CLIMATE RISK COUNTRY PROFILE

KIRIBATI

WORLD BANK GROUP

COPYRIGHT

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

This work is a product of the staff of the World Bank Group (WBG) 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.

The WBG does 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. 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, its Boards, or the governments it represents, 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 the WBG 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 WBG encourages dissemination of its knowledge, this work may be reproduced, in whole or in part, for noncommercial purposes as long as full attribution to this work is given.

Please cite the work as follows: Climate Risk Country Profile: Kiribati (2021): The World Bank Group.

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: © AusAID, "Kiribati 2009" March 28, 2009 via Flickr, Creative Commons CC BY-NC-ND 2.0. © AusAID, "Fishing in Kiribati" November 19, 2007 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 developed by the World Bank Group (WBG). 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) and Ana E. Bucher (Senior Climate Change Specialist, WBG).

This profile was written by Alex Chapman (Consultant, NEF Consulting), William Davies (Consultant, NEF Consulting), Ciaran Downey (Consultant, NEF Consulting) and MacKenzie Dove (Senior Climate Change Consultant, WBG). Technical review of the profiles was undertaken by Robert L. Wilby (Loughborough University). Additional support was provided by Megumi Sato (Junior Professional Officer, WBG), Jason Johnston (Operations Analyst, WBG) and Yunziyi Lang (Climate Change Analyst, WBG). This profile also benefitted from inputs of WBG 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 current 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

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 is 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.

The World Bank Group is investing in incorporating and systematically managing climate risks in development operations through its individual corporate commitments.

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 IDA and IBRD 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 Group's Climate Change Knowledge Portal, a comprehensive online 'one-stop shop' for global, regional, and country data related to climate change and development.

Recognizing the value of consistent, easy-to-use technical resources for client countries as well as to support respective internal climate risk assessment and adaptation planning processes, the World Bank Group's Climate Change Group has developed this content. Standardizing and pooling expertise facilitates the World Bank Group 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 developing countries, the climate risk 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.

It is my hope that these efforts will spur deepening of long-term risk management in developing countries and our engagement in supporting climate change adaptation planning at operational levels.

Bernice Van Bronkhorst
Global Director
Climate Change Group (CCG)
The World Bank Group (WBG)

KEY MESSAGES

- Kiribati's island groups have experienced historical warming of between 0.1°C–0.2°C per decade since 1950.
- Future trends in warming are obscured by the inability of climate models to accurately simulate trends at sufficiently small spatial resolutions. Warming is likely to take place at a rate slightly lower than the global average. On the highest emissions pathway (RCP8.5), warming of approximately 3°C is projected by the end of the century.
- Kiribati faces a diverse set of risks from climate change but data and reliable model projections are lacking, presenting challenges for decision makers.
- Potential threats to human well-being and natural ecosystems include increased prevalence of heat wave and drought, intensified cyclones, saline intrusion, wave-driven flooding, and permanent inundation.
- Biodiversity and the natural environment of Kiribati face extreme pressure, and loss of some species of fish, coral, bird, and terrestrial species is likely without very effective conservation measures.
- Kiribati faces a potential long-term threat from permanent inundation, and some studies have suggested that many of its low-lying islands will become uninhabitable within the 21st century.
- Some displacement of communities has already been documented from Kiribati's atolls. However, other research has suggested that the risk of large-scale net loss of land may previously have been overstated.
- Kiribati's population already lives in a dynamic ecosystem, to which it has adapted, climate change is likely to increase its variability, pose new threats, and place stress on livelihoods.
- Communities are likely to need support to adapt and manage disaster risks facing their wellbeing, livelihoods, and infrastructure. Geographic isolation and economic vulnerabilities, including dependence on remittance and foreign aid, will increase the challenges faced by communities and decision makers.

COUNTRY OVERVIEW

Kiribati is a nation of 32 coral atolls and one raised limestone island, located in the central Pacific Ocean. The country contains three major island groups: the Gilbert group in the west, the central Phoenix group, and the Line group in the east. These islands have a total land area of 811 square kilometers (km^2), and occupy a vast economic exclusion zone of approximately 3.6 million square kilometers. Kiribati's coral atolls are very low-lying, with a maximum elevation of 3 to 4 meters (m) above sea level. The country straddles the equator, with an average annual temperature of 27.5°C. Kiribati had an estimated population of 119,446 in 2020, of which approximately 51% lived on the island of South Tarawa, where the capital Tarawa is located. As of 2018, the country was classified as a Least Developed Country economically and in 2016 over 90% of its exports consisted of fish products.

Kiribati is amongst the most vulnerable nations to climate change on Earth. As an extremely isolated and very low-lying island nation, Kiribati faces considerable risk from climate variability and sea-level rise. The potential risk of permanent inundation, and land and marine ecosystem degradation link climate change intrinsically with development. Kiribati has ratified the Paris Climate Change Agreement (2016), submitted its Second National Communication to the UNFCCC in 2013 and its Intended Nationally Determined Contributions (2016). The Kiribati Joint Implementation Plan on Climate Change and Disaster Risk Management (2019) estimates the cost of climate change adaptation over the period 2014–2023 at around $75 million (approximately 4–5% of GDP per year).[1]

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.

This document aims to succinctly summarize the climate risks faced by Kiribati. These include rapid onset and long-term changes in key climate parameters, as well as the impacts of such 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 area of Kiribati, therefore potentially excluding some international influences and localized impacts. The core climate projections presented are sourced from the Pacific-Australia Climate Change Science and Adaptation Planning Program.[2,3] This document also directs the reader to other useful sources of secondary data and research. For a meta-analysis of the research available on climate change adaptation in small-island developing nations please see Klöck and Nunn (2019).[4]

---

[1] Kiribati (2019). Kiribati Joint Implementation Plan for Climate Change and Disaster Risk Management (2019–2028). URL: https://www4.unfccc.int/sites/NAPC/Documents/Parties/Kiribati-Joint-Implementation-Plan-for-Climate-Change-and-Disaster-Risk-Management-2019-2028.pdf

[2] Australian Bureau of Meteorology and CSIRO (2014). Climate Variability, Extremes and Change in the Western Tropical Pacific: New Science and Updated Country Reports. Pacific-Australia Climate Change Science and Adaptation Planning Program Technical Report, Australian Bureau of Meteorology and CSIRO, Melbourne, Australia. URL: https://www.pacificclimatechangescience.org/wp-content/uploads/2014/07/PACCSAP_CountryReports2014_WEB_140710.pdf

[3] The NextGen projections for the Pacific region under CMIP5 are expected to be available from late 2021. These will provide an update on the PACCSAP 2014 projections referenced in this profile. The process for providing the new NextGen CMIP6 projections for the Pacific is still in the planning phase.

