The Future of Philippine Agriculture under a Changing Climate

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The Future of Philippine Agriculture under a Changing Climate

Policies, Investments and Scenarios

edited by Mark W. Rosegrant
and Mercedita A. Sombilla

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PREFACE

The Philippines is highly vulnerable to climatic stresses, and droughts and floods have substantially affected agricultural production over time. In particular, El Niño Southern Oscillation (ENSO)–related droughts have affected the country's water resources and temperatures, with flow-on effects to the agricultural sector, as well as to health and the environment. In addition to more frequent and severe flooding and drought, the Philippines has also experienced many catastrophic natural disasters, particularly typhoons. Yolanda (internationally known as Haiyan) devastated the country in 2013, causing 6,300 deaths; the displacement of over 5 million citizens; an estimated 89.60 billion Philippine peso (PhP) in property damage to houses, hospitals, schools, roads, bridges, and so on; and PhP42.76 billion in losses to the productive sectors, including agriculture. Consequently, the Philippines ranks high in the Global Climate Risk Index, taking first place in 2013. As recently as December 2017, Typhoons Urduja and Vinta (internationally known as Tembin and Kai-Tak, respectively) once again caused the loss of hundreds of lives, along with the destruction of property, infrastructure, and livelihoods.

The current state of climate science research does not attribute extreme events like floods, droughts, or typhoons to climate change, but there is growing consensus that climate change increases the frequency and severity of such events. In combination with key drivers of food production growth — such as income and population growth, investment in research and technology, and changes in dietary patterns — climate change will have a major impact on Philippine farmers' ability to produce sufficient food and generate enough income to support healthy and productive lives. Poor and vulnerable communities are the most severely affected based on their reliance on subsistence farming and their limited capacity to undertake measures to adapt to climate change, which is of critical importance to sustaining agricultural production growth in the pursuit of food security and poverty reduction. Failure to adapt to climate change would make the Philippines even more susceptible both to extreme events and to the long-term impacts of climate change. The country must prepare for these impacts and enhance its capacity to deal with them economically, institutionally, scientifically, and technically.

This book has been produced as a response to this need. The volume focuses on enhancing the adaptive capacity of the Philippine agriculture sector — the most vulnerable and severely affected by climate change, first, because of its high dependence on natural resources, and second, because it has the highest incidence of poverty and lagging growth compared with the rest of the economy. The volume is designed to provide a much-needed base of knowledge and menu of policy options in support of decision- and policymaking on agriculture, climate change, and food security. The volume uses newly generated data, modelling outputs, and innovative analyses to provide a scientific basis for a variety of adaptation measures under different sets of climate change scenarios to guide decisionmakers in strategic planning and policy formulation.

OVERVIEW OF CLIMATE TRENDS AND PROJECTIONS

The Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) of the Department of Science and Technology — the national agency mandated to undertake scientific and technological services in meteorology, hydrology, climatology, astronomy, and other geophysical sciences — developed climate projections as inputs for mainstreaming the analysis of vulnerability and the need for adaptation across the country's development plans, programmes, and activities. The summary analysis below used the PAGASA climate projections in combination with available observed baseline climate data for the 1951–2010 period.

The Philippines has four climate types. Type I occurs in westernmost parts of the country and is characterized by two pronounced seasons: dry from November to April and wet from May to October. Type II, in the eastern coast, has no dry season but pronounced rainfall from November to April. Type III, in the central-west, has no pronounced seasons but is characterized by a slightly drier period from November to April. Finally, Type IV occurs in the country's central-east and is characterized by an equal distribution of rainfall throughout the year. Analyses of the observed baseline climate data indicated the following changes in key climate trends during 1951–2010:

1. The yearly mean temperature rose by 0.65°C.
2. The maximum and minimum temperatures rose by 0.35°C and 0.94°C, respectively, leading to a significant increase in the number of hot days and a decrease in the number of cool nights.
3. Increased intensity of extreme daily rainfall is already being experienced in most parts of the country.
4. An average of twenty tropical cyclones formed or crossed the Philippine Area of Responsibility per year, and the number of tropical cyclones with maximum sustained winds of more than 150 kilometres per hour increased slightly, especially during the El Niño years.

