THE FEDERATED STATES OF MICRONESIA

Third National Communication and First Biennial Update Report to the United Nations Framework Convention on Climate Change

Photo credit: Micah Seidel, Rutgers University

Empowered lives.
Resilient nations.

Table of Contents

Presidential Foreword

When our 7th President of the Federated States of Micronesia, Manny Mori, wrote the foreword to our Second National Communication to the United Nations Framework Convention on Climate Change, he described Climate Change as the "gravest threat to my people's welfare, livelihoods, and general security. It is the survival issue of our time."

In the time between the Second National Communication to the United Nations Framework Convention on Climate Change and this Third National Communication, the former President's words have only become increasingly true. The facts are as sobering as they are devastating: if we don't work together for the survival of our Planet then the Planet is all that will remain while humanity will not.

That the Small Island Developing States are not responsible for Climate Change doesn't mean, however, that we will neglect our duty towards providing a good example. Our country joins hands with the global community and strives to reduce emissions and shift to renewable energy; we played a key role in the Paris Agreement and the Kigali Amendment and will continue to do so; and we have committed to Net-Zero by 2050 as detailed in our revised Nationally Determined Contribution strategy.

The Federated States of Micronesia signaled its dedication to the global effort of protecting our Ocean and its resources by being one of the first countries to support the 30x30 Initiative, and it is through programming like Micronesia Challenge and Blue Prosperity Micronesia that we accomplish this. We are committed towards a robust intergovernmental Biodiversity Beyond National Jurisdiction (BBNJ) Treaty, as we recognize that a healthy Ocean means a survivable Planet.

Climate Change continues to be a global issue that requires global cooperation. This Third National Communication and First Biennial Update Report is shared to the Secretariat of the United Nations Framework Convention on Climate Change both to fulfill our reporting obligations, of course, but also to indicate to the World the status of our Nation as we face this ever-growing crisis.

I re-commit the FSM Government and our national efforts to meet our ambitious climate goals for the sake of our people and our entire global human society. I express my humble gratitude to the People of the FSM who have contributed to this report, and I further express my gratitude to those unknown souls who may read its contents, gasp upon discovering its conclusions, and take actions today for our entire human civilization's prosperity tomorrow.

David W. Panuelo
President
Federated States of Micronesia

Executive Summary

In 1999, the Federated States of Micronesia (FSM) submitted its Initial National Communication to the UNFCCC. In 2015, the FSM submitted the Second National Communication outlining the nation's increased vulnerability to climate change, and changes in its greenhouse gas emissions, since the Initial National Communication. This Third National Communication and First Biennial Update Report continues to document the increases in the FSM's vulnerability to climate change, the efforts the FSM is making to reduce its emissions and to identify and implement adaptation options that reduce climate risks.

The FSM's pristine ecosystems and rich biodiversity on land and sea are understood to be one of the nation's greatest assets. Sustainably managing the FSM's unique environments, home to so many endemic species, is critical for FSM's cultural preservation and sustainable economic development. Ecosystem resilience, in the face of climate change, is addressed by the National Protected Areas Network Policy Guiding Framework, enacted in 2018, which "establishes a transparent, fair, and efficient system governing the designation and operation of a nationwide protected areas network." This policy reflects the FSM's commitments to the United Nations Convention on Biological Diversity and the Micronesia Challenge Initiative, but also addresses the country's commitments made towards the fulfillment of the Rio Conventions including the United Nations Framework Convention on Climate Change, and the United Nations Convention to Combat Desertification.

Climate change remains an important policy priority for the FSM. The FSM's Energy Policy (2012) and Energy Master Plans (2018) include goals to increase renewable energy, energy conservation and efficiency, and mitigation activities. The National Climate Change and Health Action Plan (2012) details climate-sensitive health risks and adaptation needs, and the Climate Adaptation Guide for Infrastructure has been developed by the Department of Transport, Communication, and Infrastructure. The FSM National Disaster Response Plan (2016) provides a comprehensive plan for climate disaster risk management. The plan establishes the National Disaster Committee and outlines arrangements to guide state disaster responses in connection with national arrangements. The FSM Infrastructure Development Plan (IDP) (2016–2025) is a comprehensive infrastructure investment plan that includes both mitigation and adaptation strategies.

Sustainably developing the FSM's local food system is, and needs to be, a national priority that enhances food security while decreasing GHG emissions from imported foods. The FSM's Agriculture Policy (2012- 2016), now under review, includes consideration of climate change impacts on the agriculture sector. In 2021, the Green Climate Fund approved the disbursement of funds for the adaptation project *Climate resilient food security for farming households across the Federated States of Micronesia (FSM)*, implemented by the Micronesia Conservation Trust (MCT). This project has a strong focus on climate change adaptation and is based upon households across the FSM expressing their vulnerabilities, needs, and aspirations to strengthen their community's resilience. Establishing a traditional and climate resilient agroforestry system will further contribute to carbon sequestration and address the country's food security mitigation targets. Substantial advances have been made in establishing and strengthening National and State institutions with mandates for managing climate and related risks, including disaster risk management. In 2017, the Department of Environment, Climate Change and Emergency Management (DECEM) was established under the Department of Resources and Development incorporating the previous The National Office for Environment and Emergency Management (OEEM). DECEM now coordinates national climate change and emergency response. The establishment of DECEM has helped to integrate policy development, strengthening the FSM's commitment towards climate change adaptation and disaster management.

DECEM is the national focal point for the Vienna Convention on Ozone Layer Protection and Montreal Protocol and the Global Environment Facilities, and coordinates activities of all climate change projects implemented in the country.

As a nation, the FSM continues to strengthen its capacity to manage climate risks by way of increased awareness, capacity, and skills training, strengthening institutions, and preparing and implementing policies while respecting and building upon the country's rich and diverse traditional knowledge. The FSM's adaptation strategies are developed with the inclusion of diverse community voices sharing a wide variety of needs, and priorities, rooted in local culture with attention to the significant role women play in Micronesian society. A chapter of this TNC BUR report is dedicated to Gender. In addition, Traditional Knowledge of ecosystem management and natural disaster response is included throughout this report offering potential guidelines for relevant and place-based approaches to climate adaptation and risk preparation. While great strides have been accomplished, as a nation we recognize there is a long way to go to ensure community safety and greater resiliency against climate change for all our citizens.

At the regional level, the FSM has endorsed the Framework for Resilient Development in the Pacific and the targets set by the Micronesia Challenge initiative, which include climate change adaptation by reducing the risks from climate impacts for communities within flood zones and on low-lying islands. The Micronesia Challenge provides a platform to regionally connect this locally-led action to the UN Sustainable Development Goals.

List of Abbreviations and Acronyms

ABM	Australian Bureau of Meteorology
ABS	Areas of Biodiversity Significance
ADB	Asian Development Bank
AF	Adaptation Fund
AFOLU	Agriculture, Forestry and Other Land Use
BAU	Business as Usual
BPA	Beijing Platform for Action
BPM	Blue Prosperity Micronesia
BUR	Biennial Update Report
CBD	Convention on Biological Diversity
CC	Climate Change
CCA	Climate Change Adaptation
CCD	Climate Change Division
CEDAW	Convention on the Elimination of All Forms of Discrimination Against Women
CH_4	Methane
CMIP	Coupled Model Intercomparison Project
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalent (also for CO_2-eq)
COFA	Compact of Free Association
COM	College of Micronesia
COM-CRE	College of Micronesia–Cooperative Research and Extension
COP	Conference of the Parties
CP	Country Program
CR	Congress Resolution
CRE	Cooperative Research Extension
CRM	Country Results Matrix
CRP	Comprehensive Reform Program
CRS	Catholic Relief Services
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSO	Civil Society Organizations
CWC	Chuuk Women's Council
DECEM	Department of Environment, Climate Change and Emergency Management
DFAT	Department of Foreign Affairs and Trade
dMRV	Domestic Measurement, Reporting and Verification
DoFA	Department of Finance and Administration
DoHSA	Department of Health and Social Affairs
DOS	Department of Statistics
DRD	Department of Resources and Development
DREA	Department of Resources and External Affairs

DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EbA	Ecosystem-based Adaptation
EE	Energy Efficiency
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMP	Energy Master Plans
ENSO	El Niño–Southern Oscillation
EPA	Environmental Protection Agency
EVAW	Elimination of Violence against Women
FAO	Food and Agriculture Organization
FAP	Forest Action Plan
FBUR	First Biennial Update Report
FEMA	Federal Emergency Management Agency
FSM	Federated States of Micronesia
FSM-DOH	Federated States of Micronesia–Department of Health
FSMPC	Federated States of Micronesia Petroleum Corporation
FSM-R&D	Federated States of Micronesia–Department of Resources and Development
FVNR	First Voluntary National Review
GAP	Gender Action Plan
GCCA	Global Climate Change Alliance
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
Gg	Gigagrams
GHG	Greenhouse Gases
GPG	Good Practice Guidance
GSO	Gender Support Office
GWP	Global Warming Potential
HFC	Hydrofluorocarbon
HIES	Household Income and Expenditure Survey
IAC	Integrated Agriculture Census
IAS	Invasive Alien Species
IASI	Integrated Aquatic Solutions Inc.
IDA	International Development Association
IEMP	Integrated Environmental Management Plan
IGO	Intergovernmental Organization
IMF	International Monetary Fund
INC	Initial National Communication
INDC	Intended Nationally Determined Contributions
IOM	International Organization for Migration
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
ITCZ	Intertropical Convergence Zone
IUCN	International Union for Conservation of Nature
JDA	Joint Damage Assessment

JICA	Japan International Cooperation Agency
KFA	Kosrae Farmers Association
KPIs	Key Performance Indicators
kW	Kilowatt
LDC	Least Developed Countries
LED	Light-Emitting Diode
LPG	Liquefied Petroleum Gas
M&E	Monitoring and Evaluation
MC	Micronesia Challenge
MCT	Micronesia Conservation Trust
MEA	Multilateral Environmental Agreement
MICCO 19	Micronesia COVID-19 Response Program
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MRV	Measurement, Reporting and Verification
MW	Megawatt
N_2O	Nitrous Oxide
NAB	National Advisory Board
NAMA	National Appropriate Mitigation Actions
NAP	National Adaptation Plan
NbS	Nature-based Solutions
NBSAP	National Biodiversity Strategies and Action Plans
NC	National Communication
NCCHAP	National Climate Change and Health Action Plan
NCD	Noncommunicable Diseases
NCEI	National Centers for Environmental Information
NDA	National Designated Authority
NDC	Nationally Determined Contributions
NGO	Nongovernmental Organization
NIM	National Implemented Project
NMVOC	Non-Methane Volatile Organic Compounds
NOAA	National Oceanic and Atmospheric Administration
NORMA	National Oceanic Resource Management Authority
OA	Ocean Acidification
ODA	Overseas Development Assistance
ODS	Ozone Depleting Substances
OFDA	Office of US Foreign Disaster Assistance
PA	Protected Area
PACCSAP	Pacific-Australia Climate Change Science Adaptation Planning
PAN	Protected Areas Network
PANPF	PAN Policy Framework
PCCDP	Pacific Climate Change Data Portal
PCCSP	Pacific Climate Change Science Program
PDO	Pacific Decadal Oscillation
PEM	Pacific Economic Monitoring
PIC	Pacific Island Countries

PIF	Pacific Islands Forum
PLGED	Pacific Leaders Gender Equality Declaration
PMU	Program Management Unit
PNA	Parties of Nauru Agreement
PoWPA	Program of Work on Protected Areas
PPA	Pacific Platform for Action
PREL	Pacific Resources for Education and Learning
PROP	Pacific Regional Oceanscape Program
PROPER	Pacific Regional Oceanscape Program Economic Recovery/Resilience
PSLMG	Pacific Sea Level and Geodetic Monitoring Project
PV	Photovoltaic
PWC	Pohnpei Women's Council
QA	Quality Assurance
QC	Quality Control
R&D	Resources and Development
R2R	Ridge to Reef
RCP	Representative Concentration Pathway
RE	Renewable Energy
RENI	Readiness for El Niño
RPPA	Revised Pacific Platform for Action
SDG	Sustainable Development Goals
SDP	Strategic Development Plan
SIDS	Small Island Developing States
SNC	Second National Communication
SOC	State of Conservation
SOE	State of the Environment
SPC	Pacific Community (formerly the South Pacific Commission)
SPREP	Secretariat of the Pacific Regional Environment Programme
SST	Sea Surface Temperature
SSTrC	South-South and Triangular Communication
SWM	Solid Waste Management
SWMS	Solid Waste Management Strategy
TC	Tropical Cyclone
TC&I	Transportation, Communication and Infrastructure
tCO_2e	Tons Carbon Dioxide Equivalent
TNC	The Nature Conservancy
TNC	Third National Communication
TNC-FBUR	Third National Communication–First Biennial Update Report
TRCT	Tamil Resources Conservation Trust
TWA	Tamil Women's Association
TWG	Technical Working Group
TWG	Thematic Working Group
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nation Framework Convention on Climate Change

USA	United States of America
USAID	United States Agency for International Development
USD	United States Dollar
USDA	United States Department of Agriculture
V&A	Vulnerability Assessment
VDS	Vessel Day Scheme
WASH	Water, Sanitation and Hygiene
WB	World Bank
WIFK	Women in Farming in Kosrae
WPM	West Pacific Monsoon
YWA	Yap Women's Association