[4] Klöck, C. and Nunn, P. D. (2019). Adaptation to Climate Change in Small Island Developing States: A Systematic Literature Review of Academic Research. The Journal of Environment & Development. DOI: https://doi.org/10.1177/1070496519835895

TABLE 1. Key indicators

Indicator	Value	Source
Population Undernourished[5]	3.0% (2017–19)	FAO, 2020
National Poverty Rate[6]	unknown	ADB, 2020a
Share of Wealth Held by Bottom 20%[7]	unknown	World Bank, 2021
Net Annual Migration Rate[8]	–0.7% (2015–20)	UNDESA, 2019
Infant Mortality Rate (Between Age 0 and 1)[9]	4.3% (2015–20)	UNDESA, 2019
Average Annual Change in Urban Population[10]	3.2% (2015–20)	UNDESA, 2019
Dependents per 100 Independent Adults[11]	67 (2020)	UNDESA, 2019
Urban Population as % of Total Population[12]	55.6% (2020)	CIA, 2020
External Debt Ratio to GNI[13]	23.0% (2019)	ADB, 2020b
Government Expenditure Ratio to GDP[14]	79.2% (2018)	ADB, 2020b

CLIMATOLOGY

Climate Baseline

Overview

Temperatures on Kiribati's islands are generally highly stable throughout the year, although there are some variations between and within island groups; however, these are more noticeable in precipitation levels. Annual rainfall varies between 1,000 millimeters (mm) per year and 3,000 mm per year across the country, with the northern parts of the Gilbert and Line groups typically receiving more rain and the Phoenix group experiencing drier weather. The country is subject to the effects of El Niño, which typically brings heavy rain to Kiribati, and La Niña, which coincides with drought periods for Kiribati.[15] Rainfall is highest between March and May, and lowest between August and October. Average monthly temperatures fall between 27°C and 28°C during every month of the year. **Figure 1** shows the seasonal cycle of temperature and rainfall in Kiribati for the latest climatology, 1991–2020.

---

[5] FAO, IFAD, UNICEF, WFP, WHO (2020). The state of food security and nutrition in the world. Building Resilience for peace and food security. FAO. Rome. URL: http://www.fao.org/documents/card/en/c/ca9692en/

[6] ADB (2020a). Basic Statistics 2020. Asian Development Bank. Manila. URL: URL: https://www.adb.org/publications/basic-statistics-2020

[7] World Bank (2021). Income share held by lowest 20%. URL: https://data.worldbank.org/indicator/SI.DST.FRST.20 [accessed 21/10/2021]

[8] UNDESA (2019). World Population Prospects 2019. URL: https://population.un.org/wpp/Download/Standard/Population/ [accessed 15/02/2021]

[9] UNDESA (2019). World Population Prospects 2019. URL: https://population.un.org/wpp/Download/Standard/Population/ [accessed 15/02/2021]

[10] UNDESA (2019). World Urbanization Prospects 2019. URL: https://population.un.org/wup/Download/ [accessed 15/02/2021]

[11] UNDESA (2019). World Population Prospects 2019. URL: https://population.un.org/wpp/Download/Standard/Population/ [accessed 15/02/2021]

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

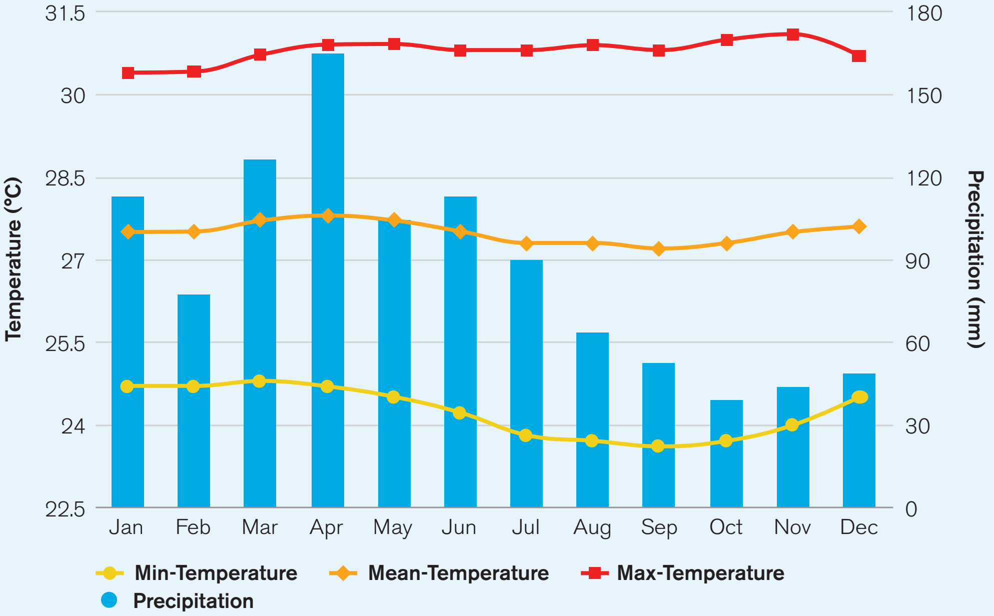
[13] ADB (2020b). Key Indicators for Asia and the Pacific 2020, 51st Edition. Asian Development Bank. ManilaURL: https://www.adb.org/sites/default/files/publication/632971/ki2020.pdf

[14] ADB (2020b). Key Indicators for Asia and the Pacific 2020, 51st Edition. Asian Development Bank. ManilaURL: https://www.adb.org/sites/default/files/publication/632971/ki2020.pdf

[15] Kiribati (2013). Second National Communication under the UNFCCC. URL: https://unfccc.int/sites/default/files/resource/kirnc2.pdf

Annual Cycle

FIGURE 1. Average monthly mean, max, and min temperatures and rainfall in Kiribati (1991–2020)[16]



Key Trends

Temperature

There has been an average increase in maximum temperatures of 0.18°C per decade during the period 1950 to 2009.[17] For the capital, Tarawa, maximum temperatures rose by 0.13°C per decade from 1950 to 2013.[1] From 1970 to 2009 there have been rises in the sea surface temperature of 0.15°C in the Gilbert group, 0.12°C in the Phoenix group and 0.10°C in the Line group.[12]

Precipitation

Annual rainfall has increased significantly between 1946 and 2013 in Kiritimati island (in the northern part of the Line islands). In the capital, Tarawa, there has been no significant change in annual precipitation over the same period.[18] Kiribati has been affected by severe droughts at sporadic intervals, with annual rainfall falling below 750 mm in 1971, 1985, 1998 and 1999. El Niño Southern Oscillation (ENSO) has a strong influence over inter-annual precipitation variation over Kiribati's islands.

