

CLIMATE RISK COUNTRY PROFILE

PHILIPPINES



WORLD BANK GROUP



ASIAN DEVELOPMENT BANK

COPYRIGHT

© 2021 by the World Bank Group
1818 H Street NW, Washington, DC 20433
Telephone: 202-473-1000; Internet: www.worldbank.org

© 2021 Asian Development Bank
6 ADB Avenue, Mandaluyong City, 1550 Metro Manila, Philippines
Tel +63 2 8632 4444; Fax +63 2 8636 2444
www.adb.org

This work is a product of the staff of the World Bank Group (WBG) and the Asian Development Bank (ADB) and with external contributions. The opinions, findings, interpretations, and conclusions expressed in this work are those of the authors' and do not necessarily reflect the views or the official policy or position of the WBG, its Board of Executive Directors, or the governments it represents or of ADB, its Board of Governors, or the governments they represent.

The WBG and ADB do not guarantee the accuracy of the data included in this work and do not make any warranty, express or implied, nor assume any liability or responsibility for any consequence of their use. This publication follows the WBG's practice in references to member designations, borders, and maps. ADB, however, recognizes "China" as the People's Republic of China. The boundaries, colors, denominations, and other information shown on any map in this work, or the use of the term "country" do not imply any judgment on the part of the WBG or ADB, their respective Boards, or the governments they represent, concerning the legal status of any territory or geographic area or the endorsement or acceptance of such boundaries.

The mention of any specific companies or products of manufacturers does not imply that they are endorsed or recommended by either the WBG or ADB in preference to others of a similar nature that are not mentioned.

RIGHTS AND PERMISSIONS

The material in this work is subject to copyright. Because the WB and ADB encourage dissemination of their knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given. This work is licensed under the Creative Commons Attribution-NonCommercial 3.0 IGO License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc/3.0/igo/> or send a letter to Creative Commons, PO Box 1866, Mountain View, CA 94042, USA.

This CC license does not apply to WBG or non-ADB copyright materials in this publication. If the material is attributed to another source, please contact the copyright owner or publisher of that source for permission to reproduce it. WBG or ADB cannot be held liable for any claims that arise as a result of your use of the material.

Please cite the work as follows: Climate Risk Country Profile: Philippines (2021): The World Bank Group and the Asian Development Bank.

Any queries on rights and licenses, including subsidiary rights, should be addressed to World Bank Publications, The World Bank Group, 1818 H Street NW, Washington, DC 20433, USA; fax: 202-522-2625; e-mail: pubrights@worldbank.org.

Cover Photos: © Dominic Chavez/World Bank, "[The view from the San Juanico bridge that links Samar](#)" July 13, 2014 via Flickr, Creative Commons CC BY-NC-ND 2.0. © Edwin Huffman/World Bank, "[Man and water buffalo in rice fields](#)" February 13, 2013 via Flickr, Creative Commons CC BY-NCND 2.0.

Graphic Design: [Circle Graphics, Inc.](#), Reisterstown, MD.

ACKNOWLEDGEMENTS

This profile is part of a series of Climate Risk Country Profiles that are jointly developed by the World Bank Group (WBG) and the Asian Development Bank (ADB). These profiles synthesize the most relevant data and information on climate change, disaster risk reduction, and adaptation actions and policies at the country level. The profile is designed as a quick reference source for development practitioners to better integrate climate resilience in development planning and policy making. This effort is co-led by Veronique Morin (Senior Climate Change Specialist, WBG), Ana E. Bucher (Senior Climate Change Specialist, WBG) and Arghya Sinha Roy (Senior Climate Change Specialist, ADB).

This profile was written by Alex Chapman (Consultant, ADB), William Davies (Consultant, ADB) and Ciaran Downey (Consultant). Technical review of the profiles was undertaken by Robert L. Wilby (Loughborough University). Additional support was provided by MacKenzie Dove (Senior Climate Change Consultant, WBG), Jason Johnston (Operations Analyst, WBG), Yunziyi Lang (Climate Change Analyst, WBG), Adele Casorla-Castillo (Consultant, ADB), and Charles Rodgers (Consultant, ADB). This profile also benefitted from inputs of WBG and ADB regional staff and country teams.

Climate and climate-related information is largely drawn from the [Climate Change Knowledge Portal \(CCKP\)](#), a WBG online platform with available global climate data and analysis based on the latest [Intergovernmental Panel on Climate Change \(IPCC\)](#) reports and datasets. The team is grateful for all comments and suggestions received from the sector, regional, and country development specialists, as well as climate research scientists and institutions for their advice and guidance on use of climate related datasets.

CONTENTS

FOREWORD	1
KEY MESSAGES	2
COUNTRY OVERVIEW	2
CLIMATOLOGY	5
Climate Baseline	5
Overview	5
Key Trends	7
Climate Future	9
Overview	9
CLIMATE RELATED NATURAL HAZARDS	13
Heatwaves	14
Drought	15
Flood	15
Cyclones and Storm Surge	16
CLIMATE CHANGE IMPACTS	19
Natural Resources	19
Water	19
The Coastal Zone	20
Economic Sectors	21
Agriculture	21
Urban and Energy	22
Communities	23
Poverty, Inequality, and Disaster Vulnerability	23
Human Health	25
POLICIES AND PROGRAMS	26
National Adaptation Policies and Strategies	26
Climate Change Priorities of ADB and the WBG	27

FOREWORD

Climate change is a major risk to good development outcomes, and the World Bank Group is committed to playing an important role in helping countries integrate climate action into their core development agendas. The World Bank Group (WBG) and the Asian Development Bank (ADB) are committed to supporting client countries to invest in and build a low-carbon, climate-resilient future, helping them to be better prepared to adapt to current and future climate impacts.

Both institutions are investing in incorporating and systematically managing climate risks in development operations through their individual corporate commitments.

For the World Bank Group: a key aspect of the World Bank Group's Action Plan on Adaptation and Resilience (2019) is to help countries shift from addressing adaptation as an incremental cost and isolated investment to systematically incorporating climate risks and opportunities at every phase of policy planning, investment design, implementation and evaluation of development outcomes. For all International Development Association and International Bank for Reconstruction and Development operations, climate and disaster risk screening is one of the mandatory corporate climate commitments. This is supported by the World Bank Group's Climate and Disaster Risk Screening Tool which enables all Bank staff to assess short- and long-term climate and disaster risks in operations and national or sectoral planning processes. This screening tool draws up-to-date and relevant information from the World Bank's Climate Change Knowledge Portal, a comprehensive online 'one-stop shop' for global, regional, and country data related to climate change and development.

For the Asian Development Bank (ADB): its Strategy 2030 identified "tackling climate change, building climate and disaster resilience, and enhancing environmental sustainability" as one of its seven operational priorities. Its Climate Change Operational Framework 2017–2030 identified mainstreaming climate considerations into corporate strategies and policies, sector and thematic operational plans, country programming, and project design, implementation, monitoring, and evaluation of climate change considerations as the foremost institutional measure to deliver its commitments under Strategy 2030. ADB's climate risk management framework requires all projects to undergo climate risk screening at the concept stage and full climate risk and adaptation assessments for projects with medium to high risk.

Recognizing the value of consistent, easy-to-use technical resources for our common client countries as well as to support respective internal climate risk assessment and adaptation planning processes, the World Bank Group's Climate Change Group and ADB's Sustainable Development and Climate Change Department have worked together to develop this content. Standardizing and pooling expertise facilitates each institution in conducting initial assessments of climate risks and opportunities across sectors within a country, within institutional portfolios across regions, and acts as a global resource for development practitioners.

For common client countries, these profiles are intended to serve as public goods to facilitate upstream country diagnostics, policy dialogue, and strategic planning by providing comprehensive overviews of trends and projected changes in key climate parameters, sector-specific implications, relevant policies and programs, adaptation priorities and opportunities for further actions.

We hope that this combined effort from our institutions will spur deepening of long-term risk management in our client countries and support further cooperation at the operational level.



Bernice Van Bronkhorst

Global Director
Climate Change Group
The World Bank Group



Preety Bhandari

Chief of Climate Change and Disaster Risk Management Thematic Group
concurrently Director Climate Change and Disaster Risk Management Division
Sustainable Development and Climate Change Department
Asian Development Bank

KEY MESSAGES

- Historical temperatures show a warming trend since the mid-20th century, with average annual mean temperature increasing by approximately 0.6°C and a significant increase in hot days and warm nights. These trends are similar to the Pacific region in general.
- Under the RCP8.5 emissions pathway, average temperatures are projected to increase by 2.9°C by the 2090s, approximately 1°C less than the global average, and 0.7°C by the 2090s under the RCP2.6 emissions pathway. These changes are reported against the 1986–2005 baseline.
- Despite high uncertainty surrounding precipitation projections, 15 of 16 climate models assessed, projected at least some increase in precipitation.
- The Philippines faces some of the highest disaster risk levels in the world, and these are projected to intensify as the climate changes. The country is especially exposed to tropical cyclones, flooding, and landslides.
- The number of tropical cyclones making landfall is steadily increasing, with tropical cyclones appearing to also have greater intensity.
- Sea-level rise is happening at an above-average rate for some parts of the Philippines, exposing up to one million people to flooding from rising sea levels by 2070–2100; investing in adaptation could potentially bring this number down significantly.
- The agricultural sector is especially vulnerable to climate change impacts. Both increased flooding and the increased likelihood of droughts could impact agricultural land. This could contribute towards decreased agricultural productivity.
- Without effective adaptation and disaster risk reduction, climate change is likely to exacerbate high existing levels of income and wealth inequality; poverty alleviation progress will be slowed.

COUNTRY OVERVIEW

The Philippines is an archipelago comprised of 7,107 islands (1,000 of which are inhabitable), with a humid climate and a topography characterized by mountainous terrain bordered by narrow coastal plains. Considered one of the most biologically rich and diverse countries in the world, the Philippines also has one of the world's longest coastlines, and its marine and coastal resources yield US\$3.5 billion annually in goods and services. The country's mineral, oil, gas, and geothermal potential are also significant. The Philippines' main economic sectors are agriculture and industry, with agriculture contributing 14% of gross domestic product and employing over a third of the population. The Philippines is also considered to be among the world's most disaster-prone countries. Commonly occurring hazards include floods, droughts, typhoons, landslides and mudslides, earthquakes, and volcanic eruptions. Recent decades have witnessed an increase in damaging extreme events, such as heavy rainfall and tropical cyclone activity, and this trend is expected to continue under a changing climate.¹

¹ GFDRR (2011) Vulnerability, Risk Reduction, and Adaptation to Climate Change: Philippines. URL: <https://www.gfdr.org/sites/default/files/publication/climate-change-country-profile-2011-philippines.pdf>

The Philippines have three primary industry sectors, which dominate the country's economic growth: (i) agriculture, forestry and fishing; (ii) industry; and (iii) services (**Table 1**). The services sector contributes an annual average of 61% of the total Gross Domestic Product (GDP), while agriculture, hunting, forestry and fishing contributes 8.8% (2019).² Despite the country's positive economic performance, the Philippines is still highly vulnerable to natural hazards, which is compounded due to the impact of altered climate patterns as well as from the lack of protection and individuals' inability to cope and manage their surroundings, because of poverty, lack of the knowledge, and a degraded and precarious environment that could turn what would have been just a minor hazard into a major disaster. Many Filipino families live and make their living along coastal areas and depend highly on the natural resources from the sea, the land, and the forests for their livelihood and survival makes the Philippines doubly susceptible to the harsh impacts of climate change.³

The Philippines' Climate Change Act was passed in 2009, which created the Climate Change Commission (CCC) as the lead policymaking body in the Philippines tasked to coordinate, monitor and evaluate the programs and action plans of the government relating to climate change. It was amended in 2012 which established the Peoples Survival Fund (PSF) for the financing of adaptation programs and projects. Important strategy documents include the [National Framework Strategy on Climate Change \(2010–2022\)](#) and the [National Climate Change Action Plan \(2011–2028\)](#), which sets out policies related to food and water security, environmental stability, human security, climate smart industries and services, sustainable energy, and knowledge and capacity development. The Philippines ratified the Paris Agreement on March 23, 2017 and submitted its [Nationally Determined Contributions](#) to the UNFCCC in 2016. The Philippines submitted its [Second National Communication \(SNC\)](#) to the UNFCCC in 2014, identifying agriculture, water resources, infrastructure and human health as sectors highly vulnerable to climate change.⁴

Green, Inclusive and Resilient Recovery

The coronavirus disease (COVID-19) pandemic has led to unprecedented adverse social and economic impacts. Further, the pandemic has demonstrated the compounding impacts of adding yet another shock on top of the multiple challenges that vulnerable populations already face in day-to-day life, with the potential to create devastating health, social, economic and environmental crises that can leave a deep, long-lasting mark. However, as governments take urgent action and lay the foundations for their financial, economic, and social recovery, they have a unique opportunity to create economies that are more sustainable, inclusive and resilient. Short and long-term recovery efforts should prioritize investments that boost jobs and economic activity; have positive impacts on human, social and natural capital; protect biodiversity and ecosystems services; boost resilience; and advance the decarbonization of economies.