Key Indicators for the FSM

KEY INDICATOR	MEASURE	SOURCE
GEOGRAPHY		
Number of islands	607	SOE, 2019
Land area	702 km^2	SOE, 2019
Max height above sea level	791 m	SPC 2021
Exclusive Economic Zone	2,980,000 km2	SOE, 2019
Land as % of EEZ	0.024	
CLIMATE		
Mean daily temperature (C°/ F°)	27.1°C / 80.8°F	PCCDP[1]
Annual average rainfall (inches)	135 in	FSM Statistics Office
Sea level rise since 1993 (mm)	10 mm per year	ABM & CSIRO 2011
SOCIAL		
Population	102,843	Census 2010
Population growth rate	0.24%	SPC 2021
Median age	24	SPC 2021
Sex ratio	103	Census 2010
Female life expectancy at birth	69.6 years	World Bank
Male life expectancy at birth	66.2 years	World Bank
Neonatal mortality rate (1,000 live births)	25.6	World Bank
Unemployment rate	16.2%	Census 2010
Human Development Index	0.62	World Bank
ECONOMIC		
Current GDP (US$' millions)	401.9	FSM National account[2]-2018
GDP per capita (US$)-2018	3,854	FSM National account[2]-2018
GNI per capita, PPP (current international US$)[3]	3,953	FSM National account[2]-2018
Dependency ratio[4]	63.7	Census 2010

[1] Pacific Climate Change Data portal: http://www.bom.gov.au/climate/pccsp/
[2] https://www.fsmstatistics.fm/economics/banking-statistics/national-accounts/
[3] Income comparisons between countries should be made at Purchasing Power Parity (PPP) rather than US$. However, these measures are currently not available for the FSM
[4] The ratio of persons in the ages defined as dependent (under 15 years and over 64 years) to persons in the ages defined as economically productive (15-64 years) in a population

ENERGY SECTOR		
Renewable capacity share	10%	NR&DC 2022[5]
Access to electricity (% of households)	76%	Castalia 2018[6]
Energy power consumption (kWh per capita)	407.5 kWh.	UN Energy statistics pocketbook 2021
WASTE		
Per Capita solid waste generation (kg)	1.12	SPC 2021
Mean waste volume production (%)	37.27%	SWMS
Waste water safely treated (%)	62.2%	DoS 2021[7]
LAND AND AGRICULTURE		
Total forest area as % of total land	82%	IAC 2016
Agriculture land as % of total land	40%	IAC 2016
Households with any livestock (percent)	67%	IAC 2016

[5] Second National R&D Conference (2022). Powering the FSM Energy sector presentation. Chuuk State, January 2022

[6] Castalia (2018). Energy Master Plans for the Federated States of Micronesia. Retrieved from: https://islands.irena.org/-/media/Files/IRENA/Sids/Publications/Micronesia---Energy-Master-Plans-for-the-Federated-States-of-Micronesia.ashx?la=en&hash=611DBBC4E55F5BB05295D385508DF9CAFD21A117

[7] FSM Department of Statistics: 2010-2015 baseline for SDG 6.3.1. Retrieved from https://www.fsmstatistics.fm/sustainable-development-goal-6/

Chapter 1
Introduction

Photo credit: Dena Seidel, Rutgers University

Empowered lives.
Resilient nations.

1.1 Introduction

The UNFCCC is the United Nations entity tasked with supporting the global response to the threat of climate change. In 1992, the Government of the Federated States of Micronesia (FSM) signed the United Nations Framework Convention on Climate Change (UNFCCC) and on November 18, 1993, the FSM Congress ratified this initiative. The UNFCCC entered into force on March 21, 1994, and since that time, the FSM has taken the necessary steps to fulfill its obligations under the Convention. This included submitting the FSM's Initial National Communication (INC) on 30 October, 1999. The INC covered such topics as the National inventory of greenhouse gas (GHG) emissions, mitigation analysis, assessments of vulnerability to climate change, adaptation options, and information and research needs, public awareness and education and capacity building. As such, it provided a baseline for subsequent assessments of the needs and opportunities related to both climate change mitigation and adaptation.

The FSM is among the first 20 countries in the world to formally ratify the 2015 Paris Agreement. On August 2, 2016, the FSM Congress adopted Congressional Resolution No. CR 19-237,[1] ratifying as a treaty "the Paris Agreement concerning the need for an effective and progressive response to the urgent threat of climate change." Ratification of the Paris Agreement was the culmination of many years' work by the FSM to make addressing climate change a priority for the country. The FSM has taken steps to "mainstream environmental considerations, including climate change, in national policy and planning as well as in all economic development activities," as outlined in its 2004-2023 Strategic Development Plan.

In November 2015, the FSM submitted its Second National Communication (SNC) to the UNFCCC. The FSM SNC used the baseline established in the INC to document the changes in the FSM's vulnerability to climate change, and in its GHG emissions, since the INC was first prepared. The SNC also reported on the efforts the FSM had made to reduce its emissions and to identify and implement adaptation measures that reduced climate risks. Continuing and new information and research needs are also described, as are the ongoing efforts to strengthen the FSM's capacity to manage climate risks by increasing awareness, enhancing knowledge and skills, strengthening institutions and preparing and implementing policies and plans designed to reduce climate risks.

In 2023, the FSM is submitting the nation's Third National Circumstances (TNC) to provide information on the climate change adaptation and mitigation commitments, progress and strategies that the FSM has put in place since its Second National Communication (SNC). The TNC presents significant progress made by the country in considering the conservation and management of natural resources as an additional response to climate-related risks while strengthening the resilience of the FSM's communities to climate change. This TNC also includes the FSM's Biennial Update Report with national Greenhouse Gas (GHG) inventories including information on mitigation actions and needs.

1.2 Institutional Arrangements

Government

At the national level, the FSM government comprises three branches: the executive, legislative and judicial. Executive power at the national level resides with the President and the Cabinet, while legislative power resides in the Congress. The judiciary is independent of the executive and the legislature. The government structure at the national level operates under the mandate of the FSM Constitution and Declaration of Rights. The FSM Constitution contains requirements to recognize the integration of the traditional political system into the modern government system. The FSM's government structure constitutionally provides the four states autonomy over

[1] C. Res. 19-237, 19th FSM Cong. (2016).

the governance of their environment and land tenure. Each state has its unique cultural traditions and languages, as well as traditional governance settings. The FSM's states operate under their own constitutions and the executive, legislative and judicial branches of the government include governors, elected legislature, and their own state court. Yap State is a unique case where traditional leaders make up a fourth branch of the government. State semi-independent governments establish their own laws, which represent the first line of implementation and enforcement to tackle climate change.

In the context of climate change and the environment, most land, with the exception for the Capital area (Palikir) in Pohnpei, and all coastal marine resources, within the 12 nautical miles, are under the ambit of the individual state governments, as are health, education, roads, and water. However, land tenure systems vary largely among the states, with Yap and Chuuk states owning limited land and marine water areas. Here, a large portion of land and marine systems are privately owned and managed by families and/or clans. The FSM Government oversees offshore activities (beyond 12 nautical miles), foreign affairs and immigration.

Climate Change Governance Arrangements

The FSM had already taken the lead on moving to an integrated approach towards climate change and disaster risk management. The National Office for Environment and Emergency Management (OEEM), under the Department of Resources and Development, on 29 September 2017, became the Department of Environment, Climate Change and Emergency Management (DECEM), which stands as the coordinator for national environmental efforts, climate change and emergency response. The establishment of DECEM has helped to integrate policy development, strengthening the FSM commitment towards climate change adaptation and disaster management, but climate financing continues to be fragmented, reducing overall effectiveness of this mainstreaming process. DECEM is the national focal point for the Vienna Convention on Ozone Layer Protection, the Montreal Protocol and the Global Environment Facilities, and coordinates activities of all climate change projects implemented in the country. The Department of Foreign Affairs is the national focal point for the Adaptation Fund, with DECEM as executive Agency and the Secretariat of the Pacific Regional Environment Programme (SPREP) as implementing agency. The FSM Department of Finance and Administration includes the National Designated Authority (NDA) for the Green Climate Fund that provides strategic support to the national government.

International Climate Commitments

The FSM is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), and submitted its Second National Communication on the 12 of December 2015. This national communication provides a comprehensive look at the country's GHG emissions, vulnerabilities and likely impacts of climate change within the FSM. In November 2015, the FSM was among the first 20 countries in the world to formally ratify the Paris Agreement, which was formally adopted by the FSM Congress in 2016 through a Congressional Resolution. Also, in November 2015, the FSM submitted its Intended Nationally Determined Contribution (INDC), through which the country committed to "unconditionally reduce by 2025 a 28% of its GHG emissions below emissions in the year 2000." In 2022, the FSM submitted an updated NDC committing to "achieving net zero greenhouse gas emissions by the year 2050." In 2017, the FSM was one of the first three countries globally to ratify the Kigali Amendment to the Montreal Protocol on Substances that deplete the Ozone Layer. Under the amendment, all parties are committed to cut the production and consumption of hydrofluorocarbons (HFCs) by more than 80% over the next 30 years thus to avoid up to 0.5^{0} C of global warming by 2100. The FSM has introduced a national action plan and will begin to phase down its HFCs consumption starting in 2024. In 2021, the FSM joined the Global Methane Pledge, which seeks a 30% reduction from 2020 methane levels by 2030. The country is also a signatory to the UN Convention to Combat Desertification, ratified in 1996, the Sendai Framework for Disaster Risk Reduction 2015–2030 and to the 2030 Agenda for Sustainable Development.

At the regional level, the FSM has endorsed the Framework for Resilient Development in the Pacific and the targets set by the Micronesia Challenge (MC) initiative, which include climate change adaptation by reducing the risks from climate impacts for communities within flood zones and on low-lying islands. The MC provides a platform to regionally connect this locally-led action to the UN Sustainable Development Goals.

National Policies and Plans

The FSM has developed a relatively strong policy landscape for climate change and disaster risk management at both the national and state level. The country developed policies that integrate both climate change and disaster risk management issues, and assist in mainstreaming these issues across sectors.

The FSM Nation Wide Integrated Disaster Risk Management and Climate Change Policy (2013), mandated through the Climate Change Act 2013, overarching goal is to:

> Promote development that proactively integrates the management of disaster and climate related hazards by investing in disaster risk management, climate change adaptation and greenhouse gas emissions reduction in pursuit of a safe, resilient and sustainable future for our country.

This policy provides an overview of the institutional arrangements for implementation, highlighting the cross-cutting nature of disaster and climate risk management, and the role of national and subnational government organizations as well as non-state actors. The goals and objectives to be achieved are reflected in specific and tangible actions presented in national and state-level policies and plans such as the states' JSAPs. This broad policy reflects the unique context of the FSM, with states and state-based actors leading the implementation of relevant climate change and disaster risk management activities (SPC and PIFS, 2019[2]).

The FSM Energy Policy (2012) and Energy Master Plans (2018) seek to increase renewable energy, energy conservation and efficiency, and mitigation activities. The main goals are to increase the share of renewable energy from 19% in 2018, to at least 30% of total energy production by 2020; and increase electricity efficiency by 50%. Both policy and EMP include increasing household access to electricity, with the EMP targeting 100% of households' electrification by 2027.

Resilience of ecosystems to climate change is addressed by the *National Protected Areas Network Policy Guiding Framework*, enacted in 2018, which "establishes a transparent, fair, and efficient system governing the designation and operation of a nationwide Protected Areas Network." This policy reflects the FSM commitments to the United Nations Convention on Biological Diversity and the Micronesia Challenge Initiative, but also addresses the country commitments made towards the fulfillment of the Rio Conventions including the United Nations Framework Convention on Climate Change, and the United Nations Convention to Combat Desertification.

The FSM's National Strategic Development Plan (NSDP) 2004-2023 provides goals for sectoral development in the country over a 20-year period. The NSDP includes a number of references to climate change, with goals targeting the mainstreaming of climate change into planning and development activities, and the conversion to renewable energy sources to reduce GHG emissions.

The FSM Infrastructure Development Plan (IDP) (2016–2025) is a comprehensive and costed infrastructure investment plan that includes both mitigation and adaptation investments. This plan is reflected in state level actions presented in the states' IDP. However, focus on climate resilient infrastructure and consideration is not given to the context of climate adaptation and vulnerability to extreme weather and climate change (IMF, 2019). The FSM proposal to develop the country National Adaptation Plan, through a partnership with SPREP is under

[2] Pacific Community and Pacific Islands Forum Secretariat (2019). Federated States of Micronesia Climate Change and Disaster Risk Finance Assessment: final Report. Pacific Community Suva, Fiji.

review by the GCF and will assist in updating the Joint States Action Plans, for adaptation and disaster risk reduction, developed by each state between 2015-16.[3] Individual projects under the IDP, JSAP and energy master plan have been costed, albeit only the IDP fully identifies total project costs, available funding and fund gaps.

The FSM National Disaster Response Plan (2016) provides a comprehensive plan for disaster risk management in the country. The plan establishes the National Disaster Committee and outlines arrangements to guide state disaster response plans and their connection to the national level arrangements. This plan was reflected in state level actions presented in the States disaster management and/or preparedness plans developed in 2017.

The National Environmental Management Strategy (NEMS), updated in 2018, restates the needs for adaptation and mitigation by aligning its goals and objectives to the FSM Energy policy and states adaptation plans (JSAPs). The FSM Agriculture Policy (2012-2016) is currently expired and under review, but included consideration of climate change impacts on the agriculture sector. The National Climate Change and Health Action Plan (2012) details climate-sensitive health risks and adaptation needs. Finally, the Climate Adaptation Guide for Infrastructure has been developed by the Department of Transport, Communication and Infrastructure.

Institutional Arrangements for the Preparation of NCs and BURs

The FSM has prepared and submitted two national communications to the United Nations Framework Convention on Climate Change, i.e., the First National Communication (1997) and the Second National Communication (2015). The country shall submit its Third National Communication (present document). The financial support for the preparation of these reports was provided by the Global Environment Facility (GEF). In the Second National Communication, the Office of Environment and Emergency Management, within the Department of Resources and Development was responsible for the coordination of the report. Presently, the First Biennial Update Report (BUR1) and the Third National Communication (TNC) are being coordinated by the Department of Environment, Climate Change and Emergency Management (DECEM). The institutional arrangements for regular preparation of national communications (NCs) and biennial update reports (BURs) have been established. The structure is depicted in Figure 1.