---

[16] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Historical. URL: https://climateknowledgeportal.worldbank.org/country/kiribati/climate-data-historical

[17] Republic of Kiribati (2016). Nationally Determined Contribution. URL: https://www4.unfccc.int/sites/ndcstaging/Pages/Home.aspx [accessed 04/10/2019]

[18] Kiribati Meteorology Service & PACCSAP (2015). Pacific-Australia Climate Change Science and Adaptation Planning Programme: Current and future climate of Kiribati. URL: https://www.pacificclimatechangescience.org/wp-content/uploads/2013/06/11_PACCSAP-Kiribati-11pp_WEB.pdf [accessed 04/10/2019]

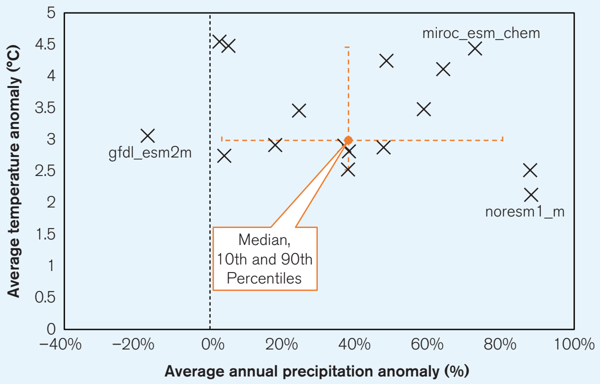
Climate Future

Model Ensemble

Due to differences in the way global circulation models (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 sub-national scales. Exploring the spread of climate model outputs can assist in understanding uncertainties associated with climate models. The range of projections from 16 GCMs on the indicators of average temperature anomaly and annual precipitation anomaly for Kiribati under RCP8.5 is shown in **Figure 2**. However, it should be noted that concerns have been raised about the realism of some of the more extreme outlier models labelled in **Figure 2**.[19]

The majority of the models from which outputs are presented in this report are from the CMIP5 round of standardization and quality assurance. Unfortunately, models of this generation operate at large spatial scales and are not well equipped to simulate the future climate of small islands. Typically, the changes projected will relate more to the expected changes over nearby ocean than the island itself. Caution should therefore be applied in interpreting results. This highlights a major area for future development, a research opportunity, and an urgent need from the perspective of policy makers planning for climate change.

FIGURE 2. 'Projected average temperature anomaly' and 'projected annual rainfall anomaly' in Kiribati. 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.[20] Three models are labelled.



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.[21] Climate change projections associated with the highest emissions pathway (RCP8.5) are presented here to facilitate decision making which is robust to these risks.

---

[19] McSweeney, C. F., Jones, R. G., Lee, R. W. and Rowell, D. P. (2015). Selecting CMIP5 GCMs for downscaling over multiple regions. Climate Dynamics, 44(11–12), pp.3237–3260. DOI: https://link.springer.com/article/10.1007/s00382-014-2418-8

[20] WBG Climate Change Knowledge Portal (CCKP, 2021). Climate Data: Projections. URL: https://climateknowledgeportal.worldbank.org/country/kiribati/climate-data-projections

[21] 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, 11, 830–835. URL: https://www.nature.com/articles/s41561-018-0227-0?WT.feed_name=subjects_climate-sciences

RCPs

The Representative Concentration Pathways (RCPs) represent four plausible futures, based on the rate of emissions reduction achieved at the global level. Four RCPs (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 low and high emissions pathways, are the primary focus; RCP2.6 represents a very strong mitigation scenario, whereas RCP8.5 assumes a high-emissions scenario. For reference, **Table 2** provides information on all four RCPs over two-time horizons across Kiribati's three island groups. In subsequent analysis RCPs 2.6 and 8.5, the low and high emissions pathways, are the primary focus. RCP2.6 would require rapid and systemic global action, achieving significant emissions reduction throughout the 21st century. RCP8.5 assumes annual global emissions will continue to increase throughout the 21st century. Climate changes under each emissions pathway are presented against a reference period of 1986–2005 for all indicators. For more information, please refer to the RCP Database.

TABLE 2. An overview of Kiribati's temperature change projections (°C) under four emissions pathways. Projected changes over the 1986–2005 baseline are given for 20-year periods centered on 2050 and 2090, with the 5th and 95th percentiles provided in brackets. Changes are broken down for each of Kiribati's three island groups.[1]

Line Group

	Mean Surface Air Temp (Annual)		Max Temp (1-in-20 Year Event)		Min Temp (1-in-20 Year Event)	
Scenario	**2050**	**2090**	**2050**	**2090**	**2050**	**2090**
RCP2.6	0.8 (0.6–1.3)	0.8 (0.5–1.3)	0.8 (0.3–1.4)	0.8 (0.3–1.3)	0.8 (0.4–1.1)	0.8 (0.4–1.2)
RCP4.5	1.1 (0.7–1.6)	1.5 (1.0–2.3)	0.9 (0.3–1.5)	1.4 (0.8–2.2)	0.9 (0.6–1.3)	1.4 (0.7–2.0)
RCP6.0	1.0 (0.6–1.4)	1.7 (1.1–2.5)	NA	NA	NA	NA
RCP8.5	1.4 (1.0–2.0)	2.9 (2.0–4.0)	1.5 (0.8–2.3)	3.0 (1.7–4.4)	1.4 (0.8–2.0)	3.0 (2.0–3.9)

Gilbert Group

	Mean Surface Air Temp (Annual)		Max Temp (1-in-20 Year Event)		Min Temp (1-in-20 Year Event)	
Scenario	**2050**	**2090**	**2050**	**2090**	**2050**	**2090**
RCP2.6	0.9 (0.6–1.5)	0.9 (0.6–1.5)	0.7 (0.3–1.2)	0.8 (0.4–1.3)	0.8 (0.4–1.5)	0.9 (0.4–1.2)
RCP4.5	1.1 (0.6–1.7)	1.6 (1.1–2.5)	0.9 (0.5–1.2)	1.3 (0.9–2.2)	1.0 (0.6–1.4)	1.4 (1.0–2.0)
RCP6.0	1.0 (0.7–1.6)	1.9 (1.1–2.9)	NA	NA	NA	NA
RCP8.5	1.5 (1.1–2.2)	3.1 (2.1–4.5)	1.5 (0.8–2.3)	2.9 (1.8–4.4)	1.6 (0.9–2.6)	3.1 (2.1–4.4)