² World Bank (2021). World Development Indicators. DataBank. URL: <https://databank.worldbank.org/source/world-development-indicators> [accessed 24 February, 2021].

³ Philippines (2014). Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/phlnc2.pdf>

⁴ Philippines (2014). Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/phlnc2.pdf>

TABLE 1. Key indicators

Indicator	Value	Source
Population Undernourished⁵	14.5% (2017–2019)	FAO, 2020
National Poverty Rate⁶	16.6% (2018)	ADB, 2020
Share of Income Held by Bottom 20%⁷	5.7% (2015)	World Bank, 2019
Net Annual Migration Rate⁸	–0.06% (2015–2020)	UNDESA, 2019
Infant Mortality Rate (Between Age 0 and 1)⁹	2.0% (2015–2020)	UNDESA, 2019
Average Annual Change in Urban Population¹⁰	2.0% (2015–2020)	UNDESA, 2018
Dependents per 100 Independent Adults¹¹	55 (2020)	UNDESA, 2019
Urban Population as % of Total Population¹²	47.4% (2020)	CIA, 2020
External Debt Ratio to GNI¹³	19.9% (2018)	ADB, 2020b
Government Expenditure Ratio to GDP¹⁴	19.4% (2019)	ADB, 2020b

This document aims to succinctly summarize the climate risks faced by the Philippines. This includes rapid onset and long-term changes in key climate parameters, as well as impacts of these changes on communities, livelihoods and economies, many of which are already underway. This is a high-level synthesis of existing research and analyses, focusing on the geographic domain of the Philippines, therefore potentially excluding some international influences and localized impacts. The core data presented is sourced from the database sitting behind the World Bank Group's Climate Change [Knowledge Portal \(CCKP\)](#), incorporating climate projections from the Coupled Model Inter-comparison Project Phase 5 (CMIP5). This document is primarily meant for WBG and ADB staff to inform their climate actions. The document also aims and to direct the reader to many useful sources of secondary data and research.

⁵ FAO, IFAD, UNICEF, WFP, WHO (2020) The state of food security and nutrition in the world. Transforming food systems for affordable healthy diets. FAO. Rome. URL: <http://www.fao.org/documents/card/en/c/ca9692en/>

⁶ ADB (2020). Basic Statistics 2020. URL: <https://www.adb.org/publications/basic-statistics-2020> [accessed 27/01/21]

⁷ World Bank (2019). Income share held by lowest 20%. URL: <https://data.worldbank.org/> [accessed 17/12/20]

⁸ UNDESA (2019). World Population Prospects 2019: MIGR/1. URL: <https://population.un.org/wpp/Download/Standard/Population/> [accessed 17/12/20]

⁹ UNDESA (2019). World Population Prospects 2019: MORT/1-1. URL: <https://population.un.org/wpp/Download/Standard/Population/> [accessed 17/12/20]

¹⁰ UNDESA (2019). World Urbanization Prospects 2018: File 6. URL: <https://population.un.org/wup/Download/> [accessed 17/12/20]

¹¹ UNDESA (2019). World Population Prospects 2019: POP/11-A. URL: <https://population.un.org/wpp/Download/Standard/Population/> [accessed 17/12/20]

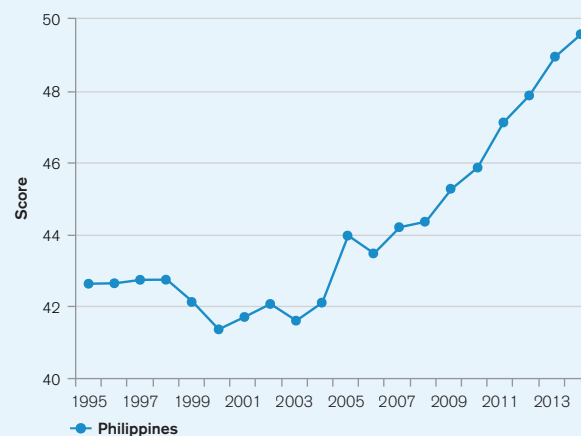
¹² CIA (2020) The World Factbook. Central Intelligence Agency. Washington DC. URL: <https://www.cia.gov/the-world-factbook/>

¹³ ADB (2020b). Key Indicators for Asia and the Pacific 2020. Asian Development Bank. URL: <https://www.adb.org/publications/key-indicators-asia-and-pacific-2020>

¹⁴ ADB (2020b). Key Indicators for Asia and the Pacific 2020. Asian Development Bank. URL: <https://www.adb.org/publications/key-indicators-asia-and-pacific-2020>

Due to a combination of political, geographic, and social factors, the Philippines is recognized as vulnerable to climate change impacts, ranked 114th out of 181 countries in the 2020 ND-GAIN Index.¹⁵ The ND-GAIN Index ranks 181 countries using a score which calculates a country's vulnerability to climate change and other global challenges as well as their readiness to improve resilience. The more vulnerable a country is the lower their score, while the more ready a country is to improve its resilience the higher it will be. Norway has the highest score and is ranked 1st. **Figure 1** is a time-series plot of the ND-GAIN Index showing the Philippines' progress.

FIGURE 1. The ND-GAIN Index summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. It aims to help businesses and the public sector better prioritize investments for a more efficient response to the immediate global challenges ahead.



CLIMATOLOGY

Climate Baseline

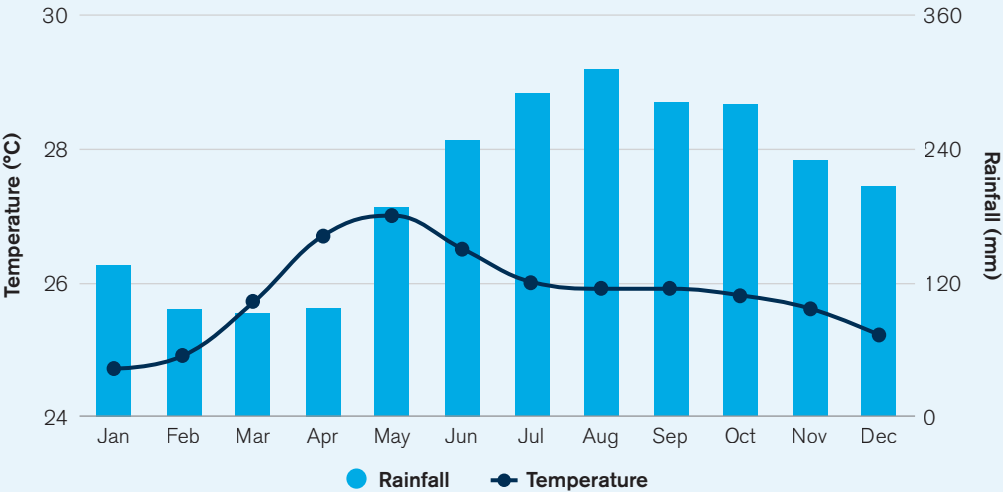
Overview

The Philippines has a humid equatorial climate characterized by high temperatures and heavy rainfall. Average annual rainfall is approximately 2,348 millimeters (mm), but this varies geographically, from 960 mm in southeast Mindanao to over 4,050 mm in central Luzon. Temperatures are generally high, particularly in the valleys and plains, averaging 27°C throughout the year. Humidity levels are high, averaging around 82% due to the warm moist trade winds that flow through the archipelago, as well as sea surface temperatures, a rich and vibrant vegetative cover and abundant rainfall. Rainfall is governed by the southwest monsoons in the summer months, and by the northeast monsoon and tropical cyclones in the winter. Convective rainfall is common due to the

¹⁵ University of Notre Dame (2020). Notre Dame Global Adaptation Initiative. URL: <https://gain.nd.edu/our-work/country-index/>

country's mountainous terrain, interspersed with narrow coastal plains. The Philippines also experiences strong periodic droughts that are linked to the El Niño Southern Oscillation (ENSO).¹ Shown in **Figure 2**, the Philippines' hottest months are April and May, with the coldest months experienced during December, January and February, across the latest climatology, 1991–2020. The mean annual temperature is 27.1°C, with a relatively low seasonal temperature variation of approximately 3°C. There is minimal spatial variation in temperatures across the country. Where temperature differences do exist, such as in Baguio City where the daily mean temperature is 19.6°C, elevation is significant factor.¹⁶ There is geographical variation in the distribution of precipitation: during June to September heavy rainfall is concentrated to the west of the country, whereas between October and March, heavy rainfall is predominantly found in the country's eastern regions.¹⁶

FIGURE 2. Average monthly temperature and rainfall in the Philippines (1991–2020).¹⁷



¹⁶ Philippines (2014). Second National Communication to the UNFCCC. URL: <https://unfccc.int/sites/default/files/resource/phlnc2.pdf>
¹⁷ WBG Climate Change Knowledge Portal (CCKP, 2021). Philippines Climate Data: Historical. URL: <https://climateknowledgeportal.worldbank.org/country/philippines/climate-data-historical>

Key Trends

Temperature

The Philippines' NC2 outlines the historical temperature trends, reporting a rise of 0.62°C in annual average mean temperature between 1958–2014 and a significant increase in the number of hot days and warm nights throughout the country between 1960–2003.¹⁶ Using Climate Research Unit time series data, Salvacion et al. (2018) found an average increase per year for maximum temperature at 0.008°C and minimum temperature at 0.019°C.¹⁸ Cinco et al. (2014) report a warming trend in the Philippines between 1951–2010 through an observed increase in annual mean temperatures, daily minimum mean temperatures and daily maximum mean temperatures.¹⁹ These trends are similar to those experienced across the Pacific region in general.²⁰

The Berkeley Earth dataset²¹ provides historical temperature change estimates for 1° × 1° grid cells, this dataset can be used to estimate warming over the 20th century. In general, it should be noted that estimates of warming over grid cells containing larger amounts of ocean cover are less reliable, but also generally show less warming. Estimated warming over Manila between 1900–2017 (average) and 2000–2017 (average) is 0.75°C. Warming over the same period in Davao in the south is estimated at 1.11°C (this higher value reflects the inland cover of the Davao grid cell) and 0.75°C in Puerto Princesa in the west.