DECEM assumes the role of national coordinating entity for the NCs and BURs and the Secretary of the Department is the Project Director that identifies a Project Manager/Coordinator to oversee the preparation of the reports and manage coordination among the different stakeholders assisting in developing the different components. The Project Manager/Coordinator liaise with the State Focal Points and technical teams appointed for drafting of the National Circumstances, Mitigation, Adaptation, Constraints & Gaps, Monitoring, Reporting & Verification and Other Information. This Project Manager/Coordinator also plays a part in facilitating communication, technical cooperation and coordination among stakeholder agencies and other project partners at national level. The Greenhouse Gas Inventory is tasked with analyzing country data on GHG emission in accordance with the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*,[4] *2006 IPCC Guidelines for Greenhouse Gas Inventories*[5] and *IPCC Good Practice Guidance* (GPG).[6]

DECEM is supported by State Focal Points, who represent State-level interests and needs and who assist in (i) providing high-level technical guidance and policy input; and (ii) facilitating communication, technical cooperation and coordination among stakeholder agencies and other project partners in the States.

The Technical Advisory Committee (TAC) consists of technical experts whose main role and responsibility is to provide technical advice and input relating to project implementation, including to share knowledge, review planned activities, verify/review findings, and support education (share information on project lessons learned

---

[3] Briones-Johnson, L. (2022). FSM Rapid Report for the update of the FSM-GCF Country Program. Under Review.
[4] https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html
[5] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
[6] Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, https://www.ipcc-nggip.iges.or.jp/public/gp/english/index.html

with stakeholders at national level). All technical documents prepared are to be reviewed by this team of experts in an internal review before being finalized.

Lastly, the Project Steering Committee (PSC) is established to provide financial, policy and administrative oversight. The function of the PSC is to focus mainly on final decisions on procurement, institutional arrangements and financial management of the project. This PSC consists of the Project Director, National Departmental Representatives, State Focal Points, UNDP Representative and Project Manager/Coordinator.

The flow of information is from the data providers to the technical teams and draft reports are submitted by these teams to the Project Manager/ Coordinator that shares these with the TAC for technical review. Upon finalizing the report, the Project Manager/Coordinator finalizes the documents for submission to the Project Director and Project Steering Committee for approval. Lastly, DECEM submits the finalized NC and BUR reports to the UNFCCC.

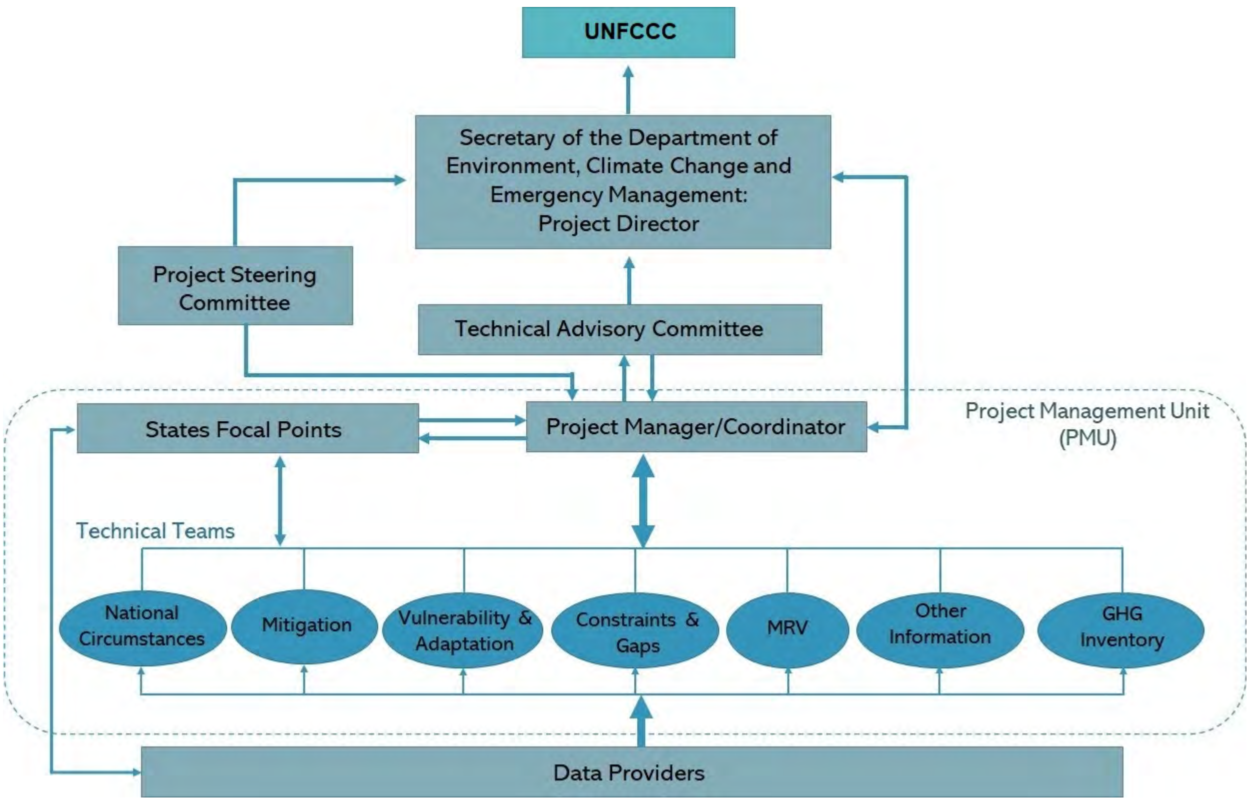


Figure 1. Institutional arrangements for the preparation of the FSM's TNC.

Chapter 2

National Circumstances

Photo credit: Dena Seidel, Rutgers University

2.1 Introduction

The Federated States of Micronesia (FSM) is an expansive North Pacific nation of 607 islands spread across a longitudinal distance of almost 2,700 km (1,678 mi^2) and within an Exclusive Economic Zone[7] (EEZ) that covers roughly 2.9 million km^2 (1.15 million mi^2) of ocean waters. The people residing in the FSM—inclusive of Indigenous Peoples and local communities (IPLCs)—are culturally diverse and inhabit 65 islands across four independently governed states—Yap, Chuuk, Pohnpei and Kosrae. The FSM is politically structured as a loose federation giving significant autonomy and power to each state government. Eight major indigenous languages are spoken in the FSM: Yapese, Ulithian, Woleaian, Chuukese, Pohnpeian, Kosraean, Nukuoro and Kapingamarangi, with English used to communicate between States. Each state has its own executive and legislative bodies and exercises considerable autonomy to manage its domestic affairs and natural resources. Most public services are delivered at the state level as each state government replicates the national government system with its own constitution and three branches of powers, with Yap State having a fourth branch for traditional leaders. Due to the federal structure and large geographical distances, accomplishing policy decisions as related to climate change preparedness and sustainable development at the national level is complex, as consensus across the national and the state governments is required.

Projections on climate change indicate that impacts in the Pacific will directly affect the FSM communities, becoming a threat to their health, incomes and subsistence. For instance, under a high emission scenario (RCP 8.5-BAU), the Asian Development Bank (ADB) estimated over a 20% decline of Skipjack tuna catches for the west Pacific, due to migration of tuna to cooler waters (ADB 2013). Similarly, changes in the climate will have repercussions for agriculture and public health as well. Agriculture yield will be reduced due to more severe droughts and the burden of health costs will increase due to increased incidence of respiratory disorders, mosquito and water borne (e.g., dengue or conjunctivitis) diseases. Another significant threat for households and infrastructures is associated with the likely decline of coral reef cover. Climate change is estimated to cause up to a 70% loss of coral cover, reducing the ability of this ecosystem to keep pace with projected sea level rise of approximately 10 inches by 2050 and up or more than 35 inches by the end of the century (Australian Bureau of Meteorology and CSIRO 2014). This important decline in coral cover will affect coastal protection and fishery catches and will also come with elevated costs for already vulnerable rural and urban communities.

As a country, the FSM has come together at the national and state levels to address these climate threats and is collectively taking bold steps to prepare and protect the country's people and their rich ocean and land biodiversity. The nation of the FSM is acutely aware that local food production, food and water security, sustainable economic development and the integrity of culture are all reliant on maintaining healthy, stable and resilient natural systems. As such, the FSM has already taken, and continues to take, substantial measures to ensure that the nation is meeting its obligations to its people while also meeting its global commitments under the United Nations Framework Convention on Climate Change (UNFCCC).

2.2 History and Traditional Knowledge

The people of the FSM have a strong relationship with their land and ocean. The islands of the FSM were first settled more than 4,000 years ago in decentralized, chieftain-based communities. Today, each of the four states exhibits its own distinct culture, traditions, social organization and language(s), but they all continue to share recognition and respect for the traditional extended family and clan systems and ritual exchanges.

The FSM's traditional cultural systems evolved over thousands of years with social mechanisms to insure the sustainable use of limited resources on small islands. The FSM's diverse and complex traditional knowledge (TK) developed as generation upon generation passed on skills for co-habiting within the many unique island

[7] An Exclusive Economic Zone is a sea zone prescribed by the United Nations Convention on the Law of the Sea (UNCLOS) over which a state has special rights regarding the exploration and use of marine resources, including energy production from water and wind.

ecosystems that are found throughout the nation. The social fabric of the FSM's people was built upon traditional knowledge and cultural norms that provided a framework for sustainably harvesting food and resources from the forests, the reefs and the ocean. The Carolinian islands of Yap and Chuuk are home to peoples who have continuously practiced way-finding, a traditional non-instrument ocean navigation, that includes a deep understanding of the stars, wind, ocean currents, weather, and migratory birds. Many of the FSM's farming and fishing families still live by their local, traditional knowledge.

The FSM's people and their traditional practices have been impacted over centuries. Beginning in the 16th century, Spain claimed islands throughout this Pacific Region as part of its colonial empire, naming the islands the Caroline Islands, after King Charles II. After the Spanish-American War, Spain sold the Caroline Islands to Germany in 1899 and the Germans then passed their control to the Japanese through the 1919 Treaty of Versailles. Following World War II, the islands became part of the UN Trust Territory of the Pacific Islands (TTPI), administered by the U.S. On May 10, 1979, the TTPI districts of Chuuk, Yap, Pohnpei, and Pohnpei's then sub-island, Kosrae ratified a new Governmental Constitution. On November 3, 1986, the Federated States of Micronesia signed the Compact of Free Association (COFA) and became a newly sovereign nation. The COFA was amended in 2004 and on-going compact negotiations are scheduled to conclude in the first half of 2023.

The FSM is vulnerable to rapid cultural and environmental change. The country's wide geographic dispersal and limited amount of land make the local people extremely at risk to climate hazards. The FSM increasingly faces severe climate impacts such as sea-level rise, coastal erosion, coral bleaching, rising temperatures, changing rainfall patterns, and extreme weather events. Demands for rapid economic development have also fostered degradation of islands ecosystems as pollution, overfishing, and unsustainable development exacerbate the country's vulnerability to climate hazards.

2.3 Geographic Profile

The islands of the Federated States of Micronesia are home to some of the world's greatest biodiversity, with a wide range of endemic species and a great deal of geographic variety, from high volcanic islands to small islets and low-lying coral atolls. Pohnpei Island, home to a rich and diverse tropical rain forest, is one of the wettest places on Earth, with an average annual recorded rainfall of 4,775 mm (188.0 in). Each of the FSM's four states centers around one or more high volcanic island where the largest populations reside, and all but Kosrae State include numerous outer island atolls. The FSM's total land area is small, approximately 701 km^2 (271 square miles), with a total lagoon area of 7,192 km^2 (2,777 square miles). Because of the FSM's wide variety of ecosystems and geology, the people of the FSM experience a wide range of climate change impacts.

Climate change represents a significant threat throughout the FSM but especially to the physical environment of the low-lying outer island coral atoll communities with mean elevation of only 1-2 meters above sea level. Natural hazards, such as typhoons, frequent heavy rains, flooding along with threats of storm surges, rising sea levels, and droughts are increasingly causing damage to the FSM's natural environment, infrastructure, and to the livelihoods of the Micronesian people.[8]

The FSM's high biodiversity, combined with unique topographic and geographic features, results in a variety of ecosystems and associated services. The FSM's terrestrial and marine biodiversity and ecosystem services support the nation's economy and development of the country as well as the long-term persistence of culture and customs in the country. These natural services are inclusive of water retention (via its forest and watersheds); shoreline protection (coral reefs, mangrove forest); livelihoods (fisheries); and tourism/eco-tourism (beaches, mangroves, biodiversity, aesthetics). The protection, conservation and sustainable use of ecosystems and associated biodiversity is of paramount importance for the nation's sustainable development, which includes

[8] https://www.usgs.gov/centers/pcmsc/science/impact-sea-level-rise-and-climate-change-pacific-ocean-atolls

maintaining healthy and abundant biodiversity as well as well-functioning ecosystems that are crucial to the FSM climate change mitigation and adaptation strategies (CBD 6th National report 2020[9]).

2.4 Natural Resources

Terrestrial ecosystems

The FSM states show wide-ranging ecosystem diversities, including forest type and composition associated with diverse climate, soil type and island topography. Forest characteristics differ between high islands and outlying islands, with the latter presenting a smaller forest community diversity (SOE, 2019). The rich plant diversity found in the country is associated with the high forest cover, estimated to be nearly 82% of the total land mass area (CBD 6th National report 2020; IAC, 2016).

The forests of the FSM vary from east to west due to differences in climate, geology, topography and geographical isolation. As a result, forest type varies from state to state. The dominant vegetation types are mixed broadleaf forest, swamp, mangrove, savanna, and agroforests. The largest forest, around 330 km^2 (127 sq mi), is found within Pohnpei, while Yap contains the smallest forest with almost 70 km^2 (27 sq mi; NBSAP, 2018). FSM forests and mangroves are particularly important to subsistence economies. They provide a series of services such as firewood, building material and other wood products that are used for handicrafts, carving and making canoes. While resources and activities in the forest are generally accessed and managed by men, mangrove areas are equally used by men and women for fishing, firewood and recreational activities (IAC 2016[10]).