Phoenix Group

	Mean Surface Air Temp (Annual)		Max Temp (1-in-20 Year Event)		Min Temp (1-in-20 Year Event)	
Scenario	**2050**	**2090**	**2050**	**2090**	**2050**	**2090**
RCP2.6	0.9 (0.6–1.4)	0.9 (0.6–1.4)	0.9 (0.4–1.4)	0.8 (–0.1–1.4)	0.8 (0.4–1.1)	0.8 (0.2–1.4)
RCP4.5	1.1 (0.7–1.7)	1.6 (1.0–2.4)	0.9 (0.2–1.4)	1.4 (0.7–2.3)	1.0 (0.6–1.3)	1.4 (0.7–1.9)
RCP6.0	1.0 (0.6–1.5)	1.8 (1.1–2.8)	NA	NA	NA	NA
RCP8.5	1.5 (0.9–2.2)	3.0 (2.1–4.3)	1.4 (0.5–2.1)	3.0 (1.3–4.4)	1.5 (0.9–2.3)	3.1 (2.0–4.2)

Temperature

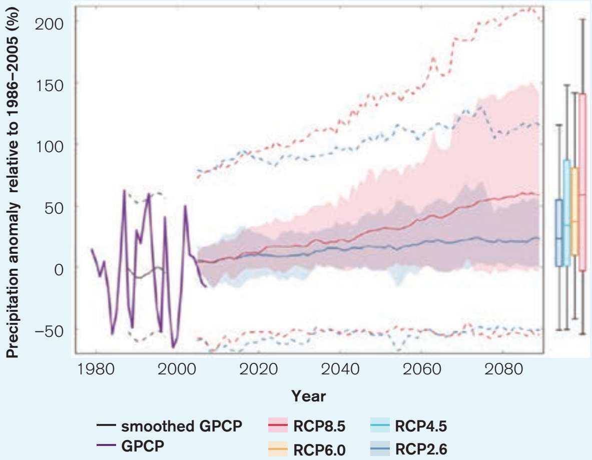
Projections of future temperature change are presented in three primary formats. Shown in **Table 2** are the changes (anomalies) in maximum and minimum temperatures over the given time period, as well as changes in the average temperature. **Figures 2** and **3** display only the average temperature 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.

The model ensemble's estimate of warming under the highest emissions pathway (RCP8.5) is an average temperature increase of approximately 1.5°C by the 2050s and approximately 3.0°C by the 2090s. These temperature increases are projected to occur relatively evenly throughout the year, with little variation from month to month. The model ensemble's estimate of warming under the lowest emissions pathway (RCP2.6) is an average temperature increase of approximately 0.9°C by the 2050s and approximately 0.9°C by the 2090s. These changes are fairly consistent across all of Kiribati's island groups.

Precipitation

While considerable uncertainty clouds 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.[22] However, as this phenomenon is highly dependent on local geographical contexts further research is required to constrain its impact in Kiribati.

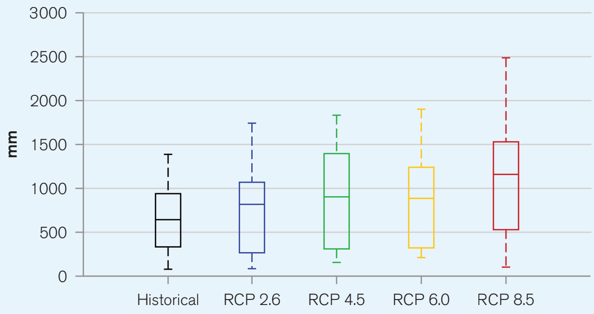
FIGURE 3. Historical and simulated surface air temperature time series for the region surrounding Kiribati's Gilbert Island group. The graph shows the anomaly (from the base period 1986–2005) in surface air temperature from observations (the GISS dataset, in purple), and for the CMIP5 models under the very high (RCP8.5, in red) and very low (RCP2.6, in blue) emissions scenarios. The solid red and blue lines show the smoothed (20-year running average) multi-model mean anomaly in surface air temperature, while shading represents the spread of model values (5–95th percentile). The dashed lines show the 5–95th percentile of the observed interannual variability for the observed period (in black) and added to the projections as a visual guide (in red and blue). This indicates that future surface air temperature could be above or below the projected long-term averages due to interannual variability. The ranges of projections for a 20-year period centered on 2090 are shown by the bars on the right for RCP8.5, 6.0, 4.5 and 2.6.[1]



---

[22] 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. DOI: https://doi.org/10.1002/2014RG000464

FIGURE 4. Boxplots showing the projected average annual precipitation for Kiribati in the period 2080–2099.[15]



The model ensemble's projections broadly suggest some increases in average monthly precipitation for Kiribati in 2050 and 2090 under all emissions pathways. The model ensemble's median estimate is a 200–300 mm (35%–45%) increase in annual precipitation by the 2090s under RCP8.5 (**Figure 4**). However, as was documented in Kiribati's Second National Communication to the UNFCCC (2013), there is great uncertainty and a minority of models also project decreases in annual average precipitation rates.[23] The Pacific Climate Change Futures Project provides some further detail,[24] broadly suggesting that around half of the global climate models in the IPCC model ensemble project much higher increases in average precipitation, the remaining models then project a range of changes from a large decrease in precipitation to little to no change. Changes are likely to depend on the interaction between global warming and the ENSO phenomenon, which is currently poorly understood.

Spatial Variation

Kiribati's islands can be approached in three distinct groups based on their geographic locations, the Phoenix Group, Line Group, and Gilbert Group. The projections of change across the groups are broadly similar. However, the greatest model agreement can be seen for the Gilbert Island Group where 27 of 45 models suggest large (e.g. 117% under RCP8.5) increases in precipitation, while least agreement is seen in the Line Island Group where only 16 models show consensus and suggest lesser increases (e.g. 33% under RCP8.5). The remaining group, the Phoenix Group sees moderate consensus (23 models) and moderate increases (e.g. 73% under RCP8.5). The directions of change and discrepancies between models remain similar across all of the different emissions pathways, but the magnitude of change reduces as the emissions level reduces, such that under RCP2.6 most increases are in the 10%–30% range.[25]

---

[23] Republic of Kiribati (2013). Second Communication Under the United Nations Framework Convention on Climate Change. URL: https://unfccc.int/sites/default/files/resource/kirnc2.pdf

[24] Bureau of Meteorology and CSIRO (2018). Pacific climate change science – climate futures. Australian Government. URL: https://www.pacificclimatefutures.net/en/

[25] Pacific Climate Change Portal (2019). Data – Kiribati. URL: https://www.pacificclimatechange.net/ [accessed 14/05/2019]

Heat Waves

Kiribati regularly experiences high maximum temperatures, but typically has a very stable temperature regime, with an average monthly maximum of around 30.8°C and an average May maximum of 31°C. Further research is required to better understand the implications of climate change, and its interaction with the ENSO phenomenon, for Kiribati's future temperature regime and potential heat waves. In statistical terms, the probability of heat waves is likely to grow significantly, as the average temperature moves away from the historical baseline. However, the implications for communities, and particularly the likelihood that key thresholds of human health risk will be passed (approximately 35°C wet bulb temperature), require further study.