¹⁸ Salvacion, A.R., Magcale-Macandog, D.B., Sta. Cruz, P.C. et al. (2018). Exploring spatial patterns of trends in monthly rainfall and temperature in the Philippines based on Climate Research Unit grid. *Spat. Inf. Res.* 26: 471. URL <https://link.springer.com/article/10.1007%2Fs41324-018-0189-8>

¹⁹ Cinco, T.G. de Guzman, R., Hilario, F and Wilson, D. (2014). Long-term trends and extremes in observed daily precipitation and near surface air temperature in the Philippines for the period 1951–2010. *Atmospheric Research*. 145–146. 12–26. URL: <https://www.sciencedirect.com/science/article/pii/S0169809514001495?via%3Dihub>

²⁰ Griffiths, G & Chambers, Lynda & R. Haylock, M & J. Manton, M & Nicholls, Neville & Baek, H.-J & Choi, Youngeun & Della-Marta, Paul & Gosai, A & Iga, N & Lata, R & Laurent, Victoire & Maitrepierre, Luc & Nakamigawa, H & Ouprasitwong, N & Solofa, D & Tahani, L & T. Thuy, D & Tibig, L & Zhai, Panmao. (2005). Change in mean temperature as a predictor of extreme temperature change in the Asia-Pacific region. *International Journal of Climatology*. 25. 1301 - 1330. URL: <https://rmets.onlinelibrary.wiley.com/doi/pdf/10.1002/joc.1194>

²¹ Carbon Brief (2018). Mapped: How every part of the world has warmed — and could continue to. Infographics, Berkeley Dataset. 26 September 2018]. URL: <https://www.carbonbrief.org/mapped-how-every-part-of-the-world-has-warmed-and-could-continue-to-warm>

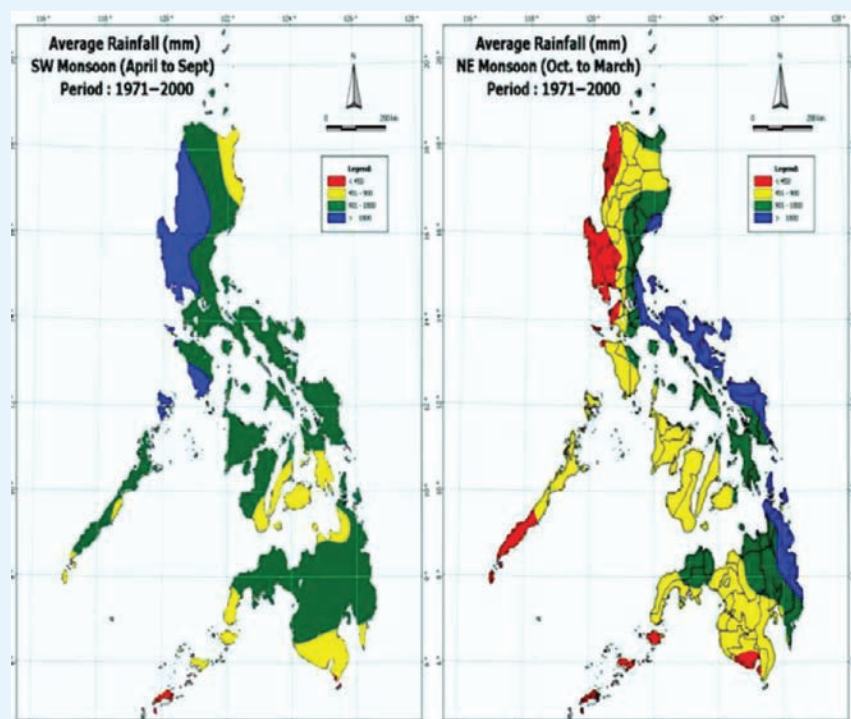
Precipitation

The Philippines' NC2 describes a sharp increase in amount and intensity of rainfall as a result of climate change in recent years, with more rainy days observed since the 1990s. Furthermore, they note wetter conditions during the dry season, with the five-year running average showing there are more tropical cyclones of typhoon intensity happening during El Niño events. Cinco et al. (2014) find a weak increase in extreme rainfall event intensity and frequency between 1951 and 2010.¹⁹ Salvacion et al. (2018) report significant trends in monthly rainfall, with an increase of 0.34 mm/year.¹⁸ **Figure 3** shows observed precipitation patterns for the Philippines' two rainy seasons, for 1971 to 2000.

A Precautionary Approach

Studies published since the last iteration of the IPCC's report (AR5), such as Gasser et al. (2018), have presented evidence which suggests a greater probability that earth will experience medium and high-end warming scenarios than previously estimated.²³ Climate change projections associated with the highest emissions pathway (RCP8.5) are presented here to facilitate decision making which is robust to these risks.

FIGURE 3. Seasonal rainfall distribution in the Philippines 1971–2000, (left) April to September and (right) October to March²²



²² Philippines (2014). Second National Communication to the UNFCCC. p. 6. URL: <https://unfccc.int/sites/default/files/resource/phlnc2.pdf>

²³ Gasser, T., Kechiar, M., Ciais, P., Burke, E. J., Kleinen, T., Zhu, D., . . . Obersteiner, M. (2018). Path-dependent reductions in CO2 emission budgets caused by permafrost carbon release. *Nature Geoscience*. URL: <http://pure.iiasa.ac.at/id/eprint/15453/>

Climate Future

Overview

The main data source for the World Bank Group's Climate Change Knowledge Portal (CCKP) is the Coupled Model Inter-comparison Project Phase 5 (CMIP5) models, which are utilized within the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), providing estimates of future temperature and precipitation. Four Representative Concentration Pathways (i.e. RCP2.6, RCP4.5, RCP6.0, and RCP8.5) were selected and defined by their total radiative forcing (cumulative measure of GHG emissions from all sources) pathway and level by 2100. In this analysis, RCP2.6 and RCP8.5, the extremes of low and high emissions pathways, are the primary focus where RCP2.6 represents a very strong mitigation scenario and RCP8.5 assumes business-as-usual scenario. For more information, please refer to the [RCP Database](#).

For the Philippines, these models show a trend of consistent warming, with more significant warming occurring towards the end of the century. **Tables 2** and **3** below, provide information on temperature projections and anomalies for the four RCPs over two distinct time horizons; presented against the reference period of 1986–2005.

TABLE 2. Projected anomaly (changes °C) for maximum, minimum, and average daily temperatures in the Philippines for 2040–2059 and 2080–2099, from the reference period of 1986–2005 for all RCPs. The table is showing the median of the CCKP model ensemble and the 10–90th percentiles in brackets.²⁴

Scenario	Average Daily Maximum Temperature		Average Daily Temperature		Average Daily Minimum Temperature	
	2040–2059	2080–2099	2040–2059	2080–2099	2040–2059	2080–2099
RCP2.6	0.8 (–0.1, 1.8)	0.8 (–0.1, 2.0)	0.8 (0.2, 1.6)	0.8 (0.1, 1.7)	0.8 (0.3, 1.6)	0.8 (0.3, 1.7)
RCP4.5	1.0 (0.1, 2.1)	1.5 (0.6, 2.7)	1.1 (0.5, 1.9)	1.5 (0.9, 2.5)	1.1 (0.6, 1.8)	1.6 (0.9, 2.5)
RCP6.0	0.9 (–0.1, 2.0)	1.9 (0.8, 3.2)	0.9 (0.3, 1.8)	1.9 (1.1, 2.9)	1.0 (0.5, 1.7)	2.0 (1.2, 3.0)
RCP8.5	1.5 (0.5, 2.5)	3.1 (2.0, 4.6)	1.5 (0.8, 2.3)	3.2 (2.3, 4.5)	1.5 (0.9, 2.3)	3.2 (2.4, 4.4)

²⁴ WBG Climate Change Knowledge Portal (CCKP, 2021). Philippines Climate Data: Historical. URL: <https://climateknowledgeportal.worldbank.org/country/philippines/climate-data-historical>

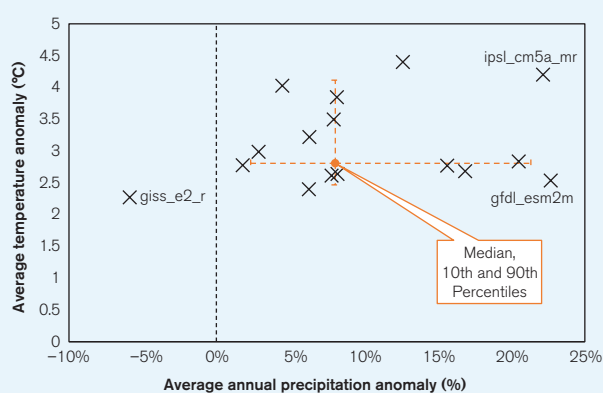
TABLE 3. Projections of average temperature change (°C) in the Philippines for different seasons (3-monthly time slices) over different time horizons and emissions pathways, showing the median estimates of the full CCKP model ensemble and the 10th and 90th percentiles in brackets.²⁴

Scenario	2040–2059		2080–2099	
	Jun–Aug	Dec–Feb	Jun–Aug	Dec–Feb
RCP2.6	0.9 (0.4, 1.5)	0.8 (0.0, 1.5)	0.9 (0.4, 1.6)	0.7 (0.0, 1.6)
RCP4.5	1.1 (0.6, 1.7)	1.1 (0.4, 1.8)	1.6 (1.0, 2.3)	1.5 (0.7, 2.4)
RCP6.0	1.0 (0.5, 1.7)	0.9 (0.2, 1.5)	2.0 (1.4, 2.8)	1.8 (1.0, 2.6)
RCP8.5	1.5 (0.9, 2.1)	1.5 (0.7, 2.2)	3.2 (2.5, 4.3)	3.1 (2.1, 4.1)

Model Ensemble

Climate projections presented in this document are derived from datasets available through the CCKP, unless otherwise stated. These datasets are processed outputs of simulations performed by multiple General Circulation Models (GCM) (for further information see Flato et al., 2013).²⁵ Collectively, these different GCM simulations are referred to as the ‘model ensemble’. Due to the differences in the way GCMs represent the key physical processes and interactions within the climate system, projections of future climate conditions can vary widely between different GCMs, this is particularly the case for rainfall related variables and at national and local scales. The range of projections from 16 GCMs for annual average temperature change and annual precipitation change in the Philippines under RCP8.5 is shown in **Figure 4**.

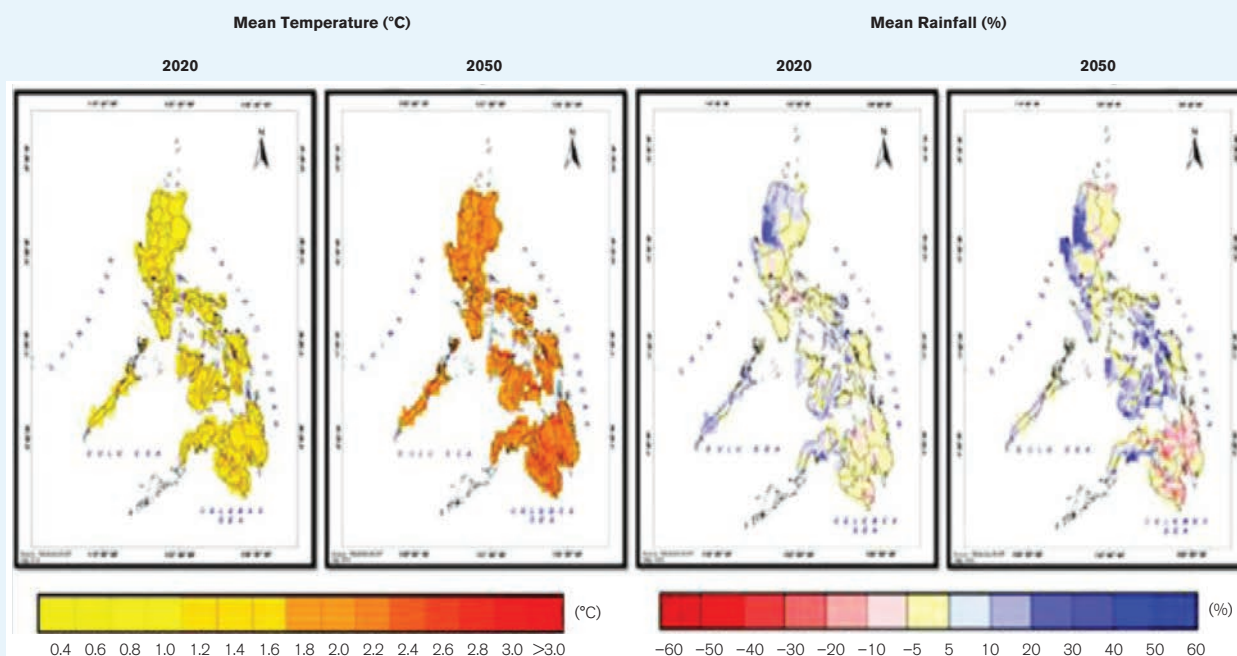
FIGURE 4. ‘Projected average temperature anomaly’ and ‘projected annual rainfall anomaly’ in the Philippines. Outputs of 16 models within the ensemble simulating RCP8.5 over the period 2080–2099. Models shown represent the subset of models within the ensemble that provide projections across all RCPs and therefore are most robust for comparison.²⁴ Three models are labelled.