Cross-cutting threats to the FSM's forest systems are climate change, invasive alien species (IAS), wildfires and deforestation due to unsustainable use associated with monocropping or development (FAP 2020,[11] SOE 2019).

In 2006, 46% of the forested lands in the FSM were classified as highly drought resilient, while the remaining 54% was medium (51%) to low (3%) drought resilient (SOE, 2019). Nearly 600 alien species, the majority being terrestrial plant species, are considered to be invasive or potentially invasive (IUCN SSC, 2015[12]), which, along with the climate change impacts, is increasing food insecurity throughout the country. Of the 130 Areas of Biodiversity Significance identified in the FSM at the beginning of this millennium, IAS were assessed as being a major threat at 9% of such sites.[13] Currently there are no nationwide studies assessing the effects of climate change on the spread of IAS in the FSM, although synergistic effects are largely known. Forest habitat fragmentation and loss in the high islands is also associated with road construction, causing spread of fast-growing invasive vines.

[9] Federated States of Micronesia (2020). The Federated States of Micronesia Sixth National Report to the Convention on Biological Diversity. Retrieved from: https://www.cbd.int/doc/nr/nr-06/fm-nr-06-en.pdf (Accessed: July 2021).
[10] FSM Department of Resources and Development (2019). Federated States of Micronesia Integrated Agriculture Census 2016. Department of Resources and Development, Palikir, Pohnpei, FM.
[11] FSM Department of Resources and Development (2020). Federated States of Micronesia Forest Action Plan 2020-2030. Palikir, FSM.
[12] Compile and Review Invasive Alien Species Information for the Federated States of Micronesia and its constituent states Chuuk, Kosrae, Pohnpei and Yap. Unpublished draft report for the Secretariat of the Pacific Regional Environmental Programme, 2015. 31 pp. Invasive Species Specialist Group, Pacific Regional Office, Auckland, NZ.
[13] TNC (2002), A Blue Print for Conserving the Biodiversity of the Federated States of Micronesia.

Table 1. Land cover in the FSM.

	FSM	Yap	Chuuk	Pohnpei	Kosrae
Land Area (km^2)[a]	701	102.9	127	371	111.3
Forest Area (km^2)[b]	580.6	69.5	73.4	330.5	107.2
Forest Area as percent of total land[b,d]	0.82	0.67	0.57	0.89	0.96
Agriculture land as percent of total land[c]	0.4	0.47	0.70*	0.40	0.10
Agroforest with IAS presence (percent)[d]	0.86	0.09	1	0.85	0.99

[a]SNC, 2015; [b]Donnegan et al, 2011- forest cover includes secondary forest (agroforest); [c]IAC, 2016; [d]FAP, 2020
*Data derived from IAC (2016): total land area of Chuuk in the IAC was estimated for Chuuk lagoon only (94.11 km^2). The value of agricultural land as percent of total land is representative of the Chuuk Lagoon islands.

Inland Waters

Approximately 60% of water resources in the FSM exist as surface water in the form of small, intermittent streams that drain catchment areas of limited aerial extent (Johnston 2011). The remaining 40% exist as groundwater in small, dispersed zones of sedimentary deposits, weathered volcanics and schists.

Kosrae and Pohnpei have perennial stream flow and serve as a nearly infinite resource. Chuuk has several ground and surface water sources across the islands in the lagoon. Yap's water sources are primarily from ground water and from a man-made water reservoir that supplies part of Yap Proper; there are no perennial streams on Yap. For outlying islands, residents depend on shallow aquifers (water lens), varying from a minimum of 25 inches (635mm) to 52 feet (16 meter) thickness, for some of their domestic water needs and for food production (Bailey and Jonsen 2010[14]). The thickness of these freshwater lenses is determined by climate variability associated with seasonal rainfall fluctuation and salt mixing due to tide- or storm-induced pressure. Other determinants are the size of the island, the permeability of the rock beneath the island and rates of water withdrawal. Low-lying islands' water resources are most vulnerable to changes in rainfall pattern, rising sea level, and extreme tides. During extreme drought events (e.g., 2015/2016 El Niño–ENSO related), communities have suffered from severe water shortages throughout the country, but particularly on low-lying atoll islands. Rising sea level leads to an increased impact of king tides, which inundate large parts of the islands and contaminates freshwater aquifers, wetlands, and other crop fields. Similar contamination is reported during tropical storms and typhoons due to a combination of rising sea level, wind-driven waves and tidal surges. Traditional knowledge on managing groundwater aquifers on outlying islands is still in use and communities work together to preserve natural water resources to be prepared to respond to droughts. However, climate change sea level projections indicate that for these low-lying atoll systems, groundwater lenses are likely to become more and more compromised over time, indicating the urgency, for the most remote communities, to increase their water capacity.

Marine Ecosystem

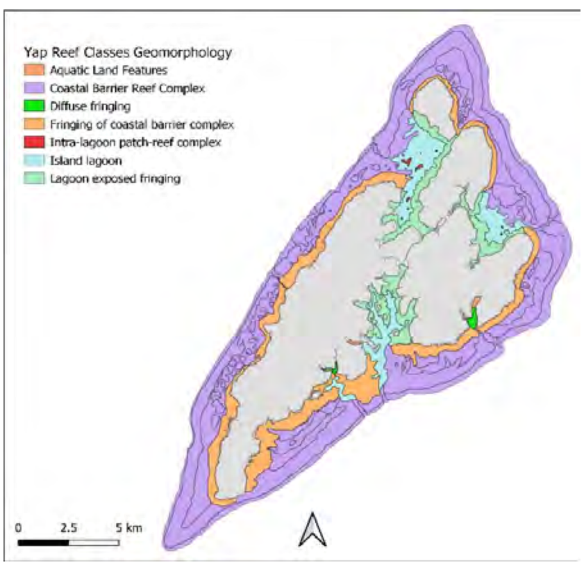
The FSM has a range of marine habitats and species from nearshore coral reefs to seagrasses and mangroves. These are key to the FSM population, which relies heavily on marine resources for income and livelihoods. It is estimated that the FSM coral reefs provide an annual value of $16 million through tourism and recreation, while more than 70% of households engage in fishing activities (CBD 6th National report 2020). Coral reefs are valuable ecosystems. They are essential in the formation and protection of beaches, provide a habitat for a variety

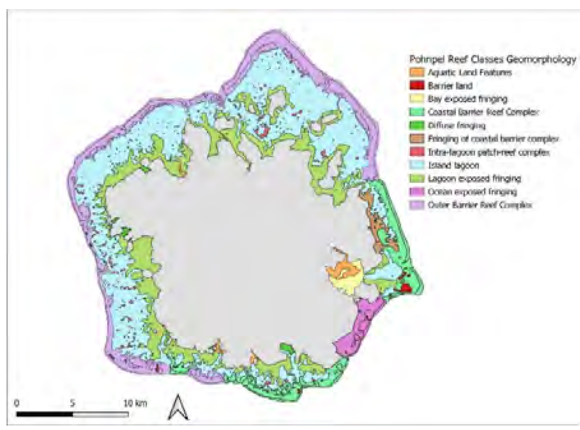
[14] Bailey R.T., Jenson J.W. (2011). Groundwater resources analysis of atoll islands in the FSM using an algebraic model. Technical Report No. 134

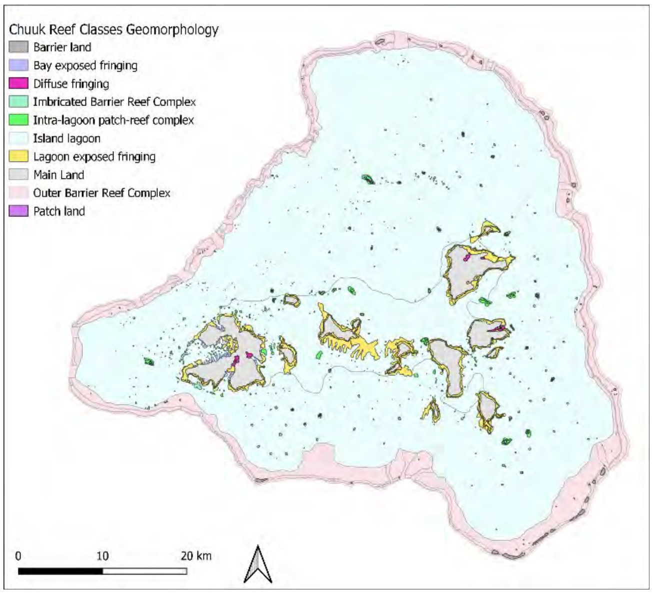
of species, and play an important role in economic activities. Three main types of coral reefs surround the FSM islands: fringing reefs, barrier reefs and atolls. The FSM coral reefs are estimated at 14,517 km^2 (5,605 sq mi).

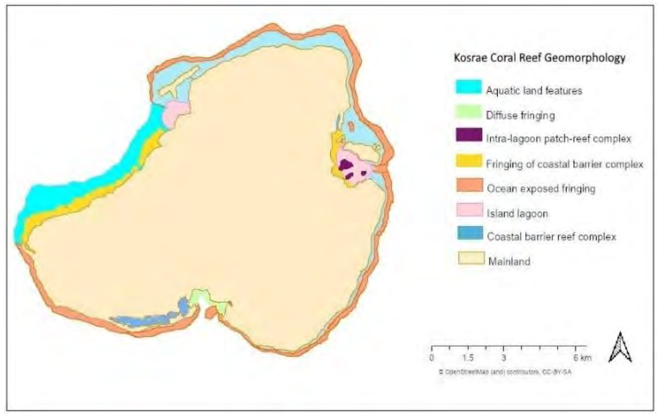
The high island of Pohnpei has an outer barrier reef with several natural passes and channels surrounding a shallow water lagoon that terminates onto a shallow land based fringing reef. The lagoon contains small islands and extensive seagrass beds. The State of Chuuk contains one of the largest semi-closed circular oceanic atoll lagoons in the world, with a total area of 2,131.5 km^2 (823 sq miles), comprising a large outer barrier reef with a number of natural passes and channels. The numerous high islands in the lagoon (total area of 99 km^2) are surrounded by shallow nearshore fringing reef and patch reefs terminating directly onto the islands. Extensive seagrass beds occur throughout the lagoon. Yap Proper is the only volcanic island within the FSM's states consisting of 4 separate islands joined by a common coral reef. The island is surrounded by an outer barrier reef with natural passes and channels surrounding a shallow narrow water lagoon that terminates onto a shallow land-based fringing reef or in some cases beaches, which terminate directly onto the islands. Seagrass beds and mangrove forests are located through the islands. Yap, Chuuk and Pohnpei States comprise outlying islands, all including extensive outer barrier reefs, which in some islands are open naturally through reef passes and channels enclosing extensive shallow water lagoons that possess small islets made up mainly of coral limestone. These low-lying atoll islands, contain critical nesting and spawning sites for commercially valuable marine species, including clams, pelagic and reef fish, as well as keystone species such as the green turtle (*Chelonia mydas*) and Hawksbill turtle (*Eretmochelys imbricata*), sharks and rays.

Figure 1. Coral reefs geomorphology at the four States main islands. (Pohnpei, Chuuk and Yap data source: Digital Atlas of Micronesia. https://islandatlas.org/; Kosrae map modified from Digital atlas of Micronesia https://islandatlas.org/gallery)









Coral Reefs

Coral reefs around the high volcanic islands of Pohnpei, Chuuk, Yap and Kosrae, where a larger number of the FSM population reside, are most at risk from high fishing pressure and coastal development threats. Fishing pressure is the main driver of coral reef changes in the country (Houk et al. 2015[15]). Projections for ocean thermal stress and acidification suggest that the FSM coral reefs will be threatened with about 50% at high, very high, or critical threat levels by 2030 (SOE, 2019). Coral reefs are consistently declining throughout the country, with the exception of Yap, where coral cover is increasing slightly. At some sites the observed decline is associated with extensive bleaching events and with high densities of coral-eating Acanthaster starfish, particularly in Kosrae (Houk et al. 2020[16]). Healthy and resilient coral reefs are crucial habitats that sustain the FSM coastal fisheries, which for generations have provided for food, recreation, social cohesion, culture, and more recently economic security (SOE, 2019). In recent years, the FSM coastal fisheries have seen a decline fish stocks, linked to unsustainable harvesting levels, throughout the country, particularly at high-islands where a large part of the population live (Houk et al. 2012[17]; Hernandez-Ortiz et al. 2016[18]; Houk et al. 2017[19]; Cuetos-Bueno et al. 2018[20]), and exacerbated by global warming and climate change.

Mangroves

Mangroves provide a wide array of services including food, firewood and building material, coastal buffering against typhoons and other extreme weather events, regulate coastal water quality, and are important nursery for juvenile fish. In the FSM, mangroves vary across the states with highest cover in Pohnpei (72% of the total mangroves in the country) and the lowest in Chuuk (7% of the total mangroves in the country; SOE, 2019). At least 17% of the FSM's land mass is in terrestrial protected areas and 27% of it is mangrove forests (SOE, 2019).

[15] Houk, P., Camacho, R., Johnson, S., McLean, M., Maxin, S., Anson, J., et al. (2015) The Micronesia Challenge: Assessing the Relative Contribution of Stressors on Coral Reefs to Facilitate Science-to Management Feedback. PLoS ONE 10(6): e0130823. doi:10.1371.
[16] Houk, P., Yalon, A., Maxin, S., Starsinic, C., Mcinnis, A., Gouezo, M., Yimnang Golbuu, Y., van Woesik, R. (2020). Predicting coral-reef futures from El Niño and Pacific Decadal Oscillation events. Scientific Reports (2020) 10:7735; https://doi.org/10.1038/s41598-020-64411-8.
[17] Houk, P. et al. 2012. Commercial coral-reef fisheries across Micronesia: A need for improving management. Coral Reefs, 31(1), pp.13–26.
[18] Hernandez-Ortiz, D. et al. 2016. Characteristics and drivers of coral-reef fishery landings in Pohnpei, Federated States of Micronesia. Proc 13th International Coral Reef Symposium.
[19] Houk, P. et al. 2017. An applied framework to assess exploitation and guide management of coral-reef fisheries. Ecosphere, 8(3).
[20] Cuetos-Bueno, J. et al. 2018. Human and environmental gradients predict catch, effort, and species composition in a large Micronesian coral-reef fishery. PLoS ONE, 13(5).