It should be noted that the analysis indicated significant variation in the above observed trends across the country's regions (see Chapter 4, this volume, for more information).

PAGASA projected the Philippine climate at two future points in time, 2020 and 2050, based on the observed climate trends outlined above, and the mid-range A1B emission scenario of the Fourth Intergovernmental Panel on Climate Change (see Chapter 9, this volume). The results can be summarized as follows:

- All areas of the Philippines are projected to become warmer, more so in the relatively warmer summer months.
- In all areas of the country, yearly mean temperatures (that is, the average of maximum and minimum temperatures) are projected to rise by 0.9°C to 1.1°C in 2020 and by 1.8°C to 2.2°C in 2050.
- All seasonal mean temperatures are projected to rise in both 2020 and 2050, and be consistent in all the provinces across growing seasons.
- Substantial regional differences are projected in rainfall changes in 2020 and 2050 in most parts of the country, with reduced rainfall in most provinces during the summer season, which is projected to make the usually dry season drier and increase the likelihood of drought. Rainfall is expected to be higher in most areas of Luzon

and Visayas during the southwest monsoon and the September–November months, making these periods wetter and increasing the chances of floods.

- Northeast monsoon rainfall is projected to increase, particularly in areas characterized by the country's Type II climate. This is projected to increase the likelihood that these provinces will experience flooding.
- The southwest monsoon season is projected to have larger increases in rainfall, particularly in the provinces of Luzon (0.9–63 per cent) and Visayas (2–22 per cent). In contrast, rainfall during the southwest monsoon season is generally projected to decrease in the provinces of Mindanao.
- Projections for extreme events in 2020 and 2050 show that hot temperatures (indicated by the number of days with maximum temperature exceeding 35°C) will continue to become more frequent, that the number of dry days (those with less than 2.5 millimetres (mm) of rain) will escalate in all parts of the country, and that occurrences of heavy daily rainfall (exceeding 300 mm) will continue to increase in Luzon and Visayas.

These climate projections were subsequently extended to 2100 and, under the same mid-range scenario, indicated a rise in temperature approaching as much as 3.1°C based on the assumption that past emissions deposited in the atmosphere will continue to induce an upward trend, ultimately with negative impacts for almost all economic sectors, but particularly for agriculture.

THE IMPACT ON PHILIPPINE AGRICULTURE

Previous studies have shown that the direct impacts of climate change on agriculture could be both positive and negative. The negative impacts, however, greatly outweigh the positive ones. On the positive side, for example, typhoons increase the agricultural water supply, and soil erosion resulting from floods has the potential to improve soil fertility as nutrients flow from upland to lowland areas. Other factors being equal, these impacts are considered to produce positive effects because they facilitate increased agricultural production in the areas affected, thereby helping to improve food security.

In contrast, natural hazards — such as severe typhoons, floods, and droughts — can reduce farm productivity, damage farm structures and facilities (including irrigation systems), limit farm planting options, and destroy infrastructure facilities that affect the flow and mobility of farm inputs and outputs. Studies have shown that crops suffer yield reductions whenever temperatures exceeded threshold values. Similarly, temperature increases coupled with rainfall changes that lead to drought conditions increase the incidence or outbreaks of pests and diseases, both in plants and animals. During the severe El Niño in 1997–98, heavy locust infestations occurred in twenty-three provinces. The country experienced a mild El Niño in 2010, followed by a severe one in 2014–15, resulting in infestations of armyworms in twenty-four provinces. Occurrences of coconut scaling insects in the provinces of Batangas, Laguna and Quezon and nearby areas have been attributed to these heat wave conditions. At the other extreme, declining temperatures in the Cordillera Autonomous Region have caused frost-related damage to vegetables and other high-value crops grown in the region. In the fisheries subsector, migration of fish to cooler and deeper waters would force fishers to travel further from the coasts to increase their catch. Seaweed production, which is already being practised as an adaptation to climate change in many poor and depressed coastal communities, has likewise been adversely affected.