²⁵ Flato, G., Marotzke, J., Abiodun, B., Braconnot, P., Chou, S. C., Collins, W., . . . Rummukainen, M. (2013). Evaluation of Climate Models. Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, 741–866. URL: http://www.climatechange2013.org/images/report/WG1AR5_ALL_FINAL.pdf

Spatial Variation

FIGURE 5. Annual projected change under a medium-range emissions scenario for temperature and precipitation in the Philippines for 2020 and 2050²⁶



Temperature

Projections of future temperature change are presented in three primary formats. Shown in **Table 2** are the changes (anomalies) in daily maximum and daily minimum temperatures over the given time period, as well as changes in the average temperature. **Figures 6** and **7** display the annual and monthly average temperature projections. While similar, these three indicators can provide slightly different information. Monthly and annual average temperatures are most commonly used for general estimation of climate change, but the daily maximum and minimum can explain more about how daily life might change in a region, affecting key variables such as the viability of ecosystems, health impacts, productivity of labor, and the yield of crops, which are often disproportionately influenced by temperature extremes.

²⁶ Philippines (2014). Second National Communication to the UNFCCC. p. 10. URL: <https://unfccc.int/sites/default/files/resource/phlnc2.pdf>

Under the RCP8.5 emissions pathway, average temperatures are projected to increase by 3.1°C by the 2090s, nearly 0.5°C less than the global average, and 0.8°C by the 2090s under the RCP2.6 emissions pathway, 0.2°C less than the global average. Under all emissions scenarios, projected maximum and minimum temperature increases are greater than increases in the average temperature (**Table 2**).

All of the projections made by the large suite of global climate models in the CCKP ensemble should be treated with caution in the case of the Philippines. These models operate on large spatial scales. These scales will be too large as to discern ocean cover from land cover over many of the Philippines' smaller islands. Statistically downscaled projections from the KNMI Climate Explorer, which operate on a slightly finer spatial resolution, show a rise nearer 3.4°C under RCP8.5, over the 2080–2099 period over the Philippines' largest landmasses of Luzon and Mindanao.²⁷ Similar caution should be applied to precipitation projections and there is a general need for spatially accurate global climate models and wider availability of downscaled projections.

FIGURE 6. Historic and projected average annual temperature in Philippines under RCP2.6 (blue) and RCP8.5 (red) estimated by the model ensemble. Shading represents the standard deviation of the model ensemble.²⁸

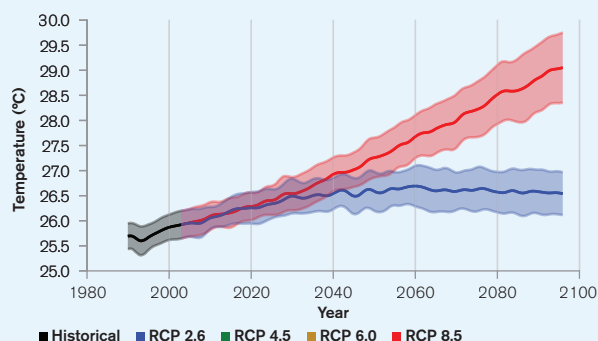
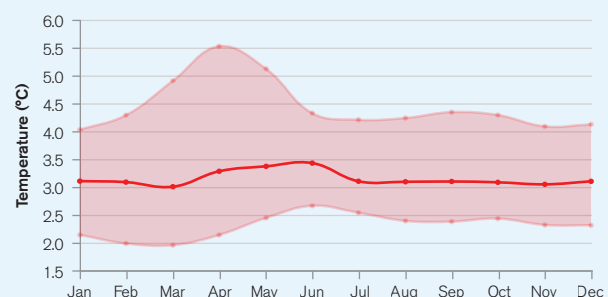


FIGURE 7. Projected change (anomaly) in monthly temperature, shown by month, for the Philippines for the period 2080–2099 under RCP8.5. The value shown represents the median of the model ensemble with the shaded areas showing the 10th–90th percentiles.²⁸



As shown in **Table 3** and **Figure 7**, there is relatively little seasonal variation in projected temperature rises, across all emissions pathways. What is evident in **Figure 7** is the high degree of uncertainty surrounding these projections.

²⁷ WMO (2020). KNMI Climate Explorer. CMIP5 projections. URL: <https://climexp.knmi.nl/start.cgi>

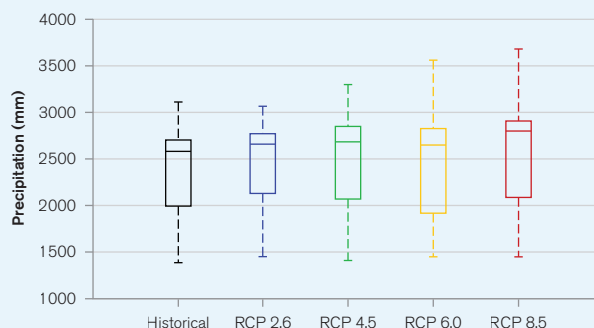
²⁸ WBG Climate Change Knowledge Portal (CCKP, 2021). Philippines Climate Data: Projections. URL: <https://climateknowledgeportal.worldbank.org/country/philippines/climate-data-projections>.

Precipitation

As the scatter plot in **Figure 4** shows, despite high uncertainty surrounding precipitation projections, 15 of the 16 models project an increase in precipitation. The boxplots presented in **Figure 8** point to only a slight increase in average annual precipitation under all emissions pathways by the 2090s, with the largest uncertainty found in RCP6.0 and RCP8.5 emissions pathways.

While considerable uncertainty surrounds projections of local long-term future precipitation trends, some global trends are evident. The intensity of sub-daily extreme rainfall events appears to be increasing with temperature, a finding supported by evidence from different regions of Asia.²⁹ However, as this phenomenon is highly dependent on local geographical contexts further research is required to constrain its impact in the Philippines. The future of precipitation in the Philippines, and particularly inter-annual variability will depend on the interaction of climate change with the ENSO phenomenon. The CMIP5 iteration of climate models have generally performed inconsistently in simulating future ENSO and further work is required in this area.³⁰

FIGURE 8. Projected average annual precipitation for the Philippines in the period 2080–2099.²⁸



CLIMATE RELATED NATURAL HAZARDS

The Philippines faces some of the highest disaster risk levels in the world, ranking joint 38th out of 191 countries in the INFORM 2019 Risk Index (**Table 4**).³¹ The country is especially exposed to tropical cyclones, ranking 2nd highest in terms of risk. Flooding is also a considerable risk (ranked 29th) and exposure to earthquake (ranked 10th) is a major contributor to the Philippines' position on the INFORM index. Tightly linked to these risks is the threat of landslides, which is significant, particularly in the country's northern regions. The risks associated with drought, however, are less pronounced (ranked 68th). In terms of 'coping capacity', the Philippines ranks joint 88th, notably better than expected when compared to its nominal GDP per capita.³² The following section focuses on

²⁹ Westra, S., Fowler, H. J., Evans, J. P., Alexander, L. V., Berg, P., Johnson, F., Kendon, E. J., Lenderink, G., Roberts, N. (2014). Future changes to the intensity and frequency of short-duration extreme rainfall. *Reviews of Geophysics*, 52, 522–555. URL: <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2014RG000464>

³⁰ Chen, C., Cane, M.A., Wittenberg, A.T. and Chen, D. 2017. ENSO in the CMIP5 simulations: life cycles, diversity, and responses to climate change. *Journal of Climate*, 30, 775–801. URL: <https://journals.ametsoc.org/jcli/article/30/2/775/96236/ENSO-in-the-CMIP5-Simulations-Life-Cycles>

³¹ European Commission (2019). INFORM Index for Risk Management. Philippines Country Profile. URL: <https://drmkc.jrc.ec.europa.eu/inform-index/INFORM-Risk/Country-Profile/moduleId/1767/id/386/controller/Admin/action/CountryProfile>

³² World Bank (2020). DataBank - GDP per capita. URL: https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?year_high_desc=true

the climate change implications for the natural hazard exposure component of risk in the Philippines. As seen in **Figure 1**, the ND-GAIN Index presents an overall picture of a country's vulnerability and capacity to improve its resilience. In contrast, the Inform Risk Index identifies specific risks across a country to support decisions on prevention, preparedness, response and a country's overall risk management.

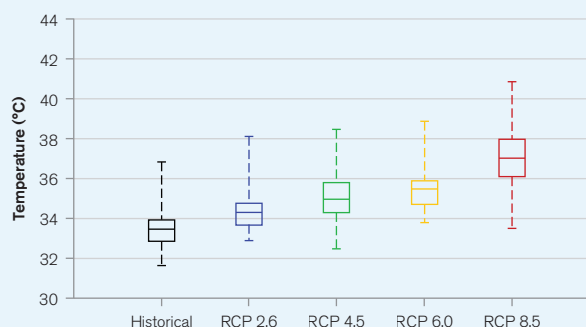
TABLE 4. Selected indicators from the INFORM 2019 Index for Risk Management for Philippines. For the sub-categories of risk (e.g. "Flood") higher scores represent greater risks. Conversely the most at-risk country is ranked 1st. Global average scores are shown in brackets.

Flood (0–10)	Tropical Cyclone (0–10)	Drought (0–10)	Vulnerability (0–10)	Lack of Coping Capacity (0–10)	Overall Inform Risk Level (0–10)	Rank (1–191)
7.2 [4.5]	9.5 [1.7]	4.1 [3.2]	4.7 [3.6]	4.1 [4.5]	5.3 [3.8]	38

Heatwaves

The Philippines regularly experiences high maximum temperatures, with an average monthly maximum of around 30°C and an average May maximum of 32°C. The current median probability of a heat wave (defined as a period of 3 or more days where the daily temperature is above the long-term 95th percentile of daily mean temperature) is around 2%. This low value reflects the relatively stable temperature regime typically found in the Philippines. Under all emissions pathways projections, the probability of experiencing a heat wave increases dramatically by 2080–2099, up to 52% under the RCP6.0 pathway and 76% under the RCP8.5 pathway. In Mindanao in the south, particularly large increases in heatwave probability are projected, with potential for year-long heatwaves by 2050.³³ However, this indicator is somewhat distorted by the definition of a heatwave used. Climate change continually pushes temperatures away from the baseline (1986–2005) meaning a long-term change is captured as a heat wave. Another lens through which to measure heatwave potential is through the annual maximum of daily maximum temperatures (**Figure 9**).