Conservation Areas

The FSM is a country on the frontline of climate change, already experiencing its impacts through rising average atmospheric temperatures, increasing coral bleaching and changing patterns of precipitation and crop harvest. National and states' government recognize that the protection of ecosystems, through the establishment of protected areas, is an essential route to building national resilience to climate change. The FSM has a long history of protected areas established through community endorsement and/or recognized by state laws and municipal ordinances.

These local efforts have been accompanied by multilateral environmental agreements (MEAs) and regional commitments, such as Agenda 2030-SDG, SAMOA Pathway, CBD Aichi Targets, and Regional Framework for the Conservation and Protected Areas, the Micronesia Challenge, among the others. The country established a National Protected Areas Policy in 2018, the *Protected Areas Network National Guiding Policy Framework* (PANPF), which aggregates and supports state and local protected area mechanisms. In 2019, FSM reported 2,135 km^2 of Marine Protected Areas (MPA) established within states' waters and 121.4 km^2 at the four states. Presently, implementation of nationwide projects (i.e., FSM R2R) and the PANPF, assisting the nation in expanding its network of Protected Areas, accounts for the differences in land tenure and use of resources in the four states. For future protected areas, the FSM has commenced marine spatial planning for the established Blue Prosperity Micronesia program, which aims to protect 30% of the FSM's oceans by 2030.

2.5 Biodiversity and Ecosystems

In the FSM, terrestrial and marine biodiversity and ecosystem services support the economy of the country and social well-being. Ecosystem services and biodiversity are vital to food and water security, coastal protection and the long-term persistence of culture and customs in the country. The FSM is at the forefront of climate change, which is posing a concrete threat to biodiversity, by accelerating habitat fragmentation and loss, which exacerbates the deterioration of fragile ecosystems (i.e., coral reefs, mangroves, native forests). Concurrently, ecosystems resources and services are being undermined by unsustainable use and practices and spread of invasive alien species. Impacts on agriculture, fisheries, forestry, and degrading land from climate change have been reported throughout the FSM (NBSAP, 2018; CBD 5th National report 2014[21]). The protection, conservation and sustainable use of ecosystems, and associated biodiversity, is of paramount importance for maintaining well-functioning ecosystems that are crucial to the FSM climate change mitigation and adaptation strategies (CBD 6th National report 2020[22]).

The FSM is a tropical coral ecoregion, containing some of the largest coral atoll complexes in the world, characterized by two terrestrial and one marine ecoregion. The terrestrial ecoregions are comprised of Yap, Chuuk, Pohnpei and Kosrae ecoregion (NBSAP 2018).

[21] Federated States of Micronesia (2014). Fifth National Report to the Convention on Biological Diversity The Federated States of Micronesia. Retrieved from: https://www.cbd.int/doc/world/fm/fm-nr-05-en.pdf (Accessed: July 2021).

[22] Federated States of Micronesia (2020). The Federated States of Micronesia Sixth National Report to the Convention on Biological Diversity. Retrieved from: https://www.cbd.int/doc/nr/nr-06/fm-nr-06-en.pdf (Accessed: July 2021).

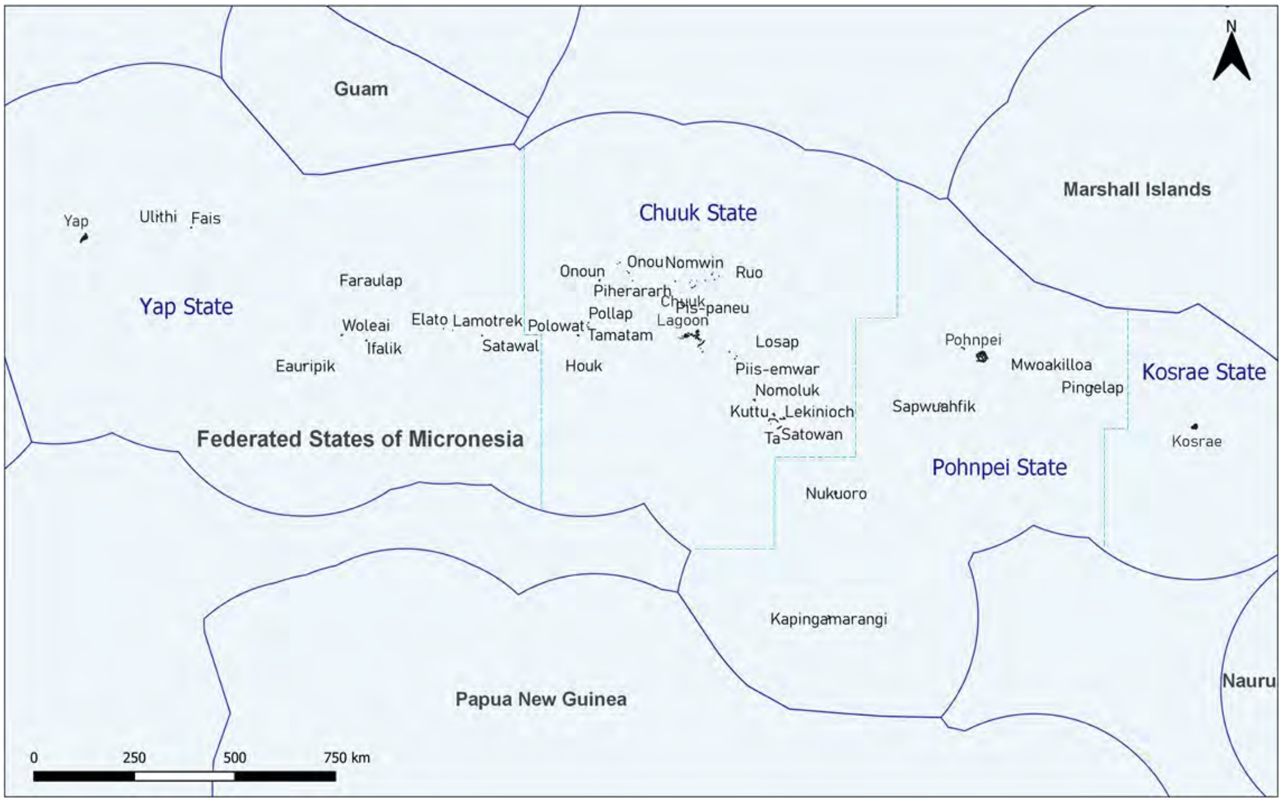


Figure 2. Map of the Federated States of Micronesia, including EEZ boundaries (blue line), main islands and outlying islands (Data source: SPREP).

Yap State consists of main island Yap where four islands are connected by a coral reef and have geology of volcanic origin characterized by gentle topography with an elevation of 175 m (574 ft) above sea level, and substantial swampy lowlands. The state's landmass is a total of 102.9 km^2. Yap state also includes several outlying coral islands and atolls of which nineteen (19) are inhabited.

Chuuk State has a total landmass of approximately 127 km^2, characterized by a unique geographical feature. The state includes seven major volcanic island groups within a large 93 km^2 lagoon enclosed by a string of islets on a barrier reef, and a group of 14 inhabited outlying atolls and low islands located outside Chuuk Lagoon. Geographically the state of Chuuk is divided into 5 regions: Northern Namoneas, Southern Namoneas, Faichuk, Mortlocks and Northwest islands. The highest elevation in Chuuk is Mt. Uinipot on Tol Island at 443 m (1,453 ft).

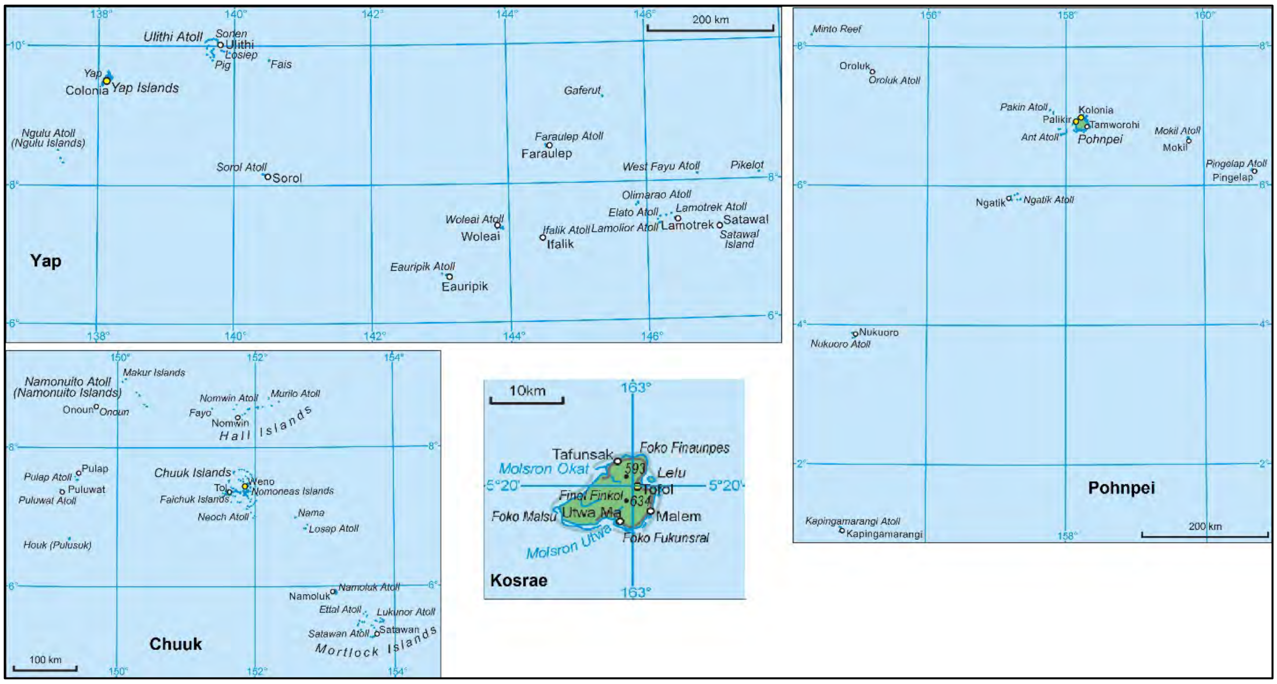
Pohnpei State has a total land area of approximately 371 km^2 and is made up of one large volcanic island and six (6) inhabited coral atolls (Mwoakilloa, Pingelap, Kapingamarangi, Nukuoro, Sapwuafik and Oroluk). Pohnpei high volcanic island is the largest in the FSM (345 km^2) and has the highest peak elevation, Nahnalaud, at 734m (2,408 ft) above sea level.

Kosrae State, farthest east, is geologically the youngest high volcanic island with a steep topography and a total landmass of approximately 111 km^2. The island is surrounded by coral reefs and has around 10.3 km^2 of land suitable for agriculture and 64.5 km^2 of forested land located on the steep mountains. The majority of the island coastline is experiencing chronic erosion. The highest elevation in Kosrae is Mt. Finkol at 635 m (2,083 ft). Kosrae is the only FSM state without outer islands.

Table 2. Summary of the FSM's states geographical features

State	Geographical features and Topography
 Yap	The four main islands of Yap are connected by a coral reef and have geology of volcanic origin characterized by gentle topography with an elevation of 175 m (574 ft) above sea level, and substantial swampy lowlands. The state's landmass is a total of 102.9 km^2 (39.7 sq mi). Yap state is comprised of outlying coral islands and atolls, nineteen (19) of which are inhabited.[23]
 Chuuk	Chuuk State has a total landmass of approximately 127 km^2 (49 sq. mi), with unique geographical features. The state includes seven major volcanic island groups within a large 93 km^2 (36 sq mi) lagoon enclosed by a string of islets on the barrier reef, and a group of 14 inhabited outlying atolls and low islands located outside Chuuk Lagoon. Geographically the state of Chuuk is divided into 5 regions: Northern Namoneas, Southern Namoneas, Faichuk, Mortlocks and Northwest islands. The highest elevation in Chuuk is Mt. Uinipot on Tol Island at 443 m (1,453 ft).[24]
 Pohnpei	Pohnpei state has a total land area of approximately 371 km^2 (143 sq mi) and is made up of one large volcanic island and six (6) inhabited coral atolls (Mwoakilloa, Pingelap, Kapingamarangi, Nukuoro, Sapwuafik and Oroluk). Pohnpei's high volcanic island is the largest in the FSM (345 km^2) and has the highest peak elevation, Nahnalaud, at 734m (2,408 ft) above sea level.[25]
 Kosrae	Kosrae, in the east, is geologically the youngest, high volcanic island with a steep topography and a total landmass of approximately 111 km^2 (43 sq mi). The island is surrounded by coral reefs and has around 10.3 km^2 (4 sq mi) of land suitable for agriculture and 64.5 km^2 (25 sq mi) of forested land located on the steep mountains. The majority of the island's coastline is experiencing chronic erosion. The highest elevation in Kosrae is Mt. Finkol at 635 m (2,083 ft). Kosrae is the only FSM state without outer islands.[26]

[23] Government of the Federated States of Micronesia (2016). Yap Joint State Action Plan for Disaster Risk Management and Climate Change. SPC's Suva Regional Office, Fiji.
[24] Government of the Federated States of Micronesia (2016). Chuuk Joint State Action Plan for Disaster Risk Management and Climate Change. SPC's Suva Regional Office, Fiji.
[25] Government of the Federated States of Micronesia (2016). Pohnpei Joint State Action Plan for Disaster Risk Management and Climate Change. SPC's Suva Regional Office, Fiji.
[26] Government of the Federated States of Micronesia (2016). Kosrae Joint State Action Plan for Disaster Risk Management and Climate Change. SPC's Suva Regional Office, Fiji.