The negative impacts of climate change lead to increases in the overall cost of agricultural production, declines in agricultural productivity, contraction of the food supply, and increased food prices. Decreased yields and inadequate job opportunities in the sector can prompt migration and shifts in population, leading to increased pressure on already depressed urban areas. Insufficient food supply can further lead to increased incidence of malnutrition; higher poverty levels; and, potentially, heightened social unrest and civil conflict in certain areas. All these negative impacts pose threats to food security, particularly in areas directly affected.

In value terms, the total damages to Philippine agriculture due to typhoons, droughts, and floods between 2000 and 2016 is estimated at PhP295.31 billion or US$6.46 billion (see Tables 8.2 and 8.3 in Chapter 8, this volume). Yearly losses averaged PhP17.37 billion, equivalent to about 1.8 per cent of the sector's yearly average gross value-added. This includes production losses and damages to farm equipment, facilities, structures, irrigation, and road facilities. Losses were highest in 2014, at PhP40.40 billion, and lowest in 2002, at PhP1.21 billion. According to the

Department of Agriculture, the two most recent typhoons (Urduja and Vinta) caused total agricultural losses of approximately PhP1.24 billion. The most affected commodities were rice, coconuts, corn, high-value cash crops, bananas, and fisheries (see Table 8.1 in Chapter 8 of this volume).

THE STRUCTURE OF THE BOOK

In Part I, the book begins by laying out the context of Philippine agriculture, along with relevant historical evidence and information on the challenges facing the sector. Chapter 1, by Majah-Leah V. Ravago, Arsenio M. Balisacan, and Mercedita A. Sombilla, provides an overview of the patterns, composition, policies, and institutional framework that have influenced the performance of the agricultural sector in recent years, along with the changing dynamics of agricultural supply and demand in the context of a growing economy, urbanization, regional market integration, and climate change. Chapter 1 also provides evidence of the effects of a changing climate on critical agricultural resource inputs, as well as on productivity performance. Chapter 2, by David M. Wilson and Rodel D. Lasco, offers a review of the evidence of impacts of land-use change in the Philippines in the past twenty years, including the role of agricultural expansion on deforestation within both regional and global contexts. The chapter details the effects of a changing climate on land-use and ecosystem services, which are key to agricultural productivity, as well as the contributory role of land-use change to global greenhouse gas emissions. Chapter 3, by Arlene B. Inocencio, focuses on water — a critical resource not only for agriculture, but also for life itself. The chapter examines agriculture’s readiness to respond to potential climate impacts through an analysis of existing evidence on water supply and demand, and especially the changing dynamics of water demand across agricultural, industrial, and domestic uses. Specifically, the chapter outlines what the Philippine government has implemented in terms of public investments in water for agriculture in the past four decades, and illustrates the need for potential climate change impacts to purposefully be factored into agricultural water-sector investments, planning, management, and development. Chapter 4, by Felino P. Lansigan, presents scientific evidence of climate change and variability, its effects and impacts on agricultural production, responses to climate risks in agriculture, and challenges and imperatives. The implications of climate variability and climate change on the agricultural sector are also discussed, along with best agricultural practices and technology- and institutionally based adaptation strategies. Chapter 5, by Asa Jose U. Sajise, Dieldre S. Harder, and Paul Joseph B. Ramirez, provides an examination of the links between agricultural growth and the environment. The chapter describes the state of the Philippine natural resource base and environment in the context of agricultural productivity by reviewing current evidence on the extent of environmental externalities in four domains: land degradation, water availability, agrobiodiversity, and climate change. The impact of climate change is illustrated by assessing the sustainability of productivity growth for rice through a case study on greenhouse gas emissions.