An additional factor for consideration is the potential for marine heat waves. Research has identified the Western Tropical Pacific as a global hotspot for climate change impacts on marine heat waves. Marine heat waves are projected to extend their spatial footprint and to grow in duration and intensity.[26] The consequences of this trend may be serious for marine ecosystems in the region (and the livelihoods dependent on them), which are adapted to survive under very stable temperature regimes.

Drought

The primary type of drought affecting Kiribati is meteorological drought, usually associated with a precipitation deficit. The CMIP5 model ensemble does not provide robust information on future drought severity in Kiribati. Various issues affect accurate model projections, including the nation's small land mass, wide distribution, sensitivity to El Niño, remote pacific location and the lack of data on historical trends. General global and regional trends towards greater climatic extremes are recognized as a cause concern, and a need for disaster risk reduction and preparedness measures in Kiribati's Second National Communication to the UNFCCC (2013).[19] Some limited attempts to derive more useful projections, as reported in the National Communication, broadly suggested that little change from present-day drought distributions might be expected; there is a strong need for further research.

Floods, Cyclones and Storm Surge

Climatic patterns currently tend to shelter Kiribati's islands from the direct impact of cyclones however, impacts can still be felt when cyclones pass within a few hundred kilometers. Climate change is expected to interact with cyclone hazard in complex ways which 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 wind speed 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.[27,28] Trends emerging from the scientific literature in regard to tropical

---

[26] Frölicher, T. L., Fischer, E. M., & Gruber, N. (2018). Marine heatwaves under global warming. Nature, 560(7718), 360–364. URL: https://www.nature.com/articles/s41586-018-0383-9

[27] 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. DOI: https://doi.org/10.1002/wcc.371

[28] Widlansky, M. J., Annamalai, H., Gingerich, S. B., Storlazzi, C. D., Marra, J. J., Hodges, K. I., . . . Kitoh, A. (2019). Tropical Cyclone Projections: Changing Climate Threats for Pacific Island Defense Installations. Weather, Climate, and Society, 11(1), 3–15. DOI: https://doi.org/10.1175/WCAS-D-17-0112.1

cyclone genesis and tracks in the Pacific point towards a climate change-driven westward shift in the genesis location of cyclones.[29] Evaluation of the climate change implications for severe wind hazard have thus far produced inconclusive results.[30] Other characteristics, such as maximum wave height, have been shown to be strongly linked to El Niño-Southern Oscillation, and as such will depend upon the poorly understood relationship between climate change and ENSO.[31] One study has suggested that under future climates, cyclone generation will become more frequent during El Niño events, but less frequent during La Niña events.[32] 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. See below for further discussion of the impacts relating to wave-driven flooding and storm surge.

CLIMATE CHANGE IMPACTS

Natural Resources

Water

Water supply on Kiribati's islands depends primarily on rainwater collection and groundwater. Both are highly dependent on rainfall replenishment, and groundwater is vulnerable to saline contamination. Projections of future trends in water resources in Kiribati are not conclusive. Most models agree that extreme hydrological events will grow in intensity and as such Kiribati should develop its capacity to endure droughts, storms, and intense rainfall. As discussed in Kiribati's Second National Communication to the UNFCCC, droughts in particular place strain on groundwater resources and terrestrial ecosystems. Kiribati's ecology, including nesting bird species, has already shown to be highly sensitive to heavy rainfall events and drought and saline intrusion. These same events also present risks to human health, notably increasing the risks of bacterial and pollutant contamination and, through its impact on subsistence agriculture, and hence on food security. The vulnerability and sustainability of groundwater resources under climate changes and potentially amplified extremes in Kiribati are enhanced by issues with legislation and regulation enforcement.[33]

---

[29] Wu, L., Wang, C., & Wang, B. (2015). Westward shift of western North Pacific tropical cyclogenesis. Geophysical Research Letters, 42(5), 1537–1542.DOI: https://doi.org/10.1002/2015GL063450

[30] Siquera, A., Arthur, A., Woolf, M. (2014). Evaluation of severe wind hazard from tropical cyclones – current and future climate simulations. Pacific-Australia Climate Change Science and Adaptation Planning Program. URL: https://ecat.ga.gov.au/geonetwork/srv/eng/catalog.search#/metadata/79681

[31] Stephens, S. A., & Ramsay, D. L. (2014). Extreme cyclone wave climate in the Southwest Pacific Ocean: Influence of the El Niño Southern Oscillation and projected climate change. Global and Planetary Change, 123, 13–26. DOI: https://doi.org/10.1016/j.gloplacha.2014.10.002

[32] Chand, S. S., Tory, K. J., Ye, H., & Walsh, K. J. E. (2016). Projected increase in El Niño-driven tropical cyclone frequency in the Pacific. Nature Climate Change, 7, 123. URL: https://ui.adsabs.harvard.edu/abs/2017NatCC...7..123C/abstract

[33] Holding, S., Allen, D. M., Foster, S., Hsieh, A., Larocque, I., Klassen, J., & Van Pelt, S. C. (2016). Groundwater vulnerability on small islands. Nature Climate Change, 6, 1100. URL: https://ui.adsabs.harvard.edu/abs/2016NatCC...6.1100H/abstract

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 meter (m)–0.74 m by the end of the 21st century by the IPCC's Fifth Assessment Report[34] but some studies published more recently have highlighted the potential for more significant rises (**Table 3**). Localized sea-level rise can in fact be an extremely complex phenomenon to measure and model, notably due to the influence of large-scale climate phenomena such as ENSO. Some studies have suggested that the western Pacific has been experiencing above average rates of sea-level rise, but the extent to which this is attributable to human-driven climate change and/or likely to continue requires further research.[35]

Sea-level rise is not just a threat due to long-term encroachment on coastal areas, but also due to the projected increase in the frequency of extreme sea-level events.[36] The return period of exceptionally high sea-levels, driven by climate circulations, is expected to reduce and low-lying Pacific island nations are particularly at risk.[37] Studies have shown that the extent of wave-driven flooding is impacted by coral reef height and health, highlighting the importance of coral conservation as an adaptation.[38] Without successful adaptation, some studies have estimated that wave-driven flooding will make many atoll islands (including many in Kiribati's island groups) uninhabitable by the mid 21st century.[39] However, the scientific field lacks consensus on the gravity of the threat. Other studies have shown the potential of atoll islands to sustain and even grow despite sea-level rise thanks to geomorphological processes which build land.[40] The picture is more likely one of a dynamic ecosystem, which will demand adaptive lifestyles and livelihoods from inhabitants.