Endemic Species

Compared to the available land mass and the broadly dispersed geography of the nation, the FSM presents high endemism[27] across the four states. In the FSM are found over 364 endemic plants, at least 4 reptiles, 22 birds and 4 mammal species (Table 3).

Table 3. Summary of species richness in the FSM (Source: NBSAP, 2018; FSM SOE, 2019;[28] CBD country profile;[29] Mazancourt et al. 2018;[30] Falanruw, 2002;[31] Edward, 2002[32])

Terrestrial Biome	12 terrestrial biomes: atoll forest, littoral beach strand, mangrove forest, swamp forest, freshwater marsh, riparian forest, freshwater rivers and streams, grassland, secondary (agro) forest, primary forest, rain forest, and crest (dwarf or montane cloud) forest	
Marine Biome	Mangrove forest, estuaries, sea grass beds, lagoons, coral reefs and open ocean	
Mammals 	Fruit bats mammal species are all endemic to the FSM	Three fruit bat of the genus *Pteropus* spp.[2] and one sheath-tailed bat of the genus *Emballonura* spp.[2]

[27] Endemism is the condition of being endemic, or restricted in geographical distribution to an area or region.
[28] SPREP (2019). Federated States of Micronesia State of Environment Report. Apia, Samoa.
[29] CBD, FSM Country Profile: https://www.cbd.int/countries/profile/?country=fm
[30] Mazancourt V. de, Marquet G. and Keith P. (2018). *Caridina variabilirostris* (Crustacea: Decapoda: Atyidae), a new species of freshwater shrimp from Pohnpei (Micronesia). European Journal of Taxonomy 453: 1–16.
[31] Falanruw M.C. (2002). Terrestrial biodiversity of the Federated States of Micronesia. Report prepared for the FSM National Biodiversity Strategy and Action Plan Project. https://www.sprep.org/att/IRC/eCOPIES/Countries/FSM/17.pdf (Accessed: July 2021).
[32] Edward, A. (2002). Marine biodiversity of the Federated States of Micronesia. Report prepared for the FSM National Biodiversity Strategy and Action Plan Project. http://www.comfsm.fm/bchm/MarineBio.pdf (Accessed: July 2021).

<table>
<tr><td>Birds</td><td>Across the four states there are 128 native birds with 22 endemic species and 12 globally threatened species.</td><td>Among the endemic species are:
▪ Yap State: Yap monarch [Monarcha godeffroyi] and two species of white-eye Truk white-eye [Rukia ruki][1]
▪ Chuuk State: Truk monarch [Metabolus rugensis][1] and the oceanic fly catcher [Myiagra oceanica] Pohnpei Kingfisher [Todiramphus reichenbachii], Pohnpei Lorikeet [Trichoglossus rubiginosus][3]
▪ Pohnpei State: Pohnpei Fantail [Rhipidura kubaryi] Pohnpei Flycatcher [Myiagra pluto] long-billed whiteeye [Rukia longirostra][3]
▪ Kosrae State: Dusky White-eye [Zosterops cinera]</td></tr>
<tr><td>Reptile and Amphibians</td><td colspan="2">The FSM is home for over 27 species of reptile and amphibians, of which at least 4 are endemic.
<u>Terrestrial:</u>
▪ About 22 species of lizards and at least one snake, the Braminy blind snake [Rhamphotyphlops braminus].
▪ Found only in Pohnpei the endemic skink Emoia ponapea.
▪ The giant Micronesian gecko [Perochirus scutellatus] reported on Kapingamarangi and Ulithi atolls.
<u>Marine:</u>
▪ 4 species of sea turtles, including the most common green turtle [Chelonia mydas] and hawksbill turtle [Eretmocheleys imbricata] and the less common leatherback turtle [Dermocheleys coriacea] and olive ridley turtle [Lepidocheleys olivacea]</td></tr>
<tr><td>Fish, Corals, Mollusks and Crustaceans</td><td colspan="2"><u>Marine:</u>
▪ 1,221 fish species recorded in the FSM waters
▪ 472 coral species identified in the FSM's waters, 100 are vulnerable and three endangered
▪ 1,200 species of mollusks
<u>Freshwater:</u>
▪ 64 freshwater fish identified in the FSM with four endemic species
▪ 3 families of Decapod crustaceans, including 3 atyid shrimp (Atyidae) species and a newly discovered Atyidae in Pohnpei, the freshwater shrimp Caridina variabilirostris
▪ 2 families of snails 2 species of Macrobrachium</td></tr>
<tr><td>Plants</td><td colspan="2">▪ Over 1,239 species of ferns and flowering plants in the FSM. Approximately 782 species are native, including about 145 native species of ferns, 267 native species of monocots, and 370 species of dicots.
▪ 364 vascular plant species are considered endemic to Micronesia</td></tr>
</table>

[1]Endangered species; [2]Threatened; [3]Near threatened species

Across the FSM species richness declines from east to west, while the level of endemism increases from east to west with increasing distance from landmasses. Each state of the FSM has its own outstanding features and biodiversity. Among the islands of volcanic origin, known as high-islands, Kosrae has last standing *Terminalia carolinensis* swamp forests in the world, the Yela Ka Forest; Yap has the most diverse mangroves and agroforests, contributing to the island food resilience; Pohnpei has the most endemic species in the FSM (Falanruw, 2002). The FSM coral and sand islets of the outlying islands are also very important nesting sites for seabirds and sea turtles. Some of these atolls have unique features with "inland mangroves" (e.g., *Bruguiera gymnorrhiza*) that make use of the fresh or brackish water lens toward the interior of the islet (Falanruw, 2002).

The significant importance of biodiversity and ecosystems for the FSM economy and communities necessitates a nationwide approach to the sustainable management and conservation of the country's natural resources and to reduce the pressures from unsustainable use and practices and climate change impacts. As part of this approach, the FSM is implementing nationwide projects such as the FSM Ridge-to-Reef (R2R) project, a $4.7 million Global Environment Facility (GEF) executed by the United Nations Development Programme (UNDP), with DECEM as key national executing partner. The FSM R2R project final objective is to strengthen local, State and National capacities and actions to implement integrated ecosystem-based management through a "ridge to reef" approach on the High Islands of the four States of the FSM.[33] This holistic ecosystem-based management "ridge to reef" approach aims to conserve globally important biodiversity while sustaining local livelihoods.

2.6 Social Context

Population

A national census is conducted every 10 years by the Statistics Division, within the Department of Resources and Development. The latest available census data are from 2010, since the 2020 national census has been delayed due to the SARS-CoV-2 pandemic. The FSM has completed a Household Income and Expenses Survey in 2013 (HIES 2013/14) and an Integrated Agricultural Census in 2016 (IAC, 2016), both complementing the findings from the 2010 nationwide census.

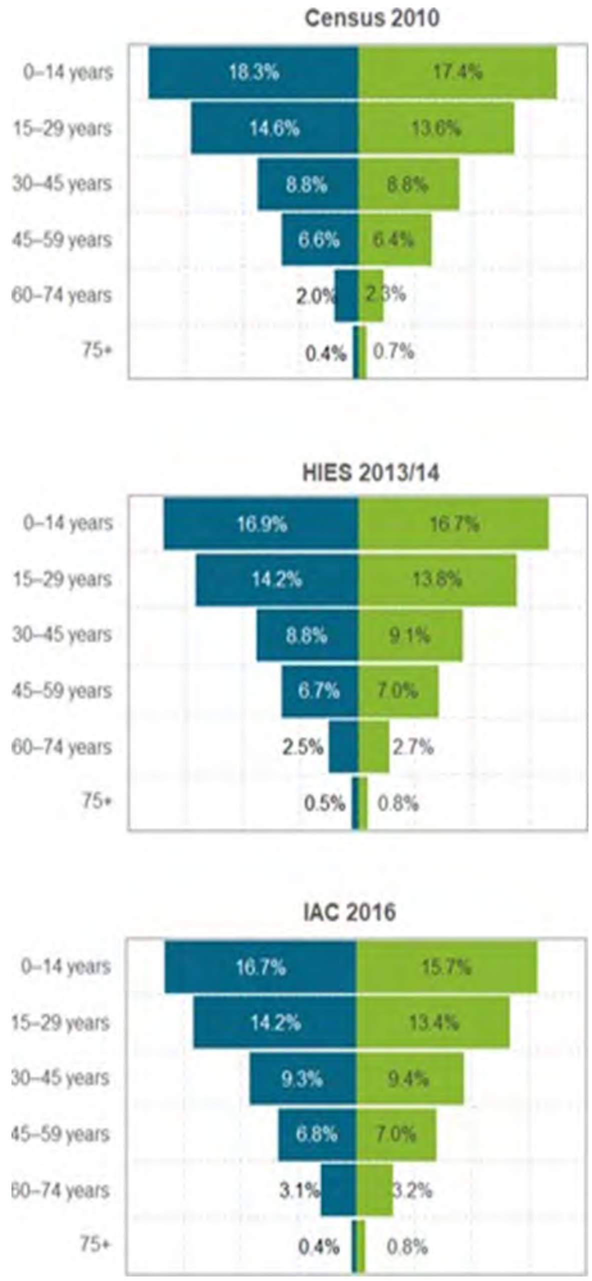


Figure 3. Changes in male (blue) and female (green) FSM population structure between 2010 and 2016 (Census 2010; HIES 2013-14; IAC 2016).

The FSM population structure and distribution has not changed significantly in the years between 2010 and 2015, with the ratio between men and women remaining similar. The FSM is characterized by a young population, with the majority of the population below 29 years old. At state level, Chuuk remains the state with the largest population (n = 48,703), followed by Pohnpei (n = 36,948), while Yap (n = 11,995) and Kosrae (n = 5,748) have considerably lower populations (HIES 2013/14). Between 2007 and 2014, the population of the FSM has decreased by 1.8% due to out-migration to Guam, Hawaii and mainland USA (SPC 2019[34]). The average household size in the FSM declined from 6.7 persons in 2000 to 6.1 persons in 2010. Similarly, average family size declined from 7.0 in 2000 to 4.4 in 2010 indicating a preference for smaller families by couples. This also reflects the decline in fertility as well, as young people delaying first marriage. In the country, male-headed households are the majority (80%), albeit Yap has the highest proportion of female-headed households (26%; IAC 2016).

[33] https://www.thegef.org/projects-operations/projects/5517
[34] The Pacific Community (2019). Gender analysis of the fisheries sector in Federated States of Micronesia. The Pacific Community (SPC), Noumea, New Caledonia.

Current estimated population for the FSM in 2020 is 105,503. The National Projected population based on 2010 Census and HIES survey is 104,832. Long-range population projections suggest a continuation of little or no population growth for the foreseeable future. Projections to 2030 suggest no population growth from 2010 and less than 10% total growth to 2050. The level of urbanization in the FSM remains relatively low at 22.9% of the total population in 2020 (FSM FVNR, 2020[35]).

Education

The FSM's education sector comprises the National Department of Education, State Departments of Education, and the College of Micronesia-FSM. The FSM's national law, Title 40, guarantees free public education from age 6 through 15, or the completion of 8th grade. There are 12 public secondary schools, which are also free, but are not compulsory. About 24,000 students are enrolled across the four states, with a nearly even split between boys and girls at the elementary level and with a slight majority of girls (53%) at the secondary level. About 15% of these 24,000 students are enrolled in private schools. The College of Micronesia-FSM provides accredited post-secondary education from campuses spread across all states, offering both vocational and academic programs of study, from the certificate to bachelor's degree level. Nearly 1,900 students are enrolled across the nation in 2020, with about 59% female.[36] Annually, the FSM National Scholarship distributes about $3,000,000 in local revenue to nearly 500 students pursuing post-secondary education both at the COM-FSM and abroad, with 62% of recipients being female.

The Cooperative Research & Extension (CRE) under College of Micronesia Land Grant has programs for enhancing food security and improving adaptation to climate change. The College of Micronesia-FSM is recipient of grants from United States Department of Agriculture (USDA); among the most recent projects implemented are those relative to food security in Yap[37] and rehabilitation of degraded land in Pohnpei.[38] The FSM has allocated $205.8 million over a decade (2016-2025) toward the construction of new schools and school facilities throughout the islands (FSM FVNR, 2020). This will be a collaborative effort between the respective Departments of Public Works and the Departments of Education. In terms of bilateral aid to the FSM, the education sector receives the most assistance, with more than 35% of all Overseas Development Assistance (ODA) going to educational opportunities, activities and infrastructure (FSM FVNR, 2020).

Health

The FSM national and state Constitutions affirm the right to healthcare for all citizens. This constitutional right was reaffirmed in the national health strategic framework developed during the National Health Summit held in 2014. The FSM spends about 20.6% of total government expenditure on health. According to the Department of Health and Social Affairs (DoHSA) approximately 73% of the FSM population has received the Measles, Mumps and Rubella (MMR) vaccine, but detection of disease as tuberculosis and eradication of leprosy is still not effective (FSM FVNR, 2020). Non-communicable diseases (NCDs) continue to be the major cause of premature death in the FSM, accounting for more than 70% of deaths. Obesity and overweight, among the causes of NCDs, appear to affect more women than men. According to DoHSA, 73% of the population is overweight, with 43% being obese. Among the overweight population 75% of females, while 44% of females are part of the obese population. Diabetes is rising rapidly (+81% change since 1990), increasing the financial costs of healthcare assistance for the country's healthcare system (FSM FVNR, 2020). A National Strategic Plan, "Prevention and Control of NCDs in FSM 2019–2024," was developed to address the

Among climate change related diseases are water- and vector-borne diseases, which show an increasing trend,

[35] FSM, 2020. First Voluntary National Review on the 2030 Agenda for Sustainable Development June 2020, Government of FSM.
[36] College of Micronesia-FSM: Fall 2020 Semester Summary. Available at http://www.comfsm.fm/?q=irpo-enrollment.
[37] https://portal.nifa.usda.gov/web/crisprojectpages/0230116-developing-climate-smart-agriculture-to-enhance-food-security-in-the-federated-%20states-of-micronesia.html.
[38] https://portal.nifa.usda.gov/web/crisprojectpages/1007511-rehabilitating-degraded-lands-of-pohnpei-fsm-with-focus-on-mal-soils.html.

albeit mental health is becoming a growing issue, particularly in relation to major disasters. It is predicted that climate change may increase the number of patients suffering from a variety of mental health problems including depression, anxiety, substance abuse and post-traumatic stress disorder (NCCHAP, 2012).