Part II of the book focuses on the challenges climate change imposes on the Philippine agricultural sector and strategies that need to be implemented to respond to these challenges. Chapter 6, by Maria Emilinda T. Mendoza, focuses on the gender-differentiated impacts of climate change, emphasizing the importance of mainstreaming gender issues into climate change–related policies and programmes. The chapter demonstrates the importance of determining women's capabilities and vulnerabilities in being able to contribute to viable adaptation and mitigation measures, along with the challenge of supporting women's ability to participate in decisionmaking processes related to such responses. Chapter 7, by Marites M. Tiongco, focuses on the country's adaptation and mitigation strategies in terms of priorities and limitations in key vulnerable areas (food, land, water, and energy); trends in government budget allocations; and the roles of the institutions involved, together with their capacity and effectiveness in addressing climate change risks in the agriculture sector. Chapter 8, by Majah-Leah V. Ravago, James A. Roumasset, and Karl Robert L. Jandoc, provides a conceptual framework for understanding risk management and resilience at farm-household and national levels. The authors then apply the framework at the household level to explore how farm households cope with natural hazards such as typhoons, droughts, and floods. At the national level, the discussion focuses on how public policy can be designed to maximize economic welfare both before and after a disaster occurs. The discussion considers the pros and cons of alternative public policies in reducing household vulnerability before, during, and after a disaster.

Part III of the book presents the results of economic modeling work designed to explore the country's potential agricultural "futures" under climate change, thereby evaluating agricultural strategies to address climate change in the Philippines. The framework underlying the three chapters in this section of the book is a linked modelling approach to assess the effects on agriculture of alternative agricultural policies, technologies, and investments in combination with macroeconomic policies and climate adaptation strategies under a range of simulated climate and socioeconomic conditions. Chapter 9, by Timothy S. Thomas, Vijay Nazareth, and Renato A. Folledo, Jr. describes and presents the results of the biophysical approach to modelling alternative agricultural futures under climate change. Chapter 10, by Nicostrato D. Perez and Mark W. Rosegrant, uses a partial equilibrium agricultural model with forty-six crop and livestock commodities — the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) of the International Food Policy Research Institute (IFPRI) — to analyse and simulate the agricultural impacts and costs of climate change; the effectiveness of existing and emerging production technologies; and the contribution of demographic, development, and investment policies to food security and climate change adaptation efforts. Chapter 11, by Angga Pradesha and Sherman Robinson, uses a general equilibrium approach to assess the impacts of climate change on the Philippine agricultural sector and economy, focusing on the country's agricultural production, income distribution, and the macroeconomic environment.

In Part IV, Chapter 12, by Mercedita A. Sombilla and Mark W. Rosegrant, synthesizes the book's recommendations to address the necessary policy and institutional challenges and enable the agricultural sector to perform its role as a key pillar for the country's pursuit of inclusive growth, poverty reduction, and sustainable development. Strategies and investments options for agriculture, including the pros and cons of its implementation and operationalization, are identified and summarized for policymakers, development planners, and agricultural scientists.

THE BROADER RELEVANCE OF THIS WORK ACROSS ASIA

The analysis and tools presented in this book have direct relevance to other countries in the Asia and Pacific regions, which share many characteristics related to agriculture and climate change with the Philippines. Climate projections in other parts of Asia are like those estimated for the Philippines. The temperature projections for the twenty-first century under the mid-range scenario indicate strong warming. In Southeast Asia, warming is similar to the global mean of 2.5°C by the end of the twenty-first century. Warming at levels above the global mean is projected for South Asia (3.3°C) and East Asia (3.3°C), and much higher levels than the global mean are projected in the continental interior of Asia (3.7°C in central Asia, 3.8°C in Tibet, and 4.3°C in northern Asia). Precipitation in summer is likely to increase in northern Asia, East Asia, South Asia, and most of Southeast Asia but is projected to decrease in central Asia. Summer heat waves/hot spells are projected to be more intense, of longer duration, and more frequent in East Asia. Fewer very cold days are projected to occur in East Asia and South Asia, and an increase in the frequency of intense precipitation events is expected in parts of South Asia and in East Asia. Extreme rainfall and winds associated with tropical cyclones are also projected to increase in East Asia, Southeast Asia, and South Asia.

The impacts of climate change on temperature and precipitation in much of the rest of Asia will generally have the same negative effect on food production and food security as in the Philippines. Higher temperatures threaten agricultural productivity by stressing crops and reducing yields. Projected impacts on rice and wheat yields suggest that any increases in production associated with carbon dioxide fertilization will be more than offset by reductions in yields resulting from temperature or moisture changes.

