Limited irrigation and water management systems with heavy dependency on rainfed agricultural production, which is not sustainable • Consideration of the sustainable use of groundwater to prevent saltwater intrusion

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Annex 4.1: ***Continued***

Current Plans/ Evidence Needed	Analysis and Data for Effective Implementation of the Agriculture Development Strategy	Gaps
Outcome: Increased use of improved crop production inputs and technologies by crop growers		
• Build the capacity of seed research stations to produce breeder and foundation seeds. • Develop and implement a biodiversity policy and varietal conservation programme. • Implement measures to improve productivity and fertiliser use efficiency, including the promotion and demonstration of soil conservation techniques. • Develop and promote integrated pest management and bio-control of weeds.	• Develop and distribute climate-resilient (stress-resistant) crop seeds and adjust the cropping system. • Regulate fertiliser use for soil conservation and carbon sequestration. • Plant disease management system focused on climate change risk	• Lack of research and technological capacity • Accessibility and distribution of existing and forthcoming CRM measures • Limited understanding of the linkage between crop production and CRM • Discordance between the CRM measurements and agriculture expansion
Outcome: Increased application of appropriate mechanisation in the agricultural value chain **Outcome:** Increased use of improved animal and fish breeding, health, and husbandry services and technologies by livestock producers		
• Establish contingency planning and financing for emerging animal disease threats. • Establish an identification, inventory, and fishery resource for the conservation of adaptable fish species.	• Animal disease management system focused on climate change risk • Research the transformation of the ecosystem (both the livestock and fishery sectors) caused by climate change impacts (e.g. rising ocean temperatures, high temperatures, droughts, and floods). • Identify measurements to minimise methane emissions and deforestation caused by the livestock industry.	• Lack of research and technological capacity • Accessibility and distribution of existing and forthcoming CRM measures • Limited understanding of the linkage between the livestock and fishery sectors, and CRM • Discordance between the CRM measurements and agriculture expansion
Outcome: Establishing and adopting sustainable farming, GAP, good animal husbandry practices, good aquaculture practices, and organic agriculture practices		
• Coordinate, formulate, elaborate, document, and promote concepts, principles, guidelines, laws, regulations, and protocols for GAP, good animal husbandry practices, and organic agriculture. • Increase the production, value-addition, sale, and consumption of GAP and organic agriculture products.	• GAP in real practice (e.g. hybrid rice production technology, including a modified system of rice intensification, and alternate wetting and drying irrigation techniques)	• Incentivise and motivate farmers and stakeholders to apply GAP as adaptive farming practices.

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Annex 4.1: ***Continued***

Current Plans/ Evidence Needed	Analysis and Data for Effective Implementation of the Agriculture Development Strategy	Gaps
Outcome: Improved resilience of farmers to climate change and disasters		
• Conduct research on stress-tolerant varieties and breeds of crops, livestock, and fish to develop climate-resilient agriculture that has higher yields. • Establish an early warning system and adopt early warning information for managing climate change risks. • Establish a climate information and weather indexation system designed to provide information to farmers. • Strengthen the seed and fodder reserve system to cope with natural disasters. • Improve the capacity of extension staff and farmers in climate-smart agricultural practices. • Implement a programme to in-build mitigation factors and resilience of livestock farmers to climate change. • Increase the use of climate-smart and conservation-oriented livestock utilisation practices and conservation farming. • Establish a fund for preparedness and response to droughts, flood, epidemics, and emergencies. • Carry out community-based disaster risk management capacity building.	• Develop and distribute climate-resilient (stress-resistant) crops, livestock, and fisheries. • Farmers' access to and awareness of climate information (including early warning systems and capacity-building programmes) • Policy countermeasures for climate change risks and negative impacts on agriculture	• Lack of research and technological capacity • Limited understanding about the importance of climate-resilient measures • Incentivise and motivate farmers and stakeholders to apply climate-resilient practices (i.e. climate-smart agriculture). • Lack of access and mobility of farmers with respect to CRM programmes and services