As such, in 2012 the FSM has developed a Climate Change and Health Action Plan (NCCHAP), which details climate-sensitive health risks and adaptation needs (FSM FVNR, 2020). Importantly the plan defines those that are the most vulnerable among the FSM population such as residents of outlying islands or those living close to coasts, rivers and hillsides, which have a higher probability of being displaced; women; children and elderly; population presenting co-morbidity; population below the poverty line; workers more vulnerable to exposure to climate extremes; and the population that lack access to public information broadcasts and communications.

Employment

The FSM labor force in partly involved in formal jobs (48% employed full- or part-time) with more men employed in the private and public sectors than women (62% vs. 38% and 71% vs. 29%, respectively; Braun 2012[39]); over half are employed in education (24.6%), public administration and defense (18.6%), wholesale/retail trade and motor vehicle repair (9.7%) and health and social work (9.1%). Very few earn a wage or salary in the fishing (1.8%) or agriculture (0.6%) sectors, as most of the activities from these sectors are for subsistence. Nearly 50% of the FSM's households engage in fisheries activities, with 60 to 90% of households using their catch for subsistence[40] (HIES 2013/14). Agriculture contributes largely to the FSM subsistence sector, with about 40% of households engaged in agriculture for subsistence. The value of agricultural products from crops and livestock is more than $30 million USD, with $28 million solely from crops sold or used for subsistence (HIES 2013/14).

Poverty

Poverty and hardship exist in FSM, and low-income households mostly spend their resources on food, especially in Yap and Chuuk. Although considerable progress has been made, the incidence of hardship in the FSM is still high: 31.4 % of the FSM population live below the national basic-needs poverty line, with a slight increase from 2005 to 2013(UNICEF, 2017[41]). The poverty incidence is higher or more severe in Pohnpei and Chuuk than in Yap and Kosrae, particularly affecting children and female-headed households (UNICEF, 2017). As welfare levels rise, food share falls in all States. With more than 90% of families having access to land for farming, combined with strong cultural norms of sharing, hunger is rare in the nation, but malnutrition is still a considerable issue (FSM FVNR, 2020).

Economy

The FSM has an economy largely dependent on its oceanic fishing resources and external grant assistance. In this section revenues and GDP are presented for the country's Fiscal Year, which starts on October 1 and ends on September 30 of each year. In 2018 the country had a nominal GDP of about US$402 million, with US$3,854 per capita GDP (IMF, 2021[42]). However, GDP per capita average growth diverge at state level, with Chuuk being the state with the lowest GDP per capita growth (EconMAP, 2021[43]). The economy grew by 1.9% in the years between 2015-2019, compared to the lower long-term average growth of -0.6% over the period 2004-2014 (IMF, 2021). Fishing royalties have driven domestic revenue in recent years, but the country remains dependent on aid—primarily through the Compact of Free Association (COFA) with the US—to meet both recurrent and

[39] Braun T. (2012). Stocktake of the gender mainstreaming capacity of Pacific island governments: Federated States of Micronesia. Secretariat of the Pacific Community (SPC).
[40] FSM Code defines "subsistence fishing" and fishing by a citizen or resident substantially for personal consumption, and does not include any fishing resulting or intended for sale: 24 FSM Code § 102(60).
[41] United Nations Children's Fund, Situation Analysis of Children in the Federated States of Micronesia, UNICEF, Suva, 2017.
[42] International Monetary Fund (2021). Federated States of Micronesia Country Report No 21/237. Washington D.C.
[43] EconMAP (2021). Impact of the COVID-19 Pandemic on the Federated States of Micronesia: Economic Outcomes and Policy Review, https://pubs.pitiviti.org/fsm-covid-impact-update.

development financing needs. Revenues from the fishing fees have tripled from about 6% GDP, before implementation, in 2012, of the Vessel Day Scheme (VDS) under the Parties to the Nauru Agreement (PNA), to about 15% of GDP in the period from 2012 to 2016, contributing to 24% of the national average revenues over the period 2016-2019. Daily fishing rates average close to $12,000 per vessel day and the FSM received $72 million of revenues or 21% of GDP in 2018, with a similar trend observed for 2019 (ADB PEM, 2017[44]). Oceanic resources depend on natural habitats and projections suggest that by 2050, climate change can lead to an eastward shift of skipjack tuna biomass, although economic benefits could exceed the threats.[45] The country's economy remains highly dependent on foreign assistance (i.e., US COFA Grant, financial programs, multilateral, and bilateral grants), which contributed to 38% of the government total revenue in 2018 (EconMAP, 2021). Since 1986, the Compact of Free Association (COFA) with the United States has provided external financial transfers to support the FSM Government in delivering key services, particularly education and health and substantial public sector investment at the state level. Under an Amended Compact Agreement, which took effect in 2004, the FSM has been receiving payments of an inflation adjusted US$92.7 million per year starting in 2004, with US$76.2 million in the form of grants, US$16.0 million in a Compact Trust Fund, and US$0.5 million for an annual audit. Amended Compact Agreement in 2023 is anticipated to support investment income from the Compact Trust Fund (WB, 2018[46]).

Since the beginning of 2020, extended borders closure due to the SARS-CoV-2 pandemic has prevented the normal transshipment activities from the pelagic vessels resulting in an economic contraction of 5.4% (real GDP growth was down nearly 6%) in 2020 (ADB, 2020[47]). Domestic services activity has contracted considerably, and real GDP declined by 1.8% in 2020 (IMF, 2021). The SARS-CoV-2 pandemic has put severe strains on the country. Although FSM economic policy response to SARS-CoV-2 is helping to counter the negative effects of the pandemic, the future economic trend is still uncertain.

The public sector plays a central role in the economy, with 25% of the GDP comprising national, state, and municipal agencies. About 24% of the FSM GDP comes from both the informal and non-marketed or subsistence production that occur at household level (fiscal period 2017-2019; EconMAP, 2021). In the country the private sector is underdeveloped accounting for 22% of the FSM GDP during the fiscal period 2017-2019 (EconMAP, 2021).

The FSM labor force is partly involved in formal jobs (48% employed full- or part-time), with, in 2012, more men employed in the private and public sectors than women (62% vs, 38% and 71% vs. 29%, respectively; Braun 2012[48]). Among those involved in formal jobs, over half are employed in education (24.6%), followed by public administration and defense (18.6%), wholesale/retail trade and motor vehicle repair (9.7%) and health and social work (9.1%). Very few earn a wage or salary in the fishing (1.8%) or agriculture (0.6%) sectors, and these sectors largely contribute to the informal economy of the country (FSM Census, 2010[49]). About 24% of GDP during the period 2017-2019 comes from the household sector, indicating that the informal sectors remain relevant for subsistence production in the FSM (EconMAP, 2021).

---

[44] ADB (2017). Pacific Economic Monitoring, December 2017. Asian Development Bank, Manila, Philippines. Retrieved from: www.adb.org/pacmonitor (Accessed July 2021).
[45] Bell, et al. 2013. Mixed responses of tropical Pacific fisheries and aquaculture to climate change. Nature Climate Change.
[46] World Bank (2018). Federated States of Micronesia (P161969): Project for Strengthening Public Financial Management. Combined Project Information Documents / Integrated Safeguards Datasheet. Retrieved from: https://documents1.worldbank.org/curated/en/616651522294773431/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Project-for-Strengthening-Public-Financial-Management-P161969.pdf.
[47] ADB (2020). Assessing and improving policy response to economic shocks in the North Pacific, December 2020. Asian Development Bank, Manila, Philippines.
[48] Braun T. (2012). Stocktake of the gender mainstreaming capacity of Pacific island governments: Federated States of Micronesia. Secretariat of the Pacific Community (SPC).
[49] Division of Statistics, SBOC (2010). Summary analysis of key indicators from the FSM 2010 Census of Population and Housing. FSM Office of Statistics, Budget, Overseas Development Assistance and Compact Management (S.B.O.C), Palikir, Pohnpei, FM.

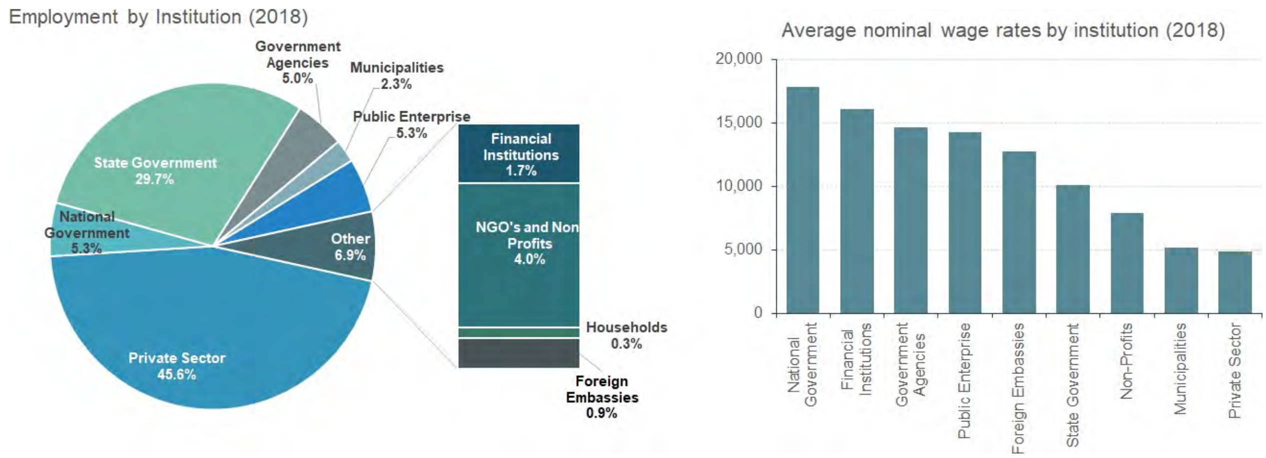


Figure 3. Number of employees by institution and wage rates (USD) in the FSM

Coastal fishery is estimated to contribute to 14.9% of GDP of US $318.1 million in 2014 (IASI, 2018[50]). In 2013, nearly 50% of the FSM's households engaged in fisheries activities, with 60 to 90% of households using their catch for subsistence[51] (HIES 2013/14). Both men and women are involved in various aspects of fishing with specific roles undertaken based on traditional and cultural norms of the different states and communities (IASI 2018). Agriculture contributed largely to the FSM subsistence sector, with about 40% of households engaged in agriculture for subsistence in 2013. The value of agricultural products from crops and livestock is more than $30 million USD, with $28 million solely from crops sold or used for subsistence (HIES 2013/14). In 2015, this sector contributed to about 16% of the FSM GDP, indicating an increasing trend of 1.2% per year, since 2005, mostly associated with subsistence production and consumption (IAC, 2016).

Table 4. Human pressure index (people per square mile of reef area), estimated annual commercial landings of reef and nearshore pelagic fish (x1,000 lb. per year), estimated annual value of combined nearshore commercial landings (USD $ millions per year), and estimated proportion of overall annual economic value that results in net income for fishing families (x1,000 $ per year), for each state and the whole FSM (Source: SOE, 2019; *SOE data derived from*: Houk et al. 2012; Hernandez-Ortiz et al. 2016; Houk et al. 2017; Cuetos-Bueno et al. 2018).

	Yap Proper	Chuuk	Pohnpei	Kosrae	FSM
Population (FSM census 2010)	7,371	36,152	34,789	6,616	84,928
Person per reef area (person/mi^2)	142	41	262	739	1,184
Reef Landings (x1,000 lb/year)	132	583	552	16	1,283
Pelagic landings (x1,000 lb/year)	56	134	235	22	447
Overall landings (x1,000 lb/year)	188	717	787	38	1,730
Fishers' income (x1,000 $)	159	703	772	20	1,654
Value (million USD $)	**0.33**	**1.25**	**1.38**	**0.07**	**3.03**

[50] Integrated Aquatic Solutions Inc. (2018). Final report of the Federated States of Micronesia coastal fisheries assessment. Prepared for the FSM Department of Resources & Development FSM National Oceanic Resource Management Authority, by Integrated Aquatic Solutions Inc., Australia, June 2018. Retrieved from: https://www.fsmstatistics.fm/wp-content/uploads/2019/10/5-Prop-final-2-volumes.pdf (Accessed July 2021).
[51] FSM Code defines "subsistence fishing" and fishing by a citizen or resident substantially for personal consumption, and does not include any fishing resulting or intended for sale: 24 FSM Code § 102(60).

Fisheries

The FSM fisheries is a major sector contributing to the country's economy. The Marine Division of the FSM Department of Resources and Development (R&D) assists the states to sustainable and develop its coastal fisheries from high-water mark to 12 nautical miles. The status of coastal fisheries in the FSM varies among the states, but a general decline of fish stocks has been reported throughout the country (see Marine ecosystems). The National Oceanic Resource Management Authority (NORMA) is mandated to develop and manage the FSM's fisheries resources from the 12 nautical miles territorial sea out to the 200 nautical miles EEZ. NORMA is mandated to ensure the sustainable use of the country's oceanic resources, while obtaining maximum sustainable economic benefits. Since the SNC in 2015, the FSM financial efforts towards sustainable fisheries have been multiple.