Kiribati's low-lying islands have experienced serious impacts from sea-level rise induced by climate change, some of these are documented in Kiribati's Second National Communication to the UNFCCC.[19] Communities in outer islands, such as the village of Tebunginako, Abaiang, have already had to undertake managed relocation after studies highlighted its vulnerability to permanent inundation. Documentation of other cases of community relocation is lacking, but many more occurrences are believed to have taken place. Kiribati's major urban areas are also exposed, the Second National Communication reports that the combined impact of future scenarios of sea-level rise and a 1-in-10-year storm event would result in widespread inundation of Tarawa.

---

[34] Church, J. a., Clark, P. U., Cazenave, 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

[35] Peyser, C. E., Yin, J., Landerer, F. W., & Cole, J. E. (2016). Pacific sea level rise patterns and global surface temperature variability. Geophysical Research Letters, 43(16), 8662–8669. DOI: https://doi.org/10.1002/2016GL069401

[36] Widlansky, M. J., Timmermann, A., & Cai, W. (2015). Future extreme sea level seesaws in the tropical Pacific. Science Advances, 1(8). DOI: https://doi.org/10.1126/sciadv.1500560

[37] Vitousek, S., Barnard, P. L., Fletcher, C. H., Frazer, N., Erikson, L., & Storlazzi, C. D. (2017). Doubling of coastal flooding frequency within decades due to sea-level rise. Scientific Reports, 7(1), 1399. DOI: https://doi.org/10.1038/s41598-017-01362-7

[38] Beetham, E., Kench, P. S., & Popinet, S. (2017). Future Reef Growth Can Mitigate Physical Impacts of Sea-Level Rise on Atoll Islands. Earth's Future, 5(10), 1002–1014. DOI: https://doi.org/10.1002/2017EF000589

[39] Storlazzi, C. D., Gingerich, S. B., van Dongeren, A., Cheriton, O. M., Swarzenski, P. W., Quataert, E., . . . McCall, R. (2018). Most atolls will be uninhabitable by the mid-21st century because of sea-level rise exacerbating wave-driven flooding. Science Advances, 4(4). DOI: 10.1126/sciadv.aap9741

[40] Kench, P. S., Ford, M. R., & Owen, S. D. (2018). Patterns of island change and persistence offer alternate adaptation pathways for atoll nations. Nature Communications, 9(1), 605. URL: https://www.nature.com/articles/s41467-018-02954-1

TABLE 3. 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).[41]

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		1.84 m (0.98–2.47)

Island Ecology

Sea-level rise not only threatens humans residing on Pacific islands, but also their unique ecosystem functions and ecology. Indeed, island biodiversity faces a variety of human pressures.[42] Research has shown that inundation of low-lying islands has the potential to remove important refuges for migrating sea birds.[43] As climate changes, so the suitable range for species to inhabit shifts, typically either upslope or away from the equator. In the Island environment the capacity for species to shift is extremely limited and as such loss and extinction are becoming increasingly likely. Major concerns have been raised for the terrestrial ecology of low-lying Pacific islands, for example endemic lizards, which may become trapped in a shrinking habitat.[44] Research has also highlighted the risks to biodiversity in the Pacific through study of tree richness in New Caledonia, where the range sizes of 87–96% of species was projected to decline, typically by 52%–84%.[45]

---

[41] 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

[42] Jupiter, S., Mangubhai, S., & Kingsford, R. T. (2014). Conservation of Biodiversity in the Pacific Islands of Oceania: Challenges and Opportunities. Pacific Conservation Biology, 20(2), 206–220. DOI: https://doi.org/10.1071/PC140206

[43] Reynolds, M. H., Courtot, K. N., Berkowitz, P., Storlazzi, C. D., Moore, J., & Flint, E. (2015). Will the Effects of Sea-Level Rise Create Ecological Traps for Pacific Island Seabirds? PLOS ONE, 10(9), 1–23. URL: https://doi.org/10.1371/journal.pone.0136773

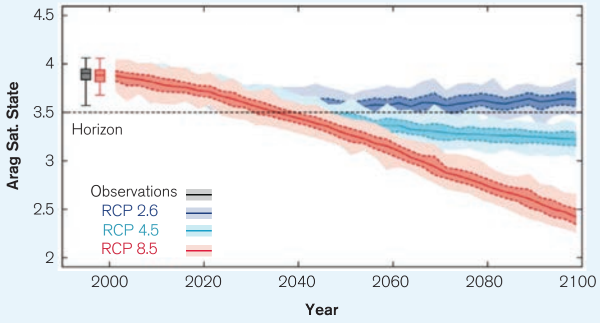
[44] Taylor, S., & Kumar, L. (2016). Global Climate Change Impacts on Pacific Islands Terrestrial Biodiversity: A Review. Tropical Conservation Science, 9(1), 203–223. DOI: https://doi.org/10.1177/194008291600900111

[45] Pouteau, R., & Birnbaum, P. (2016). Island biodiversity hotspots are getting hotter: vulnerability of tree species to climate change in New Caledonia. Biological Conservation, 201, 111–119. URL: https://agris.fao.org/agris-search/search.do?recordID=FR2017101025

Coral Reefs and Fisheries

Calcium carbonite is used for the external skeletons of multiple marine organisms – for instance, plankton, coral reefs, and shell-fish. Increases in atmospheric carbon dioxide are understood to lead to reduced levels of calcium carbonite saturation on the ocean's service via an increase in ocean acidification and by decreasing carbonite ion concentrations. As a result, there are serious concerns that if carbonite minerals, such as aragonite, become under saturated, it could undermine current ocean ecosystems.[46] **Figure 5** shows the projected aragonite saturation state under three emission scenarios for Kiribati. Worryingly under RCP4.5 and RCP8.5 the saturation state is expected to decrease below the threshold needed to sustain healthy coral reefs.