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Annex 4.1: *Continued*

Current Plans/ Evidence Needed	Analysis and Data for Effective Implementation of the Agriculture Development Strategy	Gaps
Pillar 3: Competitiveness		
Outcome: Improved business environment, information, and investment along the agri-food supply chain		
• Design and implement an investment promotion strategy for the agricultural and food sector. • Help strengthen the capacity of the Myanmar Investment Commission to expedite investment applications in the agriculture sector while effectively accounting for environmental and social impact analysis.	• CRM investment to strengthen the agricultural environment	• Attract more investment in a climate-resilient agro-environment • Coordinate CRM measures with national decision-making tools, including environmental and social impact analysis. • Promote climate-resilient diversification of rural livelihoods with more on- or off-farm income-generating opportunities.
Outcome: Protected intellectual property rights for the agricultural and food sectors		
• Develop, approve, and implement a Plant Variety Protection Law.	• Develop and distribute climate-resilient (stress-resistant) crop and energy crop varieties. • Develop and distribute CSA technology.	• Incentivise and promote the research and development of new climate-resilient crop and CSA technology. • Support farmers with the appropriate access to the intellectual property rights needed to deploy CSA technology.
Outcome: Development of a reliable quality system that helps farmers and food processors get higher prices for higher quality goods, incentivising quality upgrading **Outcome:** Institutionalisation of an enhanced framework for gender-equitable and participatory planning and implementation of rural development programmes		
• Implement a village-level community development initiative. • Build community capacity in the preparation and drafting of action plan projects.	• Adaptation and mitigation measures for CRM in the community development initiative or action plan	• Limited understanding of the importance of climate-resilient measures • Lack of access and mobility of farmers with respect to CRM programmes and services • Specific focus on the vulnerable, landless, women, and marginalised groups in climate-sensitive geographic areas

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Annex 4.1: ***Continued***

Current Plans/ Evidence Needed	Analysis and Data for Effective Implementation of the Agriculture Development Strategy	Gaps
Outcome: Improved rural infrastructure to boost the efficiency and profitability of smallholder agriculture		
• Promote renewable energies (e.g. mini-hydro, solar, biomass, and biogas). • Construct rural water supply infrastructure.	• A secured and efficient power-generation system considering the high potential of renewable energy sources and shorter return periods of climate hazards • Effective water management system dealing with diverse climate hazards	• Capacity building for inclusive, sustainable, and resilient renewable energy systems that take climate change into consideration • Lack of climate-resilient measures and technologies to manage climate hazards • Limited irrigation and water management systems that are heavily dependent on rainfed agricultural production, which is not sustainable
Outcome: Increased competitiveness and stakeholder participation in agricultural value chains engaged with prioritised commodities		
• Train trainers on climate-friendly agribusiness value chains.	• Capacity building programme for human resources, especially focused on CRM measurements	• Promote a training programme related to climate-resilient measurements and practices that can be adopted for the agricultural value chain.
Outcome: Enhanced food quality and safety **Outcome:** Improved access to a range of financial services for farmers and agribusiness enterprises		
• Explore options for financially and economically sustainable agricultural insurance and develop policies, laws, and regulations as appropriate.	• A financially sound and affordable agricultural insurance programme for farmers at risk of climate change	• Encourage in-depth consideration and research to formulate an insurance programme that is universally available and flexible to the diverse hazards of climate change.
Outcome: Trade-facilitated growth of agri-food and agricultural product exports		
	• Carbon emission-efficient trade facilitation	• Consider the carbon footprint of the trade of agricultural products.

CRM = climate risk management; CSA = climate-smart agriculture; GAP = good agriculture practice; MAPDRR = Myanmar Action Plan on Disaster Risk Reduction; MCCSAP = Myanmar National Climate Change Policy, Strategy and Action Plan; MOALI = Ministry of Agriculture, Livestock and Irrigation.

Source: Authors.