Coastal erosion and land loss, inundation and sea flooding, upstream movement of the saline/freshwater front, and seawater intrusion into freshwater lenses are projected to occur in the large deltaic regions of Bangladesh, Myanmar, Vietnam, and Thailand, and in the low-lying areas of Indonesia, the Philippines, and Malaysia with rising sea levels and increased sea-surface temperatures potentially leading to the displacement of several million people from the region's coastal zone. The costs of response measures to reduce the impact of a 30–50 centimetres sea-level rise in the region could amount to millions of dollars per year.

Although many Asian countries have grown more rapidly than the Philippines, agriculture remains an important economic sector in most Asian and Pacific countries. The rising need for food and industrial crops over time has triggered to the need for increased agricultural production, which has exerted substantial strain on the environment.

Water resources, which are already under heavy stress from increasing population and economic growth, continue to fall under considerable pressure. Furthermore, economic growth in Asia and the Pacific is also dependent on other natural resources, especially forest products. Like the Philippines, other countries in the region are confronted with the impacts of climate change, including droughts, floods, typhoons, rising sea levels, and heat waves. As in the Philippines, climate change poses significant threats to the sustainability of the region's economic growth and poverty reduction.

Given the similarity of these challenges, the analysis and analytical tools presented in this book to support policymakers, scientists, and others are relevant not only for the Philippines, but also for other Asian and Pacific countries. It is intended that this work facilitates much-needed analysis of the effects of climate change and the identification of appropriate adaptation interventions to mitigate the impact on agriculture and food production.

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LIST OF CONTRIBUTORS

Arsenio M. Balisacan is the Chairman and Chief Executive Officer of the Philippine Competition Commission, and former Socioeconomic Planning Secretary and Director-General of the National Economic and Development Authority, Manila.

Renato A. Folledo, Jr. is Consultant at the International Council for Research in Agroforestry.

Dieldre S. Harder is Consultant at the Resources, Environment, and Economics Center for Studies Inc., Quezon City.

Arlene B. Inocencio is Full Professor and Department Chair at the School of Economics, De La Salle University, Manila.

Karl Robert L. Jandoc is Assistant Professor at the School of Economics, University of the Philippines, Diliman.

Felino P. Lansigan is Professor and Dean of the College of Arts and Sciences, University of the Philippines Los Baños.

Rodel D. Lasco is Country Coordinator of the World Agroforestry Centre.

Maria Emilinda T. Mendoza is Associate Professor at the Department of Social Development Services, College of Human Ecology, University of the Philippines Los Baños.

Vijay Nazareth is Research Analyst at the Environment and Production Technology Division, International Food Policy Research Institute.

Nicostrato D. Perez is Senior Scientist at the Environment and Production Technology Division, International Food Policy Research Institute.

Angga Pradesha is Senior Research Analyst at the Development Strategy and Governance Division, International Food Policy Research Institute.

Paul Joseph B. Ramirez is Assistant Professor at the Department of Economics, College of Economics and Management, University of the Philippines Los Baños.

Majah-Leah V. Ravago is Research Faculty at the Department of Economics, Ateneo de Manila University, and previously Assistant Professor at the School of Economics, University of the Philippines, Diliman.

Sherman Robinson is Research Fellow (emeritus) at the International Food Policy Research Institute and Professor of Economics (emeritus) at the University of Sussex.

Mark W. Rosegrant is Research Fellow Emeritus in the Director General's Office and former Director of the Environment and Production Technology Division, International Food Policy Research Institute.

James A. Roumasset is Professor (emeritus) at the Department of Economics, University of Hawaii, USA.

Asa Jose U. Sajise is Associate Professor at the Department of Economics, College of Economics and Management, University of the Philippines Los Baños.

Mercedita A. Sombilla is Assistant Secretary of the Regional Development Office, National Economic and Development Authority, Manila.

Timothy S. Thomas is Research Fellow at the Environment and Production Technology Division, International Food Policy Research Institute.

Marites M. Tiongco is Full Professor and Dean at the School of Economics, De La Salle University, Manila.

David M. Wilson is Consultant at the World Agroforestry Centre.