FIGURE 9. Historical (1986–2005) and projected (2080–2099) annual maximum of daily maximum temperatures under four emissions pathways in the Philippines.²⁸



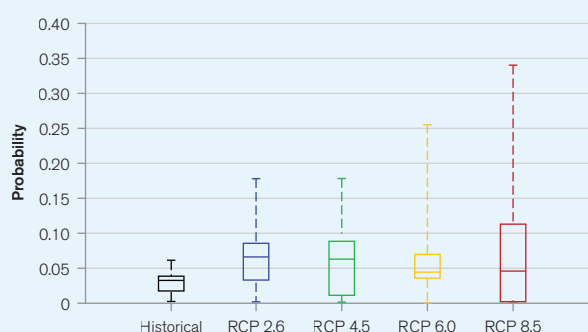
³³ Mora, C., Dousset, B., Caldwell, I.R., Powell, F.E., Geronimo, R.C., Bielecki, C.R., Counsell, C.W., Dietrich, B.S., Johnston, E.T., Louis, L.V. and Lucas, M.P., 2017. Global risk of deadly heat. *Nature Climate Change*, 7(7), pp. 501–506. URL: <https://www.nature.com/articles/nclimate3322>

Drought

Two primary types of drought may affect the Philippines, meteorological (usually associated with a precipitation deficit) and hydrological (usually associated with a deficit in surface and subsurface water flow, potentially originating in the region's wider river basins). At present the Philippines faces an annual median probability of severe meteorological drought of around 3%, as defined by a standardized precipitation evaporation index (SPEI) of less than -2 .

Naumann et al. (2018)³⁴ provide a global overview of changes in drought conditions under different warming scenarios. In comparison to West and Central Asia, Southeast Asia is less likely to experience extreme increases in drought intensity. As **Figure 10** shows, projections under all emissions pathways show minimal change in the probability of experiencing a year with a severe drought by the 2090s. In general, drought experienced in the Philippines coincides with extreme El Niño events³⁵. However, this is not always the case, as in 2007 where drought conditions were observed despite occurring during a La Niña period (often associated with excessive rains).³⁶ Increased droughts, both in intensity and frequency, can lead to reduced agricultural productivity, as well as impacting hydro-electric production that can lead to power outages.^{16,56}

FIGURE 10. Boxplots showing the annual probability of experiencing a 'severe drought' in the Philippines (-2 SPEI index) in 2080–2099 under four emissions pathways.²⁸



Flood

The World Resources Institute's AQUEDUCT Global Flood Analyzer can be used to establish a baseline level of river flood exposure. As of 2010, assuming protection for up to a 1 in 25-year event, the population annually affected by flooding in the Philippines is estimated at 176,000 and the expected annual damages at \$625 million. According to the UNISDR, the average annual loss associated with flooding in the Philippines is slightly less at approximately US\$500 million.³⁷ Development and climate change are both expected to increase these figures. The climate change component can be isolated and by 2030 is expected to increase the annually affected population by 61,000 people, and the damages by \$451 million under the RCP8.5 emissions pathway (AQUEDUCT Scenario B).³⁸

³⁴ Naumann, G., Alfieri, L., Wyser, K., Mentaschi, L., Betts, R. A., Carrao, H., . . . Feyen, L. (2018). Global Changes in Drought Conditions Under Different Levels of Warming. *Geophysical Research Letters*, 45(7), 3285–3296. URL: <https://agupubs.onlinelibrary.wiley.com/doi/10.1002/2017GL076521>

³⁵ Marcelino Q. Villafuerte II, M.Q., Matsumoto, J., Akasaka, I., Takahashi, H.G., Kubota, H. and Cinco, T.A. 2014. Long-term trends and variability of rainfall extremes in the Philippines. *Atmospheric Research* 137: 1–13. URL <https://pubag.nal.usda.gov/catalog/5459264>

³⁶ Yumul, G.P., Cruz, N.A., Servando, N. T and Dimalanta, C.B. (2010). Extreme weather events and related disasters in the Philippines, 2004–08: A sign of what climate change will mean? *Disasters*. 35. 362–82. URL: <https://pubmed.ncbi.nlm.nih.gov/21073508/>

³⁷ UNISDR (2014). PreventionWeb: Basic country statistics and indicators. URL: <https://www.preventionweb.net/countries>

³⁸ WRI (2018). AQUEDUCT Global Flood Analyzer. URL: <https://floods.wri.org/#> [Accessed: 22/11/2018]

Work by Paltan et al. (2018) demonstrates that even under lower emissions pathways coherent with the Paris Climate Agreement almost all Asian countries face an increase in the frequency of extreme river flows.³⁹ What was historically a 1 in 100-year flow, could become a 1 in 50-year or 1 in 25-year event in most of South, Southeast, and East Asia. There is good agreement among models on this trend. Research by Willner et al. (2014)⁴⁰ suggests the median increase in the population affected by an extreme (90th percentile) river flood by 2035–2044 is approximately 2.6 million people (see **Table 5**). This represents an increase of 135% from the population exposed to extreme flooding in 1971–2004.

TABLE 5. Estimated number of people in the Philippines affected by an extreme river flood (extreme river flood is defined as being in the 90th percentile in terms of numbers of people affected) in the historic period 1971–2004 and the future period 2035–2044. Figures represent an average of all four RCPs and assume present day population distributions.⁴

Estimate	Population Exposed to Extreme Flood (1971–2004)	Population Exposed to Extreme Flood (2035–2044)	Increase in Affected Population
16.7 Percentile	727,957	2,586,306	1,858,349
Median	1,943,597	4,543,065	2,599,468
83.3 Percentile	3,139,901	5,359,664	2,219,763

The Philippines is highly exposed to flooding, the consequence of severe cyclones and heavy rainfall.⁴¹ Acosta et al. (2016) describe how damage from floods and associated landslides are escalating due to an increase in frequency and intensity of typhoons.⁴² The risks from flooding are exacerbated by land-use change such as urbanization and logging.⁴³ The Second National Communication to UNFCCC describes how “the unusual amount of rainfall may have been due to climate change, but it was the wastes clogging the sewers and waterways that trapped the water, resulting in floods that caused immense damage and loss of lives” (p21).

Cyclones and Storm Surge

The Philippines is one of the most cyclone-prone countries in the world, lying on what is often described as the ‘typhoon belt’. Approximately 19–20 cyclones enter the Philippine Area of Responsibility annually, with 7–9 reaching landfall.³⁶ Takagi and Esteban (2016) report the number of typhoons making landfall around the Leyte

³⁹ Paltan, H., Allen, M., Haustein, K., Fuldauer, L., & Dadson, S. (2018). Global implications of 1.5°C and 2°C warmer worlds on extreme river flows Global implications of 1.5°C and 2°C warmer worlds on extreme river flows. *Environmental Research Letters*, 13. URL: <https://iopscience.iop.org/article/10.1088/1748-9326/aad985/meta>

⁴⁰ Willner, S., Levermann, A., Zhao, F., Frieler, K. (2018). Adaptation required to preserve future high-end river flood risk at present levels. *Science Advances*: 4:1. URL: <https://advances.sciencemag.org/content/4/1/eaao1914>

⁴¹ USAID (2017). Climate Change Risk Profile — Philippines. URL: <https://www.climate-links.org/resources/climate-change-risk-profile-philippines>

⁴² Acosta, L., Eugenio, Macandog, P.B.M., Magcale-Macandog, D. et al. 2016. Loss and damage from typhoon-induced floods and landslides in the Philippines: Community Perceptions on climate impacts and adaptation options. *International Journal of Global Warming*, 9. 33–65. URL: <https://www.inderscienceonline.com/doi/abs/10.1504/IJGW.2016.074307>

⁴³ Mag-aso, J.R., Ancog, R.C., Pacardo, E.P., Rapera, C.L. 2018. Estimation of Economic Costs of Flood Impacts of Typhoon “Crising” in Kabacan, North Cotabato, Philippines. *International Journal of Agricultural Economics*, 3(2): 31–36. URL: <http://www.sciencepublishinggroup.com/journal/paperinfo?journalid=232&doi=10.11648/j.ijae.20180302.12>

Island region of the country has steadily increased over the last 70 years.⁴⁴ Typhoons appear to have greater intensity: Typhoon Haiyan in 2013 was recorded as one of the fastest on record, with a propagation speed nearly twice that of an average cyclone.⁴⁴ Despite the importance of the moisture content typhoons bring into Philippines, providing just over 40% of the country's annual rainfall, in general the consequences of frequent typhoon events are negative. As Holden and Marshall (2018) describe, 'they set off landslides, cause severe and recurrent flooding of lowland areas, and are responsible for more loss of life and property than any other natural hazard' (p411).⁴⁵

Natural hazards, especially cyclones and typhoons, cause significant damage to the Philippines. Physical damage, asset loss and financial recovery all impact the country's economy, particularly in regards to its exposure to physical losses in the banking sector and capability of insurance payout to claims in the insurance sector. This requires the Government of the Philippines to start factoring in risk analysis and mitigation instruments in planning, prioritization of public investments. **Table 6** shows the financial impact to the agricultural and infrastructure sectors from recent disasters in the Philippines.

TABLE 6. Financial impact for the agricultural sector in the Philippines from recent disasters

	EQ in Mindanao ⁴⁶ October 2019	TY Tisoy (Kammuri) ⁴⁷ December 2019	EQ in Davao Del Sur ⁴⁸ December 2019	TY Ursula (Phanfone) ⁴⁹ December 2019	Taal Volcano Eruption ⁵⁰ February 2020
Maximum Sustained Winds		155 kph		130 kph	
Magnitude	6.6 and 6.5		6.9		
No. of Affected Provinces	7	24	4	15	4
No. of Affected Persons	349,266	1,993,580	394,355	3,296,877	586,045
No. of Damaged Houses	47,662	558,844	45,085	527,201	3,813
Cost of Damage to Infrastructure and Agriculture	US\$ 635,853 (agriculture cost only)	US\$130,545,671		US\$ 85,546,334	US\$ 66,746,894

⁴⁴ Takagi, H. and Esteban, M. (2015). Statistics of tropical cyclone landfalls in the Philippines: unusual characteristics of 2013 Typhoon Haiyan. *Natural Hazards*. 80. URL: <https://link.springer.com/article/10.1007/s11069-015-1965-6>

⁴⁵ Holden, W.H. and Marshall, S. (2018). Climate Change and Typhoons in the Philippines: Extreme Weather Events in the Anthropocene. *Integrating Disaster Science and Management*. 407–421. URL: <https://www.sciencedirect.com/science/article/pii/B9780128120569000245?via%3DIihub>

⁴⁶ NDRRMC Philippines (2020). SitRep No. 39 regarding Magnitude 6.6 and 6.5 Earthquakes in Tulunan, North Cotabato, 22 January 2020, 6:00 PM. URL: <https://reliefweb.int/report/philippines/ndrrmc-update-sitrep-no-39-regarding-magnitude-66-and-65-earthquakes-tulunan>

⁴⁷ NDRRMC Philippines (2020). Situational Report No. 21 regarding Response Actions and Effects of Typhoon "TISOY" (I.N. KAMMURI), 22 January 2020, 6:00 PM. URL: <https://reliefweb.int/report/philippines/ndrrmc-update-situational-report-no-21-regarding-response-actions-and-effects>

⁴⁸ NDRRMC Philippines (2020). SitRep No. 15 regarding Magnitude 6.9 Earthquake in Matanao, Davao del Sur (Region XI) as of 10 January 2020, 8:00 AM. URL: <https://reliefweb.int/report/philippines/ndrrmc-update-sitrep-no-15-regarding-magnitude-69-earthquake-matanao-davao-del>