Annex 4.2: Investment Priorities for a Climate-Resilient Food System

Outcomes	Investment Priorities
Pillar 1: Improved governance	
Effective integrated planning based on participatory processes at both the union and state or regional levels.	• Existence of indicators, baselines, and targets of ADS impacts relevant to CRM
Improved capacity for policy formulation and analysis	• Increased investment in policy studies and review, focusing on the linkage between agriculture and CRM • Number of capacity-building programmes regarding policy formulation and analysis relevant to the linkage between agriculture and CRM • Number of MOALI (and Agriculture Policy Unit) staff members participating in the CRM capacity-building programme
Timely and effective monitoring and evaluation processes	• Existence of implementation plan for monitoring and evaluating CRM outcomes in the agricultural sector • Existence of indicators, baselines, and targets of ADS impacts relevant to CRM
Sound statistical systems for making evidence-based decisions	• Proportion of sustainable development indicators produced at the national level with full disaggregation when relevant to the target, in accordance with the Fundamental Principles of Official Statistics (SDGs indicator) • Monetary value of all resources made available to strengthen statistical capacity in Myanmar (SDGs indicator) • Collection of data especially related to the effects of climate change on the agriculture, livestock, and fisheries sectors • Disaggregation level of statistic information, which can track the climate vulnerability of at-risk regions
Strong farmer and industry associations and federations	• Creation of Unit of Farmer Organizations Affairs • Number of annual meetings of the MOALI with farmer organisations addressing CRM issues
Strengthened farmers' land rights and enhanced capacity of institutions involved in agricultural land	• Number of laws and regulations created or amended to arrange land tenure with climate change adaptation and mitigation instruments (i.e. improved land inventory and land-use regulation in at-risk areas) • Existence of a monitoring system to investigate the effect of climate change on soil condition (i.e. deforestation, encroachment, soil erosion, and the reduction of the 'carbon sink' effect) • Expenditures (monetary and in-kind) on capacity building and land rights-protection activities (especially in at-risk regions) • Input data collected for the analysis of climate change effects on the agricultural sector while developing agro-ecological zoning

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Annex 4.2: ***Continued***

Outcomes	Investment Priorities
MOALI capacity for ADS coordination and implementation enhanced and guided by MOALI professional expertise and democratically appointed, gender-equitable civil society representatives	• Amount of budget committed to public–private and civil society partnerships (SDGs indicator, especially focused on CRM and the agricultural sector) • Communication about the strengthening of institutional, systemic, and individual capacity-building to implement adaptation, mitigation, technology transfer, and development actions (SDGs indicator) • Establishment of coordination unit for the implementation of the ADS under the Department of Planning • Capacity-building and technical assistance programme for staff members of the unit to promote better understanding of the linkage between agriculture and CRM
Improved food and nutritional security for the most disadvantaged groups	• Number of food and nutrition policy measures applied to vulnerable groups at risk of climate change • Proportion of people at risk of climate change, amongst the beneficiaries of the food and nutrition policy measures (e.g. food for work programme, food or input vouchers, and income support)
The MOALI restructured to integrate existing units better and become more responsive to farmers, enterprises, and civil society	• Institutional alternatives that can promote a climate-resilient agricultural environment and improve the capacity of staff members regarding CRM and the agricultural sector
Pillar 2: Productivity	
Improved agricultural research system for crops, livestock, and fisheries	• Research and development expenditure as a proportion of gross domestic product (SDGs indicator, focused on CRM and the agricultural sector) • Amount of international support on research and development for sustainable consumption and production and environmentally sound technologies (SDGs indicator, focused on CRM and the agricultural sector) • Researcher per one million inhabitants (SDGs indicator, focused on CRM and the agricultural sector) • Increased investment for CRM in the agricultural research system • Increased investment for research focusing on climate-resilient species and climate-smart agriculture practices • Number of CRM research programmes prioritised in research master plans