FIGURE 5. Projected changes in aragonite saturation state in Kiribati's Phoenix Group of islands from CMIP5 models under RCP2.6, 4.5 and 8.5. Shown are the median values (solid lines), the interquartile range (dashed lines), and 5% and 95% percentiles (light shading). The horizontal line represents the threshold at which transition to marginal conditions for coral reef health typically occurs.[1]



Climate change and human resource exploitation represent a dual threat to fisheries. Species living in and around coral reefs, either permanently or in their juvenile period, and particularly larger species, face an extinction threat.[47] As a result of changes in temperature, dissolved oxygen, and acidity, the maximum catch potential of currently resident species has been forecast to decline significantly in Kiribati.[48] As a result there have been strong calls for support to communities to identify suitable responses and financing mechanisms, and to adapt to the changing marine environment.[49]

---

[46] Orr, J. C., Fabry, V. J., Aumont, O., Bopp, L., Doney, S. C., Feely, R. A., . . . & Key, R. M. (2005). Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms. Nature, 437(7059), 681. DOI: 10.1038/nature04095

[47] Mellin, C., Mouillot, D., Kulbicki, M., McClanahan, T. R., Vigliola, L., Bradshaw, C. J. A., . . . Caley, M. J. (2016). Humans and seasonal climate variability threaten large-bodied coral reef fish with small ranges. Nature Communications, 7(1), 10491. DOI: https://doi.org/10.1038/ncomms10491

[48] Asch, R. G., Cheung, W. W. L., & Reygondeau, G. (2018). Future marine ecosystem drivers, biodiversity, and fisheries maximum catch potential in Pacific island countries and territories under climate change. Marine Policy, 88, 285–294. URL: https://doi.org/10.1016/j.marpol.2017.08.015

[49] Hanich, Q., Wabnitz, C. C. C., Ota, Y., Amos, M., Donato-Hunt, C., & Hunt, A. (2018). Small-scale fisheries under climate change in the Pacific Islands region. Marine Policy, 88, 279–284. DOI: https://doi.org/https://doi.org/10.1016/j.marpol.2017.11.011

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. 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. 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.[50]

Kiribati has identified a range of climate impacts in its agriculture sector, with particular threat to its subsistence farming. Key impacts identified in its Intended Nationally Determined Contribution include: reduced productivity of livestock due to heat stress, stress on water resources and hence reduced agricultural productivity, water quality and salinization damage to agricultural productivity and groundwater reserves, and damage and loss of key production, transport, and storage infrastructure. Climate change impacts in agriculture can often be mitigated through crop variety adjustments however, the local soils in Kiribati have low fertility, limiting crop choices. These issues, and other threats to agricultural productivity such as drought, are discussed in Kiribati's Second National Communication to the UNFCCC.[19]

A further, and perhaps lesser 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) 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 the 2050s under the highest emissions pathway (RCP8.5).[51] In combination, it is highly likely that the above processes will 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.

---

[50] 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

[51] Dunne, J. P., Stouffer, R. J., & John, J. G. (2013). Reductions in labor 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

Communities

Poverty, Inequality, and Vulnerability to Climate-Related Disaster

Many of the climate changes projected are likely to disproportionately affect the poorest groups in society. 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.[52] Poorer businesses are the least able to afford air conditioning, an increasing need given the projected increase in the need for air conditioning with temperature increases. Poorer farmers and communities are least able to afford local water storage, irrigation infrastructure, and technologies for adaptation.

Issues of poverty and vulnerability in Kiribati are complex due to its unique national circumstances involving very low rates of long-term employment, high dependence on international aid, and lack of data. In 2010 the Government estimated that around 66% of the population are either in poverty or vulnerable to falling into poverty. This context, combined with the nation's low food and water security, amplifies its vulnerability to natural hazards, notably the climate variability and extremes driven by El Niño Southern Oscillation. Data on contributors to disaster are sparse. However, a 2017 working paper from the Victoria University of Wellington, estimated Kiribati's Average Annual Losses at around $930,000, or approximately 0.6% of GDP.[53] The majority of these losses, around 70%, were attributable to the impact of "distant cyclones" and the remainder primarily to drought.

The most high-profile climate risk, that of permanent inundation and land loss is serious, and likely to impact on relatively impoverished communities, though its historical framing may lack nuance. The likelihood of a complete end to the viability of human inhabitation of Kiribati's islands seems low, but climate-driven risks are expected to grow. Damage and loss seem inevitable, and some relocation of populations likely. International initiatives will be needed to support communities at the front line of climate change, but must not remove the agency of local populations, nor ignore the important role of ecosystem restoration and local knowledge in regard to adaptation.[54]

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.[55]

---

[52] 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. DOI: 10.1146/annurev-publhealth-032315-021740

[53] Taupo, T. (2017). Sustainable financing for climate and disaster resilience in the atoll islands: evidence from Tuvalu and Kiribati. Victoria University of Wellington, working paper 15/2017. UR: https://ideas.repec.org/p/vuw/vuwecf/6633.html

[54] Janif, S. Z., Nunn, P. D., Geraghty, P., Aalbersberg, W., Thomas, F. R., & Camailakeba, M. (n.d.). Value of traditional oral narratives in building climate-change resilience: insights from rural communities in Fiji. Ecology and Society, 21(2). DOI: http://dx.doi.org/10.5751/ES-08100-210207

[55] 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

Human Health

The broad human health risks of climate change in Pacific island countries were assessed in a 2016 study. A large suite of issues was identified. Specifically flagged in Kiribati were the health impacts of extreme weather events, heat-related illness, water security and safety, food security and malnutrition, vector-borne diseases, respiratory illnesses, non-communicable diseases, and a variety of other disorders.[56]

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.[57] Temperatures significantly lower than the 35°C threshold of 'survivability' can still represent a major threat to human health. Climate change is expected to push global temperatures closer to this temperature 'danger zone' both through slow-onset warming and intensified heat waves.

Honda et al. (2014) utilized the A1B emissions scenario from CMIP3 (most comparable to RCP6.0) to estimate that without adaptation, annual heat-related deaths in the Australasian region, could increase by 211% by 2030 and 437% by 2050.[58] The potential reduction in heat-related deaths achievable by pursuing lower emissions pathways is significant, as demonstrated by Mitchell et al. (2018).[59] Further research is required to constrain estimates of extreme heat to Kiribati's geographical range.

Disease and General Health

Sea-level rises pose a serious threat to the water security of Pacific nations due to potential salinization of potable water sources. Saline intrusion to drinking water sources has been linked to the increased prevalence of hypertension during pregnancy in the Pacific region,[60,61] and could contribute to increased levels of hypertension more generally.