⁴⁹ NDRRMC Philippines (2020). Situational Report No. 28 re Preparedness Measures and Effects of Typhoon "URSULA" (PHANFONE), 30 January 2020, 8:00 AM. URL: <https://reliefweb.int/report/philippines/ndrrmc-update-situational-report-no-28-re-preparedness-measures-and-effects>

⁵⁰ NDRRMC Philippines (2020). Situational Report No. 84 re Taal Volcano Eruption, 25 February 2020, 6:00 AM. URL: <https://reliefweb.int/report/philippines/ndrrmc-update-situational-report-no-84-re-taal-volcano-eruption-25-february-2020>

Calculated on a long-term average basis, the Philippines is expected to incur 177 billion PHP per year in losses to public and private assets due to typhoons and earthquakes. In the next 50 years, the Philippines has a 40% chance of experiencing losses exceeding 1.73 trillion PHP and a 20% chance of experiencing losses exceeding 2.74 trillion PHP. While the impact of climate change on typhoon damage is uncertain, there is a likelihood that high intensity events will become more frequent, and available models suggest that expected annual damages could increase by up to 35% by 2050 (**Table 7**).⁵¹

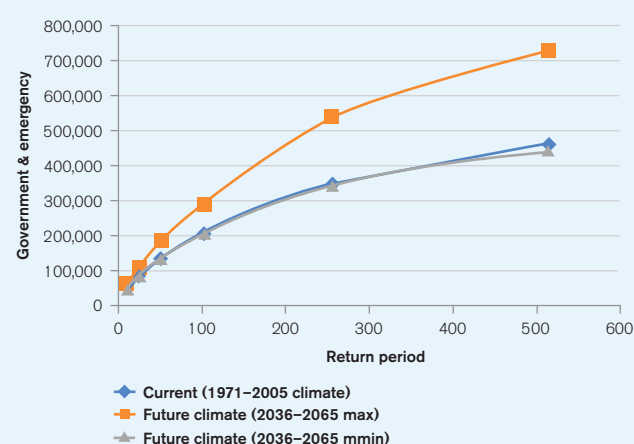
TABLE 7. Typhoon risk statistics for all of the Philippines (Millions PHP)

Private Assets (Years)	Average Annual Loss	10	25	50	100	250	500
Current (1971–2005 Climate)	127,383	296,889	509,027	739,287	1,100,479	1,794,684	2,438,047
Future Climate (2036–2065 Max)	174,853	393,354	646,754	1,036,409	1,539,242	2,791,930	3,864,873
Future Climate (2036–2065 Min)	123,637	293,532	501,098	715,580	1,055,164	1,781,276	2,346,042
Government Plus Emergency							
Current (1971–2005 Climate)	21,700	45,999	83,315	132,897	205,087	344,753	459,957
Future Climate (2036–2065 Max)	29,786	60,945	105,858	186,308	286,856	536,321	729,139
Future Climate (2036–2065 Min)	21,062	45,479	82,018	128,635	196,642	342,178	442,600

Initial modeling estimates that climate change could increase emergency response costs from typhoons by over 50% for severe events. **Figure 11** shows a potential increase in emergency response costs to the government of the Philippines from Typhoons under extreme scenarios.

Climate change is expected to interact with cyclone hazard in complex ways that are currently poorly understood. Known risks include the action of sea-level rise to enhance the damage caused by cyclone-induced storm surges, and the possibility of increased windspeed and precipitation intensity. Modelling of climate change impacts on cyclone intensity and frequency conducted across the globe points to a general trend of reduced cyclone frequency but increased intensity and frequency of the most extreme events.⁵²

FIGURE 11. Projected emergency response costs (currency: PHP) of the Government of the Philippines under future climate scenarios. This graph depicts the expected cost incurred at events of various ‘return periods’ — for example a 1-in-100-year event, which is expected to occur on average once every 100 years, or with a 1% probability in a given year.



⁵¹ WBG (2018). Philippines Catastrophe Risk Modeling Assessment and Modeling. GFDRR, Disaster Risk, Financing & Insurance Program.

⁵² Walsh, K., McBride, J., Klotzbach, P., Balachandran, S., Camargo, S., Holland, G., Knutson, T., Kossin, J., Lee, T., Sobel, A., Sugi, M. (2015). Tropical cyclones and climate change. *WIREs Climate Change* 7: 65–89. URL: <https://onlinelibrary.wiley.com/doi/abs/10.1002/wcc.371>

Research has established the Philippines as one of the most vulnerable countries in the world to the impact of storm surges with increased wave heights due to climate change. Indeed, Metro Manila is ranked as the most vulnerable city in the world, with one study suggesting a potential increase in the population exposed to storm surge as a result of a 10% increase in surge height of 3.4 million.⁵³ The cities of Taguig, Caloocan, Davao, Malabon, Butuan, and Iloilo would also face increases in the exposed population in the range of 80,000–230,000 people. This risk demands urgent adaptation attention. Further research is required to better understand potential changes in cyclone seasonality and routes, and the potential for cyclone hazards to be experienced in unprecedented locations.

CLIMATE CHANGE IMPACTS

Natural Resources

Water

Irrigation in Asia, including the Philippines, is becoming increasingly vulnerable to water scarcity, a consequence of rising population and increased demands from household and industrial consumption.⁵⁴ According to the Philippines' NC2, watershed forest reserves make up 1.56 million hectares of land area (5% of the country's total), with watersheds acting as the most significant source of water for the agricultural, industrial and commercial sectors. Water distribution across the country is variable given the difference in climate and rainfall.⁵⁵ The Philippines annual water availability per year stands at 1,900 cubic meters per person, which is the second lowest of the Southeast Asian countries and lower than global average. If current trends follow, areas of the Philippines could face water scarcity.¹

Pulhin and Tapia (2016) describe how climate change could impact hydrological processes, having significant effects on numerous aspects of water resources, including streamflow, domestic water supply, irrigation, aquifer depth and recharge as well as water quality such as saline intrusion. The water sector is particularly vulnerable to the effects of typhoons. In addition, droughts have considerable consequences for hydropower generation, with major power generation losses occurring as a result of decreased water supply.⁵⁶

⁵³ Brecht, H., Dasgupta, S., Laplante, B., Murray, S. and Wheeler, D. 2012. Sea-level rise and storm surges: high stakes for a small number of developing countries. *Journal of Environment and Development*, 21, 120–138. URL: <http://documents1.worldbank.org/curated/en/657521468157195342/pdf/WPS4901.pdf>

⁵⁴ M. Reyes, R.M., Palis, F., Rodriguez, D.G., Lampayan, R. and Bouman, B. (2011). Impact of the alternate wetting and drying (AWD) water-saving irrigation technique: Evidence from rice producers in the Philippines. *Food Policy*, 36, 280–288. URL: <https://ideas.repec.org/a/eee/jfpoli/v36y2011i2p280-288.html>

⁵⁵ Villarin, J. et al. (2017). Philippine Climate Change Assessment (PhilCCA): Impacts, Adaptation and Vulnerability. The Oscar M. Lopez Center for Climate Change Adaptation and Disaster Risk Management Foundation Inc. and Climate Change Commission. URL: <https://www.omlopecenter.org/the-philippine-climate-change-assessment/>

⁵⁶ Pulhin, J. and Tapia, M. (2016). Vulnerability and Sustainable Development: Issues and Challenges from the Philippines' Agricultural and Water Sectors. In: *Sustainable Development and Disaster Risk Reduction*. pp189–206. URL: https://link.springer.com/chapter/10.1007%2F978-4-431-55078-5_12

The Coastal Zone

Sea-level rise threatens significant physical changes to coastal zones around the world. Global mean sea-level rise was estimated in the range of 0.44–0.74m by the end of the 21st century by the IPCC's Fifth Assessment Report (Church et al., 2013)⁵⁷ but some studies published more recently have highlighted the potential for more significant rises (**Table 8**).

TABLE 8. Estimates of global mean sea-level rise by rate and total rise compared to 1986–2005 including likely range shown in brackets, data from Chapter 13 of the IPCC's Fifth Assessment Report with upper-end estimates based on higher levels of Antarctic ice-sheet loss from Le Bars et al. 2017.⁵⁸

Scenario	Rate of Global Mean Sea-Level Rise in 2100	Global Mean Sea-Level Rise in 2100 Compared to 1986–2005
RCP2.6	4.4 mm/yr (2.0–6.8)	0.44 m (0.28–0.61)
RCP4.5	6.1 mm/yr (3.5–8.8)	0.53 m (0.36–0.71)
RCP6.0	7.4 mm/yr (4.7–10.3)	0.55 m (0.38–0.73)
RCP8.5	11.2 mm/yr (7.5–15.7)	0.74 m (0.52–0.98)
Estimate inclusive of high-end Antarctic ice-sheet loss		1.84m (0.98–2.47)

As an archipelagic country with a tropical climate, high temperatures, year-round rainfall, high storm and typhoon activity, the Philippines is both reliant on coastal and marine resources while being especially vulnerable to coastal hazards likely to become exacerbated by climate change (as discussed above in regard to cyclone induced storm surge).⁵⁹ The coastal zone contains a diverse range of interconnected ecosystems including sandy beaches, mangroves, estuaries, lagoons and coral reefs. The coastal ecosystem experiences inter-annual climate pressure from the ENSO phenomenon, which notably affects water temperatures and wave heights.⁶⁰

Southeast Asia is often considered especially vulnerable to the impacts of sea-level rise and local areas of the Philippines have been experiencing relatively high rates of sea-level rise.⁶¹ Morin et al. (2016) report the above-average rates of sea-level rise experienced in Manila Bay in recent decades, suggesting 15mm per year of sea-level rise in Manila Bay between 1960 and 2012, nine-times the global average.⁶² This rise represents the relative

⁵⁷ Church, J. a., Clark, P. U., Cagenave, A., Gregory, J. M., Jevrejeva, S., Levermann, A., . . . Unnikrishnan, A. S. (2013). Sea level change. In *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* (pp. 1137–1216). Cambridge, United Kingdom and New York, NY, USA: Cambridge University Press. URL: https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_Chapter13_FINAL.pdf

⁵⁸ Le Bars, D., Drijhout, S., de Vries, H. (2017) A high-end sea level rise probabilistic projection including rapid Antarctic ice sheet mass loss. *Environmental Research Letters*: 12:4. URL: <https://iopscience.iop.org/article/10.1088/1748-9326/aa6512>

⁵⁹ Combest-Friedman, C., Patrick, C and Miles, E. (2012). Household perceptions of coastal hazards and climate change in the Central Philippines. *Journal of Environmental Management*. 112: 137–48. URL: <https://pubmed.ncbi.nlm.nih.gov/22898706/>

⁶⁰ Muis, S., Haigh, I.D., Nobre, G.G., Aerts, J.C.J.H. and Ward, P.J. (2018). Influence of El Niño Southern Oscillation on global coastal flooding. *Earth's Future*, 6, 1311–1322. URL: <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018EF000909>

⁶¹ Wetzel, F., Kissling, W., Beissmann, H. and Penn, D. (2012). Future climate change driven sea-level rise: Secondary consequences from human displacement for island biodiversity. *Global Change Biology*. 18. 2707–19. 10. URL: <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1365-2486.2012.02736.x>

⁶² Morin, V. M., Warnitchai, P., & Weesakul, S. (2016). Storm surge hazard in Manila Bay: Typhoon Nesat (Pedring) and the SW monsoon. *Natural Hazards*, 81(3), 1569–1588. URL: <https://doi.org/10.1007/s11069-016-2146-y>

rate of change considering the rapid land sinking caused by excessive groundwater extraction (note measurement of this phenomenon is subject to uncertainties).⁶³ Furthermore, 16.9% of the Philippines' islands are projected to become submerged under extreme scenarios of sea-level rise (6m).⁶⁴

As shown in **Table 9**, under the RCP8.5 emissions pathway, by 2070–2100, up to 983,700 within the Philippines are potentially exposed to flooding from sea-level rise. However, with investment in adaptation, it is projected this number might potentially reduce to as little as 2,200.