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Annex 4.2: ***Continued***

Outcomes	Investment Priorities
Transformed public–private agricultural extension system delivering improved products (crops, livestock, fisheries) and technology for adoption and adaptation, better linked to agricultural research	• Number of farmers with access to extension • Number of extension materials containing CRM materials • Number of capacity-building programmes for human resources in the extension sector (e.g. extension service staff and subject matter specialists), especially regarding CRM measurements in the agricultural sector • Proportion of vulnerable, landless, women, and marginalised groups in climate-sensitive regions amongst the beneficiaries of the extension programme • Increase in the adoption of extension techniques by farmers to improve their climate resilience
Developed (or revived) effective education and training to build 'human capital' in the agricultural and food sector responding to the evolving needs of farmers and the private sector in rural areas	• Integration of mitigation, adaptation, impact reduction, and early warning into primary, secondary, and tertiary curricula (SDGs indicator) • Number of agriculture courses with CRM contents and vice-versa • Number of students who take agriculture courses with CRM contents and vice-versa
More efficient and sustainable irrigation and water-use systems	• Increased investment in studies and policy measures related to climate-resilient water management systems • Number and coverage of agriculture extension and advisory services regarding water resource management (especially in at-risk regions) • Increase in the number of extension workers providing knowledge of water management practices with CRM measures • Implementation of environmental impact analyses for irrigation projects • Establishment and activation of the irrigation management policy and water user associations at the regional level for countermeasures of diverse climate hazards (especially in at-risk regions)
Increased use of improved crop production inputs and technologies by crop growers	• Increased investment in studies and policy measures for climate-resilient crop production systems • Data collected for the plant disease management system focused on climate change effects • Increase in the number and coverage of agriculture extension and advisory services regarding climate-resilient crop production (especially in at-risk regions) • Increase in the number of extension workers providing knowledge of crop-production practices with CRM measures • Number of regulations on fertiliser use to conserve soil fertility • Annual soil testing introduced to provide farmers with accurate information regarding fertiliser use

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Annex 4.2: ***Continued***

Outcomes	Investment Priorities
Increased application of appropriate mechanisation in the agricultural value chain	
Increased use of improved animal and fish breeding, health, and husbandry services and technologies by livestock producer industries using sustainable practices	• Increased investment in studies and policy measures for ecosystems transformed by climate change, and climate-resilient animal and fish breeding, health, and husbandry services • Data collected about emerging animal disease threats focused on climate change effects • Number and coverage of agriculture extension and advisory services regarding climate-resilient livestock and fishery production (especially in at-risk regions) • Increase in the number of extension workers providing animal and fish breeding services with CRM measures • Number of policy measures to control environmental influences of the livestock industry (e.g. methane emissions and deforestation)
Sustainable farming, good agricultural practices, and good veterinary husbandry practices established and adopted	• Number of good agricultural practices and good veterinary husbandry practices with the implementation of CRM
Resilience of farmers to climate change and disasters improved	• Increased investment in the development and distribution of climate-resilient species (crops, livestock, and fisheries) • Increase in the number of farmers with access to weather-related information (including an early warning system and capacity-building programme) • Number and coverage of early warning dissemination outlets for climate hazards (by type of outlet) • Number of policy countermeasures for the negative impact of climate risks toward the agricultural sector • Increase in CSA practices and techniques
Pillar 3: Competitiveness	
Improved business environment, information, and investment along the agri-food supply chain	• Increased investment towards a climate-resilient agriculture environment • Implementation of environmental impact analyses as the primary national decision-making tool • Number of measures promoting the diversification of income-generating opportunities in rural areas (especially in at-risk regions)
Protected intellectual property rights for the agricultural and food sectors	• Number of intellectual property rights protected by national laws especially related to CRM (e.g. climate-resilient crop and energy crop varieties, and CSA technology)

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Annex 4.2: ***Continued***

Outcomes	Investment Priorities
Development of a reliable quality system that helps farmers and food processors get higher prices for higher quality goods, incentivising quality upgrading	
Institutionalisation of an enhanced framework for gender-equitable and participatory planning and implementation of rural development programmes	• Number of regional communities who own adaptation and mitigation measures for CRM in the community development initiative of action plans (especially in at-risk regions)
Improved rural infrastructure boosts the efficiency and profitability of smallholder agriculture	• Increased investment in alternative power generation with renewable energy sources considering shorter return periods for climate hazards • Increased investment in an effective and climate-resilient water management system, including rural water supply infrastructure
Increased competitiveness and stakeholder participation in agricultural value chains engaged with prioritised commodities	• Number of capacity-building (training of trainers) programmes on CRM measurements
Enhanced food quality and safety	
Improved access to a range of financial services for farmers and agribusiness enterprises	• Number and coverage of agricultural insurance programmes for farmers at risk of climate change
Trade-facilitated growth of agri-food and agricultural product exports	• Policy measures to promote carbon emission-efficient trade of agricultural products

CRM = climate risk management; CSA = climate-smart agriculture; MOALI = Ministry of Agriculture, Livestock and Irrigation; SDG = Sustainable Development Goal.