---

[56] Lachlan, M., Rokho, K., Alistair, W., Simon, H., Jeffery, S., Dianne, K., . . . L., E. K. (2016). Health Impacts of Climate Change in Pacific Island Countries: A Regional Assessment of Vulnerabilities and Adaptation Priorities. Environmental Health Perspectives, 124(11), 1707–1714. URL: https://pubmed.ncbi.nlm.nih.gov/26645102/

[57] 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

[58] 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/

[59] Mitchell, D., Heaviside, C., Schaller, N., Allen, M., Ebi, K. L., Fischer, E. M., . . . Vardoulakis, S. (2018). Extreme heat-related mortality avoided under Paris Agreement goals. Nature Climate Change, 8(7), 551–553. DOI: 10.1038/s41558-018-0210-1

[60] Khan, A. E., Ireson, A., Kovats, S., Mojumder, S. K., Khusru, A., Rahman, A., & Vineis, P. (2011). Drinking water salinity and maternal health in coastal Bangladesh: implications of climate change. Environmental health perspectives, 119(9), 1328–1332. DOI: 10.1289/ehp.1002804

[61] WHO (2019). Global Health Observatory. Data Repository. URL: https://www.who.int/gho/ncd/risk_factors/overweight/en/ [accessed 01/03/2019]

Multiple studies have found that increased temperatures, drought, and rainfall are correlated with increases in reported levels of diarrheal disease[62,63,64] including specifically in the Pacific islands.[65] While the interaction between temperature and diarrheal disease is still unclear, one explanation of the association is that rotavirus and other bacteria that cause diarrhea are able to proliferate in warm marine water. Another possible explanation is that higher temperatures can cause food to spoil more rapidly, and thus cause food poisoning.[66] **Figure 6** shows research by Singh et al. (2001),[59] which demonstrated the link between annual average temperature and average reporting rates of diarrheal disease specifically amongst Pacific island states.

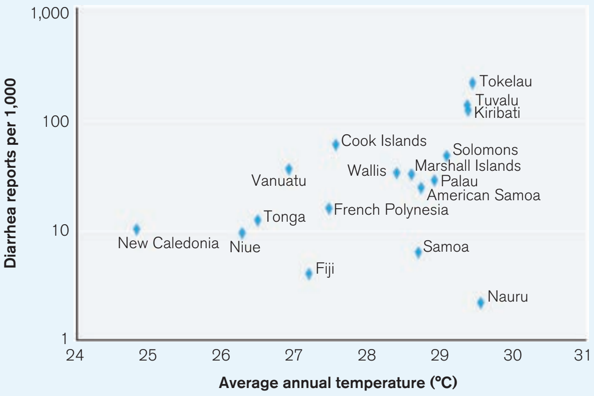


FIGURE 6. Annual average temperature and average reporting rates for diarrheal disease, Pacific islands (1986–1994). $r^2 = 0.49$; $p < 0.05$[59]

POLICIES AND PROGRAMS

National Adaptation Policies and Strategies

- Intended Nationally Determined Contribution (INDC) (2016)
- Second National Communication (2013)
- National Disaster Risk Management Plan (2012)
- National Adaptation Program of Action (NAPA) (2007)
- Initial National Communication (1999)

---

[62] Chou, W. C., Wu, J. L., Wang, Y. C., Huang, H., Sung, F. C., & Chuang, C. Y. (2010). Modelling the impact of climate variability on diarrhea-associated diseases in Taiwan (1996–2007). *Science of the Total Environment, 409*(1), 43–51. URL: https://pubmed.ncbi.nlm.nih.gov/20947136/

[63] Zhou, X., Zhou, Y., Chen, R., Ma, W., Deng, H., & Kan, H. (2013). High temperature as a risk factor for infectious diarrhoea in Shanghai, China. *Journal of epidemiology*, JE20130012. URL: https://pubmed.ncbi.nlm.nih.gov/23994865/

[64] Wu, X., Lu, Y., Zhou, S., Chen, L., & Xu, B. (2016). Impact of climate change on human infectious diseases: Empirical evidence and human adaptation. Environment International, 86, 14–23. DOI: https://doi.org/10.1016/j.envint.2015.09.007

[65] Singh, R. B., Hales, S., De Wet, N., Raj, R., Hearnden, M., & Weinstein, P. (2001). The influence of climate variation and change on diarrheal disease in the Pacific Islands. Environmental health perspectives, 109(2), 155–159. URL: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1240636/

[66] Bentham, G., & Langford, I. H. (2001). Environmental temperatures and the incidence of food poisoning in England and Wales. *International journal of biometeorology, 45*(1), 22–26. URL: https://pubmed.ncbi.nlm.nih.gov/11411411/

Climate Change Priorities of the WBG

WBG — Regional Partnership Framework

The World Bank Group has agreed a Regional Partnership Framework (RPF) with Kiribati, Republic of Nauru, Republic of the Marshall Islands, Federated States of Micronesia, Republic of Palau, Independent State of Samoa, Kingdom of Tonga, Tuvalu, and Vanuatu which covers the period 2017–2021. Climate change is one of four key focus areas of the agreement, which states: *"Protecting incomes and livelihoods. A key focus will be on strengthened preparedness and resilience to natural disasters and climate change. Interventions will also help countries strengthen health systems and address NCDs."*

Under the heading of strengthening resilience to natural disasters and climate change, the RPF aims to continue to support regional and single-country activities that help the PIC9 strengthen their resilience against natural disasters and climate change. PICs combine high exposure to frequent and damaging natural hazards with low capacity to manage the resulting risks. Vulnerability is exacerbated by poor planning, which has increased losses and exposure to natural disasters, and by climate change, which is predicted to amplify the magnitude of cyclones, droughts, and flooding. Sea level rise will worsen coastal erosion and salinization of freshwater resources and increase the severity of storm surges, which will be particularly damaging in atoll islands and low-lying areas. All these impacts adversely affect agriculture, fisheries, coastal zones, water resources, health and ecosystems and the communities that rely upon them. The cost of inaction is substantial. Investments in disaster proofing and climate resilience cost substantially less than rebuilding after a disaster. The WBG will ensure that at least 35 percent of the total portfolio will directly or indirectly support climate-related co-benefits. The RPF further identifies a range of regional and country-specific interventions including vulnerability assessment and disaster risk planning, financing and insurance initiatives for climate risks and natural hazards, as well as support to resilience building interventions in areas such as transport, agriculture and water supply.

CLIMATE RISK COUNTRY PROFILE

KIRIBATI

WORLD BANK GROUP