TABLE 9. The average number of people experiencing flooding per year in the coastal zone in the period 2070–2100 under different emissions pathways (assumed medium ice-melt scenario) and adaptation scenarios for the Philippines (UK Met Office, 2014)⁶⁵

Scenario	Without Adaptation	With Adaptation
RCP2.6	353,110	810
RCP8.5	983,710	2,200

Economic Sectors

Agriculture

Climate change will influence food production via direct and indirect effects on crop growth processes. Direct effects include alterations to carbon dioxide availability, precipitation and temperatures. Indirect effects include through impacts on water resource availability and seasonality, soil organic matter transformation, soil erosion, changes in pest and disease profiles, the arrival of invasive species, and decline in arable areas due to the submergence of coastal lands and desertification. Shifts in the optimal and viable spatial ranges of certain crops are also inevitable, though the extent and speed of those shifts remains dependent on the emissions pathway. On an international level, these impacts are expected to damage key staple crop yields, even on lower emissions pathways. Tebaldi and Lobell (2018) estimate 5% and 6% declines in global wheat and maize yields respectively even if the Paris Climate Agreement is met and warming is limited to 1.5°C.⁶⁶

Just over a third of the Philippines population is employed in the agriculture sector which contributes, when including fisheries, 15% of the country's GDP. The country's five main crops are rice, corn, sugarcane, banana and coconut, with 60% of rice production in the northern island of Luzon, 60% of corn and coconut and 80% of banana in the southern island of Mindanao, and 70% sugar cane from the Visayas Islands.¹

⁶³ Raucoules, D., Le Cozannet, G., Wöppelmann, G., De Michele, M., Gravelle, M., Daag, A. and Marcos, M. (2013). High nonlinear urban ground motion in Manila (Philippines) from 1993 to 2010 observed by DInSAR: implications for sea-level measurement. *Remote Sensing of Environment*, 139, pp. 386–397. URL: <https://www.sciencedirect.com/science/article/abs/pii/S0034425713002794?via%3Dihub>

⁶⁴ Bellard, C., Leclerc, C. and Courchamp, F. (2013). Impact of sea level rise on the 10 insular biodiversity hotspots. *Global Ecology and Biogeography*, 23(2): 203–212. URL: <https://onlinelibrary.wiley.com/doi/abs/10.1111/geb.12093>

⁶⁵ UK Met Office (2014). Human dynamics of climate change: Technical Report. Met Office, UK Government. URL: https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/climate/human-dynamics-of-climate-change/hdcc_alternative_version.compressed.pdf

⁶⁶ Tebaldi, C., & Lobell, D. (2018). Differences, or lack thereof, in wheat and maize yields under three low-warming scenarios. *Environmental Research Letters*: 13: 065001. URL: <https://iopscience.iop.org/article/10.1088/1748-9326/aaba48>

The dependency of large amounts of the population on the agriculture sector (either directly or indirectly) makes the country particularly vulnerable to climatic shocks, such as flooding and drought.¹ For example, between 1970–1990, typhoons, floods and droughts were responsible for 84.2% of Philippine rice losses.⁶⁷ Indeed, Puhlin and Tapia (2016) describe how the Philippines is projected to experience an estimated decline in agricultural productivity of 9–21% by 2050 as a consequence of climate change. Spatial analysis of how forecasted climate change impacts could affect agricultural land show that up to 85% of the country's strategically important agricultural land could be affected from typhoons, floods and droughts.¹

A further, and perhaps less appreciated influence of climate change on agricultural production is through its impact on the health and productivity of the labor force. Work by Dunne et al. (2013)⁶⁸ suggests that labor productivity during peak months has already dropped by 10% as a result of warming, and that a decline of up to 20% might be expected by 2050 under the highest emissions pathway (RCP8.5). In combination, it is highly likely that the above processes could have a considerable impact on national food consumption patterns both through direct impacts on internal agricultural operations, and through impacts on the global supply chain.

Urban and Energy

Research has established a reasonably well-constrained relationship between heat stress and labor productivity, household consumption patterns, and (by proxy) household living standards.⁶⁹ In general terms the impact of an increase in temperature on these indicators depends on whether the temperature rise moves the ambient temperature closer to, or further away from, the optimum temperature range. The optimum range can vary depending on local conditions and adaptations but in the Philippines, temperature rises are very likely to threaten human health and livelihoods, including through their impact on labor productivity.

The effects of temperature rise and heat stress in urban areas are increasingly compounded by the phenomenon of the Urban Heat Island (UHI). Dark surfaces, residential and industrial sources of heat, an absence of vegetation, and air pollution⁷⁰ can push temperatures higher than those of the rural surroundings, commonly anywhere in the range of 0.1–3°C in global mega-cities.⁷¹ Studies suggest that the UHI can be as high as 3°C in metro Manila, typically peaking during the night time.⁷² As well as impacting human health (see Impacts on Communities) the temperature peaks that could result from combined UHI and climate change, as well as future urban expansion, are likely to damage the productivity of the service sector economy, both through direct impacts on labor productivity, but also through the additional costs of adaptation.

⁶⁷ Lansigan FP, de los Santos WL, Coladilla JO (2000). Agronomic impacts of climate variability on rice production in the Philippines. *Agric Ecosyst Environ* 82(2000):129–137. URL: <https://www.sciencedirect.com/science/article/abs/pii/S016788090000222X>

⁶⁸ Dunne, J. P., Stouffer, R. J., & John, J. G. (2013). Reductions in labour capacity from heat stress under climate warming. *Nature Climate Change*, 3(6), 563–566. URL: http://www.precaution.org/lib/noaa_reductions_in_labour_capacity_2013.pdf

⁶⁹ Mani, M., Bandyopadhyay, S., Chonabayashi, S., Markandya, A., Mosier, T. (2018) South Asia's Hotspots: The Impact of Temperature and Precipitation changes on living standards. South Asian Development Matters. World Bank, Washington DC. URL: <https://openknowledge.worldbank.org/handle/10986/28723>

⁷⁰ Cao, C., Lee, X., Liu, S., Schultg, N., Xiao, W., Zhang, M., & Zhao, L. (2016). Urban heat islands in China enhanced by haze pollution. *Nature Communications*, 7, 1–7. URL: <https://www.nature.com/articles/ncomms12509>

⁷¹ Zhou, D., Zhao, S., Liu, S., Zhang, L., & Zhu, C. (2014). Surface urban heat island in China's 32 major cities: Spatial patterns and drivers. *Remote Sensing of Environment*, 152, 51–61. URL: <https://chunxun.github.io/ghaolab/assets/paper/201405.pdf>

⁷² Tiangco, M., Lagmay, A. M. F., & Argete, J. (2008). ASTER-based study of the night-time urban heat island effect in Metro Manila. *International Journal of Remote Sensing*, 29(10), 2799–2818. URL: <https://doi.org/10.1080/01431160701408360>

Research suggests that on average a one degree increase in ambient temperature can result in a 0.5–8.5% increase in electricity demand.⁷³ Notably this serves business and residential air-cooling systems. This increase in demand places strain on energy generation systems that is compounded by the heat stress on the energy generation system itself, commonly due to its own cooling requirements, which can reduce overall efficiency.⁷⁴

Approximately 60% of the country's population resides in urban areas, with urban-based services and growth major drivers of economic growth.⁷⁵ Approximately 85% of national GDP is generated from urban areas, a proportion higher than other Asian countries where urban areas generate between 65–75%.⁷⁶ Climate change impacts are expected to bring added pressure for the urban environment with respect to sustainable land use, infrastructure, access to potable water and health services, and waste management, among others. In their Coastal City Flood Vulnerability Index, Balica et al. (2012) place Manila, the country's capital, as highly vulnerable, alongside Calcutta and just under Dhaka in terms of vulnerability.⁷⁷

Communities

Poverty, Inequality, and Disaster Vulnerability

Low incomes and wealth inequality have been persistent problems in the Philippines. As of 2015, the top 10% were earning more than nine times as much as the bottom 10%.⁷⁸ Many of the climate changes projected are likely to disproportionately affect the poorest groups in society and may exacerbate this trend. For instance, heavy manual labor jobs are commonly among the lowest paid whilst also being most at risk of productivity losses due to heat stress.⁷⁹ Poorer businesses are least able to afford air conditioning, an increasing need given the trend towards dangerously high temperatures. Poorer farmers and communities are least able to afford local water storage, irrigation infrastructure, and technologies for adaptation. In the Philippines, it is often the poor who are most exposed to its numerous natural hazards, with an increase in heavy rainfall, floods and mudflow exacerbated from climate change more likely to destroy the homes of the country's poor. Baker (2012) reports numerous examples of how informal settlements have been destroyed from landslides, mudflows, fires and floods.⁸⁰

⁷³ Santamouris, M., Cartalis, C., Synnefa, A., & Kolokotsa, D. (2015). On the impact of urban heat island and global warming on the power demand and electricity consumption of buildings—A review. *Energy and Buildings*, 98, 119–124. URL: <https://www.sciencedirect.com/science/article/abs/pii/S0378778814007907>

⁷⁴ ADB (2017). Climate Change Profile of Pakistan. Asian Development Bank. URL: <https://www.adb.org/publications/climate-change-profile-pakistan>

⁷⁵ Mias-Mamonong, A.A. and Flores, Y. (2009). Climate Change Assessment for Sorsogon, Philippines: A Summary. UN HABITAT. URL: http://unfccc.int/files/adaptation/knowledge_resources/databases/partners_action_pledges/application/pdf/un-habitat_furtherinfo4_060511.pdf

⁷⁶ ADB (2014). Republic of the Philippines: National Urban Assessment. URL: <https://www.adb.org/sites/default/files/publication/42817/philippines-national-urban-assessment.pdf>

⁷⁷ Balica, S., Wright, N. and Meulen, V. (2012). A Flood Vulnerability Index for Coastal Cities and Its Use in Assessing Climate Change Impacts. *Natural Hazards*. 52. URL: <https://link.springer.com/article/10.1007/s11069-012-0234-1>

⁷⁸ Philippine Statistics Authority (2016) 2015 Family Income and Expenditure Survey. URL: <https://psa.gov.ph/sites/default/files/attachments/ird/pressrelease/tab2.pdf>

⁷⁹ Kjellstrom, T., Briggs, D., Freyberg, C., Lemke, B., Otto, M., Hyatt, O. (2016). Heat, human performance, and occupational health: A key issue for the assessment of global climate change impacts. *Annual Review of Public Health*: 37: 97–112. URL: <https://pubmed.ncbi.nlm.nih.gov/26989826/>

⁸⁰ Baker, Judy L. (2012). Climate Change, Disaster Risk, and the Urban Poor: Cities Building Resilience for a Changing World. Urban Development. Washington, DC: World Bank. URL: <https://openknowledge.worldbank.org/handle/10986/6018>

Work by Porio (2011, 2014) highlights the relationship of environmental vulnerability of urban poor communities with their social vulnerability. The environmental vulnerabilities associated with being located in wetlands, swampy environments, and in congested areas with inadequate provisions interact with social characteristics such as low-incomes, gender and migrant status. Furthermore, they highlight that significant variations in climate vulnerability exist within the Manila Metropolitan Region.^{81,82} Additionally, the Philippines possess high levels of internal migration, largely rural to urban and urban to urban, with trends involving movements towards areas near metropolitan Manila. Bohra-Mishra et al's study of the impacts of climate variability on migration in Philippines point to towards increased temperature and typhoon activity inducing outmigration driven mostly by males, more educated and younger individuals. This study also finds more outmigration in provinces with larger rural populations than those with smaller proportions as a result of climate variability and its impact on agriculture.⁸³ In particular, women working in smallholder farms are vulnerable to forced migration from climate events, as well as resource poverty and food insecurity.⁸⁴

The Philippines are highly prone to disasters triggered by natural hazards, with some estimations placing 60% of its land area and 74% of its population as exposed to numerous hazards, including floods, cyclones, droughts, earthquakes, tsunamis and landslides.¹ Since 1990, the country has faced 565 such disasters, killing 70,000 and costing \$23 billion in damages.¹ With the exception of earthquakes and volcanic eruptions, the multiple natural hazards facing the Philippines are projected to intensify under climate change.