Source: Authors.

Annex 4.3: Tracking System for a Climate-Resilient Food System

Outcomes	Impact Indicators
Pillar 1: Improved governance	
Effective integrated planning based on participatory processes at both the union and state or regional levels	• Establish or operationalise an integrated policy, strategy, or plan that increases farmers' ability to adapt to the adverse impacts of climate change, fosters climate resilience, and lowers greenhouse gas emissions in a manner that does not threaten food production (SDGs indicator) • Proportion of local governments that adopt and implement local DRR strategies in line with national DRR strategies (SDGs indicator) • Adopt and implement national DRR strategies in line with the Sendai Framework for Disaster Risk Reduction 2015–2030 (SDGs indicator) • Number of clauses or articles in the ADS that mention CRM plans and programmes • Regular and periodic tracking of the targeted CRM-relevant indicators
Improved capacity for policy formulation and analysis	• Establish or operationalise an integrated policy, strategy, or plan that increases their ability to adapt to the adverse impacts of climate change, fosters climate resilience, and lowers greenhouse gas emissions in a manner that does not threaten food production (SDGs indicator) • Number of clauses or articles in ADS that mention CRM plans and programmes • Number of policy studies and independent policy reviews regarding the linkage between agriculture and CRM • Number of MOALI (and Agriculture Policy Unit) staff who self-evaluate that they better understand the linkage between agriculture and CRM through the capacity-building programme
Timely and effective monitoring and evaluation processes	• Number and frequency of periodic monitoring and evaluation reports by the Department of Planning with targeted CRM-relevant indicators
Sound statistical systems for making evidence-based decisions	• Frequency of statistical data updates with CRM contents in the agricultural sector (census and annual surveys) • Number of statistic data collected with regard to CRM and agriculture
Strong farmer and industry associations and federations	• Number of farmer organisations with a common strategy or countermeasure toward the impact of CRM on the agriculture sector (especially in at-risk regions)
Strengthened land rights for farmers and enhanced capacity of institutions involved in agricultural land	• Proportion of the adult population with secure tenure rights to land, with legally recognised documentation, and who perceive their land rights as secure, by gender and by type of tenure (SDGs indicator, especially in at-risk regions) • Changed proportion of national land use • Rate of forest reduction (deforestation index) • Rate of illegal logging and encroachment for agricultural purposes • Rate of soil erosion • Number of analysis outcomes from agro-ecological zoning programmes that can be applied to climate resilience for agricultural production in at-risk regions

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Annex 4.3: ***Continued***

Outcomes	Impact Indicators
MOALI capacity for ADS coordination and implementation enhanced and guided by MOALI professional expertise and democratically appointed, gender-equitable civil society representatives	• Number of projects in the MOALI conducted based on the partnership with civil society or the private sector in CRM and the agricultural sector • Number of staff members who self-evaluate that they better understand the linkage between agriculture and CRM through the capacity-building and technical assistance programme
Improved food and nutritional security for the most disadvantaged groups	• Prevalence of undernourishment (SDGs indicator, especially in at-risk regions) • Prevalence of moderate or severe food insecurity in the population (SDGs indicator, especially in at-risk regions) • Prevalence of stunting amongst children younger than 5 (SDGs indicator, especially in at-risk regions) • Prevalence of malnutrition amongst children younger than 5 (SDGs indicator, especially in at-risk regions)
The MOALI restructured to integrate existing units better and become more responsive to farmers, enterprises, and civil society.	• Number of staff members who self-evaluate that they better understand the linkage between agriculture and CRM with institutional alternatives

ADS = Agriculture Development Strategy; CRM = climate risk management; DRR = disaster risk reduction; MOALI = Ministry of Agriculture, Livestock and Irrigation; SDG = Sustainable Development Goal.

Source: Authors.