The country is particularly prone to cyclones due to its location in the Northwestern Pacific Basin, the most active tropical cyclone basin in the world, with the country experiencing an average of 20 cyclones per year within its area of responsibility, with approximately 8 making landfall.³⁵ The strongest recorded typhoon happened in recent years, Typhoon Haiyan in 2013 killing 6,000 people, devastating nine regions and resulting in 1.1 million homes damaged¹ and agricultural and infrastructure damages of \$802 million.⁸⁵ While not directly climate-related, the Philippines are also located in an area of considerable tectonic activity, possessing 22 active volcanoes. An example of the threat from volcano activity is witnessed in the eruption of Mount Mayon in early 2018, which resulted in the evacuation of up to 90,000 people.⁸⁶ The number and intensity of natural hazards faced in the Philippines acts to depress economic growth and demands systemic planning and disaster risk reduction efforts.

⁸¹ Porio, E. (2011). Vulnerability, adaptation, and resilience to floods and climate change-related risks among marginal, riverine communities in Metro Manila. *Asian Journal of Social Science*, 39, 425–445. URL: <https://www.jstor.org/stable/43498807?seq=1>

⁸² Porio, E. (2014). Climate change vulnerability and adaptation in Metro Manila challenging governance and human security of urban poor communities. *Asian Journal of Social Science*, 42, 75–102. URL: https://www.jstor.org/stable/43495780?seq=1#metadata_info_tab_contents

⁸³ Bohra-Mishra, Pratikshya & Oppenheimer, Michael & Cai, Ruohong & Feng, Shuaighang & Licker, Rachel. (2016). Climate variability and migration in the Philippines. *Population and Environment*. URL: <https://link.springer.com/article/10.1007/s11111-016-0263-x>

⁸⁴ Chandra, Alvin & E. McNamara, Karen & Dargusch, Paul & Maria Caspe, Ana & Dalabajan, Dante. (2017). Gendered vulnerabilities of smallholder farmers to climate change in conflict-prone areas: A case study from Mindanao, Philippines. *Journal of Rural Studies*, 50, 45–59. URL: <https://www.sciencedirect.com/science/article/abs/pii/S0743016716307392>

⁸⁵ Mori, Nobuhito & Kato, Masaya & Kim, Sooyoul & Mase, Hajime & Shibutani, Yoko & Takemi, Tetsuya & Tsuboki, Kazuhisa & Yasuda, Tomohiro. (2014). Local amplification of storm surge by Super Typhoon Haiyan in Leyte Gulf. *Geophysical Research Letters*, 41. URL: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4373162/>

⁸⁶ ReliefWeb. (2018). Mayon Volcano — Jan 2018: URL: <https://reliefweb.int/disaster/vo-2018-000005-phl>

Gender

An increasing body of research has shown that climate-related disasters have impacted human populations in many areas including agricultural production, food security, water management and public health. The level of impacts and coping strategies of populations depends heavily on their socio-economic status, socio-cultural norms, access to resources, poverty as well as gender. Research has also provided more evidence that the effects are not gender neutral, as women and children are among the highest risk groups. Key factors that account for the differences between women's and men's vulnerability to climate change risks include: gender-based differences in time use; access to assets and credit, treatment by formal institutions, which can constrain women's opportunities, limited access to policy discussions and decision making, and a lack of sex-disaggregated data for policy change.⁸⁷

Human Health

Nutrition

The World Food Programme (2015) estimate that, without adaptation action, the risk of hunger and child malnutrition on a global scale could increase 20%, respectively, by 2050.⁸⁸ Work by Springmann et al. (2016) has assessed the potential for excess, climate-related deaths associated with malnutrition. The authors identify two key risk factors that are expected to be the primary drivers: a lack of fruit and vegetables in diets and health complications caused by increasing prevalence of people underweight. The authors' projections suggest there could be approximately 41.55 climate-related deaths per million population linked to lack of food availability in the Philippines by the year 2050 under RCP8.5.⁸⁹

Heat-Related Mortality

Research has placed a threshold of 35°C (wet bulb ambient air temperature) on the human body's ability to regulate temperature, beyond which even a very short period of exposure can present risk of serious ill-health and death.⁹⁰ Temperatures significantly lower than the 35°C threshold of 'survivability' can still represent a major threat to human health. Climate change could push global temperatures closer to this temperature 'danger zone' both through slow-onset warming and intensified heat waves.

The CCKP model ensemble highlights the dangers of higher emissions pathways in the Philippines. These push ambient temperatures towards dangerous levels on a much more regular basis. Work by Honda et al. (2014), which utilized the A1B emissions scenario from CMIP3 (most comparable to RCP6.0), estimates that without adaptation, annual heat-related deaths in the Southeast Asian region, could increase 295% by 2030 and 691% by 2050.⁹¹ Under the RCP8.5 emissions pathway, heat-related deaths for 65+ year-olds are projected to increase

⁸⁷ World Bank Group (2016). Gender Equality, Poverty Reduction, and Inclusive Growth. URL: <http://documents1.worldbank.org/curated/en/820851467992505410/pdf/102114-REVISED-PUBLIC-WBG-Gender-Strategy.pdf>

⁸⁸ WFP (2015) Two minutes on climate change and hunger: A zero hunger world needs climate resilience. The World Food Programme. URL: <https://docs.wfp.org/api/documents/WFP-0000009143/download/>

⁸⁹ Springmann, M., Mason-D'Croz, D., Robinson, S., Garnett, T., Godfray, H. C. J., Gollin, D., . . . Scarborough, P. (2016). Global and regional health effects of future food production under climate change: a modelling study. *The Lancet*: 387: 1937-1946. URL: <https://pubmed.ncbi.nlm.nih.gov/26947322/>

⁹⁰ Im, E. S., Pal, J. S., & Eltahir, E. A. B. (2017). Deadly heat waves projected in the densely populated agricultural regions of South Asia. *Science Advances*, 3(8), 1-8. URL: <https://advances.sciencemag.org/content/3/8/e1603322>

⁹¹ Honda, Y., Kondo, M., McGregor, G., Kim, H., Guo, Y-L, Hijioka, Y., Yoshikawa, M., Oka, K., Takano, S., Hales, S., Sari Kovats, R. (2014). Heat-related mortality risk model for climate change impact projection. *Environmental Health and Preventive Medicine* 19: 56-63. URL: <https://pubmed.ncbi.nlm.nih.gov/23928946/>

considerably by 2080, from a baseline of 1 per 100,000 in 1961–1990 to 31 per 100,000. The combined effect of warming and UHI could potentially make Metro Manila an internationally significant hotspot for deadly heat.⁹² Adaptation will be essential to prevent widespread health impacts, particularly in the city's poorer communities living in low quality housing and lacking basic services.

Disease

Climate change projections suggest a rise in infectious and vector-borne diseases: under low or high RCP emissions pathways, 150 million people (out of an estimated 163 million⁹³) in the Philippines could be at risk of malaria by 2070, the vectorial capacity of dengue fever is expected to rise to remain at a very high endemic transmission level and increased flooding is likely to lead to greater outbreaks of Leptospirosis, as happened in Metro Manila after a typhoon struck in September 2009.^{94,95}

POLICIES AND PROGRAMS

National Adaptation Policies and Strategies

TABLE 10. Key national adaptation policies, plans and agreements

Policy/Strategy/Plan	Status	Document Access
Nationally Determined Contribution to Paris Climate Agreement (NDC)	Submitted	April, 2016
National Communications to the UNFCCC	Two submitted	Latest: December, 2014
Technology Needs Assessment	Completed	2014
National Climate Change Action Plan	Enacted	2012
National Disaster Risk Reduction and Management Framework	Enacted	2011

⁹² Matthews, T., Wilby, R.L. and Murphy, C. (2017). Communicating the deadly consequences of global warming for human heat stress. *Proceedings of the National Academy of Sciences*, 114, 3861–3866. URL: <https://www.pnas.org/content/114/15/3861>

⁹³ PopulationPyramid (2020). Philippines 2070. URL: <https://www.populationpyramid.net/philippines/2070/>

⁹⁴ World Health Organization (2015). Climate And Health Country Profile — 2015, Philippines. URL: <http://apps.who.int/iris/handle/10665/208868>

⁹⁵ T Amilasan, Al-Shere & Ujiie, Mugen & Suzuki, Motoi & Salva, Eumelia & Cecilia P Belo, Maria & Koigumi, Nobuo & Yoshimatsu, Kumiko & Schmidt, Wolf-Peter & Marte, Shane & M Dimaano, Efren & Benito Villarama, Jose & Ariyoshi, Koya. (2012). Outbreak of Leptospirosis after Flood, the Philippines, 2009. *Emerging infectious diseases*. 18, 91–4. URL: <https://pubmed.ncbi.nlm.nih.gov/22257492/>

Climate Change Priorities of ADB and the WBG

ADB — Country Partnership Strategy (2018–2023)

ADB and the Philippines have agreed a [Country Partnership Strategy](#) (CPS) for the period 2018–2023. Within the CPS, ADB pledges to support the government in achieving socioeconomic development goals through low-carbon development and will help the government achieve its nationally determined contribution commitments through knowledge and technology transfers and capacity building of key stakeholders. ADB will continue efforts to increase the resilience of vulnerable communities to disasters and climate change risks by linking community-level resilience-building measures to wider investments in community-driven development and comprehensive land use planning. ADB recognizes that while agriculture and natural resources, urban development, transport, and energy are vulnerable to climate change and disasters, they also offer opportunities for implementing adaptation and DRM measures and strategies.⁹⁶

WBG — Country Partnership Framework

The WBG agreed a [Country Partnership Framework](#) (CPF) for the period 2019–2023. The fourth of five engagement areas were identified as Resilience to Climate Change, Environment, and Disaster Risk Management. Specifically, the WBG will continue to support the government in implementing climate change action, disaster risk reduction and environment management. Through this partnership, the WBG will emphasize the linkage between environmental sustainability, low carbon development, disaster risk reduction and climate change adaptation to the overall sustainable development agenda. The WBG will support the implementation of government climate change reforms to ensure that the enabling environment is firmly in place at national, sector and local levels and that the planning, design and implementation of key climate projects, activities and programs is effective, while providing and sustaining solid levels of financing, focusing on both national and local levels.⁹⁷

⁹⁶ ADB (2018). Country Partnership Strategy, Philippines, 2018–2023 — High and Inclusive Growth. URL: <https://www.adb.org/sites/default/files/institutional-document/456476/cps-phi-2018-2023.pdf>

⁹⁷ WBG (2019). Country Partnership Framework for the Republic of the Philippines for the period July 2019– December 2023. URL: <http://documents1.worldbank.org/curated/en/891661574699296055/pdf/Philippines-Country-Partnership-Framework-for-the-Period-July-2019-December-2023.pdf>

CLIMATE RISK COUNTRY PROFILE

PHILIPPINES



WORLD BANK GROUP



ASIAN DEVELOPMENT BANK