In 2019, the FSM and Blue Prosperity Coalition signed a Memorandum of Understanding to support the nation's efforts to optimize sustainable ocean use by protecting 30% of the FSM's marine waters, equal to 897,000 km^2 in order to mitigate climate change, building ocean resilience, preserve habitats for threatened species, while at the same time ensuring economic resilience.[52] Blue Prosperity Micronesia (BPM) is a government-led program that builds upon and integrates with existing programs and commitments from the FSM, working closely with local and international organizations to accomplish its goals for future generations. BPM is a further step the country has taken to address sustainable management of resources and food security, while developing its economy.

From 2015 to 2021, the FSM implemented the Pacific Regional Oceanscape Program (PROP) to improve the sustainable management of oceanic fisheries (through implementation of a Fisheries Information Systems, increased monitoring on fishing vessels via observers, increased surveillance patrols, and the development of a Competent Authority); the sustainable management of coastal fisheries (PROP Coastal Fisheries Resource Assessment, which provided information on the status of coastal fisheries), the conservation of critical fishery habitats, and coordination, monitoring, and evaluation. In 2021, the Pacific Regional Oceanscape Program–Economic Recovery/Resilience (PROPER), was approved. PROPER will focus on oceanic and coastal fisheries. PROPER aims to improve coastal fisheries management by developing appropriate policies, engaging in additional monitoring, conducting studies that enhance the evidence base for sound decision-making, scaling up community-based fishing and diversifying the coastal fisheries sector. For oceanic fisheries the project intends to secure public revenue and expand economic benefits, through the FSM Fisheries Investment Policy, and developing the Nation's Blue Economy (i.e., combining climate change adaptation and mitigation efforts, environmental protection, and tackling marine pollution together).

The FSM National Oceanic Fisheries Investment Policy for the FSM 2021-2026 was submitted in 2021 with the intended goal, among others, of maintaining and enhancing resource sustainability and secure and strengthen fisheries' contribution to the country economic growth.[53] Coastal fisheries, within the 12 nautical miles, are regulated by the states, with them having in place laws and regulations for the sustainable management of fish and other marine organisms. One of the country strategies to ensure food security, while reducing pressures on this sector, include the implementation of a 5-year Aquaculture Management and Development Plan,[54] which provides a comprehensive pathway to all relevant national stakeholders for long-term sustainability of current and future aquaculture activities in the FSM.

Agriculture

Agroforestry accounts for 35% of the FSM's landscape and it is an important expression of the FSM's diversity

[52] https://www.blueprosperitymicronesia.org/%20(Accessed%20January%202021).
[53] National Oceanic Fisheries Investment Policy for the FSM 2021-2026: A Policy to Maximize Value of Participatory Rights under the Vessel Day Scheme. Retrieved from: https://gov.fm/files/FSM_NATIONAL_OCEANIC_FISHERIES_INVESTMENT_POLICY_2021-2026_final_draft_as_of_9_1_2021.pdf (Accessed February 2021).
[54] FSM R&D and SPC (2019). Federated States of Micronesia Aquaculture Management and Development Plan

of cultural heritage, contributing significantly to the nation's wealth of biodiversity.[55] In Pohnpei, agroforestry expanded rapidly, partially replacing the native forest and secondary vegetation on the mountainous areas. In Kosrae, agroforestry is well developed in the lowland areas, largely exposed to saltwater intrusion. In Yap, there are scattered remnants of native forest replaced by a well-developed agroforest system throughout the main islands, which, with rising sea level, is now suffering from salt-water intrusion (in SOE 2019: Donnegan et al. 2011;[56] Falanruw and Ruegorong 2015). The proportion of the FSM population engaged in subsistence agriculture (e.g., agroforestry, home gardens) is as high as 89% (HIES 2013/14[57]). In the state of Pohnpei, sakau (kava), and in the state of Yap, betelnut, are important crops for sale, consumption and cultural exchange. In 2013, in Pohnpei sakau represented 57% of the income from agricultural sales. In Yap, betelnut represented 84% of all crop sales (HIES 2013/14), and 81% of households that have land for agriculture reported growing them (IAC 2016[58]). Severe impacts on betelnut production were reported in 2015–2016 owing to El Niño-related drought, which produced a spike of price for this product. Similarly, typhoon Maysak in 2015 and typhoon Wutip in 2019 had significant impacts on the agricultural production in Chuuk and Yap, reducing access to subsistence assets such as food and potable water. In the states of Chuuk, Pohnpei and Kosrae more men than women are engaged in crop production, reflecting the traditional role that men play in island agroforestry and the differential access and management of land and agricultural resources. This difference translates to a larger proportion of men than women receiving income from this sector (81%; IAC 2016), but also reflects the higher proportion of men with access to land used for agriculture (75% males versus 12% females) potentially increasing women vulnerability to hardship and food insecurity (Government of FSM, 2020).

Tourism

Tourism is a potentially growing sector in the FSM that can contribute to the economy by increasing employment, business incomes and tax revenues for the national and state governments. The National government, under the Department of Resources and Development, has a Division of Tourism. A National Tourism policy and State Investment Plans were adopted and funded with the goal to halt the decline in visitor arrivals in the immediate terms and progressively develop a sustainable tourism industry with consideration to social and environmental impacts and equitable distribution of its gain. Some of the challenges faced by the FSM tourism industry are the remoteness of the country, high airfares and limited infrastructure for tourists. To address these challenges, the FSM put in place various strategies and plans (Table 5).

Figure 4. Changes in international visitor arrivals to the FSM over the period 2007–2019.

Tourist and visitor arrivals in the FSM have fluctuated over the years, although in recent years more arrivals are reported (Fig. 4). In 2019, the FSM received 18,019 international visitors, of whom 60% arrived in Pohnpei, 28% arrived in Chuuk, 6% arrived in Yap, and 6% arrived in Kosrae. Some states have seen a consistent decline in arrivals, due to changes in the flight schedule, and cancelation of some routes from the airline providers that fly into the country and across the states. The border closures owing to the SARS-CoV-2 pandemic represent a further challenge that has impacted international and domestic visitor arrivals.

[55] FSM (2010), Fourth National Report to the CBD
[56] Donnegan, Joseph A.; Butler, Sarah L.; Kuegler, Olaf; Hiserote, Bruce A. (2011). Federated States of Micronesia's forest resources, 2006. Resour. Bull. PNW-RB-262. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 50 p.
[57] Division of Statistics, SBOC (2014). Federated States of Micronesia Households Income and Expenditure Survey 2013/2014: main analysis report. FSM Office of Statistics, Budget, Overseas Development Assistance and Compact Management (S.B.O.C), Palikir, Pohnpei, FM.
[58] FSM Department of Resources and Development (2019). Federated States of Micronesia Integrated Agriculture Census 2016. Department of Resources and Development, Palikir, Pohnpei, FM.

The FSM was the first Pacific Island Country to endorse the Pacific Sustainable Tourism Development Framework,[59] and further the first Pacific Island Country to endorse, in 2021, the Glasgow Tourism Declaration on the margins of COP26. A grant from US-EDA of US$1,800,000 will supplement the State Investment Plans for the tourism sector. Additionally, the FSM is working to formally adopt the term "Paradise in Our Backyards" as the country's brand (Second R&D Conference, 2022[60]) and inclusion of Nan Madol historical site as a UNESCO World Heritage Site is likely to attract a larger number of international visitors.

Table 5. Strategies and plans that addressed the FSM's challenges to develop and expand tourism sector

Tourism Sector Strategies and Plans
Pacific Regional Tourism Strategy, 2015–2019[61]
FSM National Tourism Development Strategy, 2015–2019[62]
FSM National Strategic Development Plan, 2004[63]
Pohnpei Strategic Development Plan, 2014–2023 and Beyond[64]
Kosrae Strategic Development Plan, 2014–2023[65]
Yap Five-Year Tourism Development Plan, 2013–2017
FSM National Tourism Marketing Plan, 2002
FSM National Tourism policy, 2015
State Investment Plans for Tourism, 2015

Energy

The energy sector plays a major role in GHG emission production in the FSM. Approximately 76% of households have some form of electrification, but access rates vary widely among states due to their different geography and distance from urban sites (i.e., Pohnpei 95% of electrification rate vs. Chuuk with 27%). However, the FSM has plans to extend access to the entire population by 2027 (Castalia, 2018[66]; Fig. 5). Most of the electricity in the FSM is generated through petroleum fuel (90%), while renewable energy (hydropower, solar photovoltaic systems, and wind power) constitutes 10% of the energy generation mix in the country. In the last decade, the FSM's capacity in renewable energy generation has steadily increased. The FSM has developed policies, plans and strategies to expand this capacity and improve energy efficiency, thereby reducing reliance on imported fossil fuel for which the country spends about US$40 million annually. The existing, implemented, and planned energy projects are from solar sources, and with a strong focus on improving energy efficiency by reducing system losses (approximately 17% at country level) with the goal of reducing incumbent elevated

[59] https://southpacificislands.travel/wp-content/uploads/2021/07/Pacific-Sustainable-Tourism-Policy-Framework.pdf
[60] https://gov.fm/index.php/component/content/article/35-pio-articles/news-and-updates/574-the-fsm-s-tourism-destinations-are-preparing-for-%20open-borders-the-fsm-s-agriculture-sector-hurts-from-lack-of-funding-day-4-of-the-2nd-resources-development-conference?Itemid=177%20(Accessed%20February%202022).
[61] South Pacific Tourism Organization (SPTO). 2014. Pacific Regional Tourism Strategy 2015-2019. Suva.
[62] SPTO. 2014b. FSM National Tourism Development Strategy 2015-2019. Suva
[63] Federated States of Micronesia. 2004. The Next 20 Years: Achieving Economic Growth and Self Reliance. Volume I: Policies and Strategies for Development. Palikir, Pohnpei.
[64] Pohnpei State Government. 2013. Pohnpei Strategic Development Plan–Planning for Pohnpei's Sustainable Future: 2023 and Beyond. Palikir, Pohnpei.
[65] Kosrae State Government, Division of Economic Planning. 2013. Kosrae Strategic Development Plan 2014-2023. Tofol, Kosrae.
[66] Castalia (2018). Energy Master Plans for the Federated States of Micronesia. Retrieved from: https://islands.irena.org/-/media/Files/IRENA/Sids/Publications/Micronesia---Energy-Master-Plans-for-the-Federated-States-of-Micronesia.ashx?la=en&hash=611DBBC4E55F5BB05295D385508DF9CAFD21A117.

energy costs for the public and private sectors. Based on completed and ongoing projects implemented for the energy sector, the FSM is aiming to achieve 47% of electricity production from renewable energy sources, investing about US$ 95 million by 2024 (R&D Second National Conference, 2022[67]). Presently, the country's capacity in energy generation has increased by 20.8 MW representing 81% of the total MW targeted for the FSM (R&D Second National Conference, 2022). This strategy towards a greater penetration of renewable energy throughout the country has been articulated in the FSM National Energy Policy (2012), which calls for a 30% reduction in the use of fossil fuels, 50% increase in energy efficiency and a rural electrification rate of 90% by 2020, and later expanded through the country Energy Master plans for 2019-2039, and the most recent FSM Updated NDC (2022). The FSM Energy Master Plans (EMP) set renewable energy production and energy efficiency targets, required to achieve the National Energy Policy, for each State of FSM over a 20-year period from 2019 through to 2039. The EMP set out the technical projects in the electricity sector required to (i) increase by 2027 the production of electricity from renewable sources to 63% with an equivalent reduction of 21,510 tCO_2eq emissions from the estimated 2018 baseline of 43,490 tCO_2eq (Castalia, 2018); (ii) achieve 100% access to electricity by 2027; and (iii) reduce reliance on fossil fuel.

Figure 5. Summary of the national-level outcomes of the state energy master plans (image sourced from Castalia, 2018).

The FSM Updated NDC (2022) sets, by 2030, conditional contributions that aim to assist the country towards an increased access to electricity to 100% nationwide; an increased electricity generation from renewable energy to more than 70% of total generation; and the reduce carbon dioxide emissions from electricity generation by more than 65% below 2000 levels (FSM NDC, 2022[68]). For this sector the NDC identifies synergies with SDGs 5, 7, 8, 9, 13 and 17 (Table 6).

Continuous efforts to improve access to energy and energy efficiency, aligned to the FSM Energy Policy, were also emphasized in the Joint States Action Plans, under the energy sector objectives.

[67] Resources & Development Second National Conference: Energy presentation. Retrieved from: https://gov.fm/files/Day1-01-Energy.pdf (Accessed February 2022).
[68] https://unfccc.int/sites/default/files/NDC/2022-10/Updated%20NDC%20of%20the%20MICRONESIA.pdf.

Table 6. NDC Energy sector synergies with SDGs (FSM NDC, 2022)

Contributions by 2030 on Energy Security					
By 2030, increase access to electricity to 100% nationwide					
By 2030, increase electricity generation from renewable energy to more than 70% of total generation					
By 2030, reduce carbon dioxide emissions from electricity generation by more than 65% below 2000 levels					
Synergies with SDGs					
Gender equality is advanced through a capacity building program focused on increasing the number of women working in the energy sector.	***Affordable and clean energy*** is advanced by replacing expensive, imported diesel fuels with clean, domestic renewable energy sources.	***Decent work*** is created in the energy sector with proper investments in capacity building, so that local workers have the skills to install, operate, and maintain a renewable energy system. ***Economic growth*** is advanced by deploying domestic sources of renewable energy not subject to international price fluctuations or supply disruptions.	***Resilient infrastructure and sustainable industrialization*** are advanced by deploying clean energy systems that are more distributed and less vulnerable to climate impacts.	***Climate action is enhanced*** by creating an energy system that is more resilient to climate change impacts and by reducing emissions of carbon dioxide, as well as co-emitted SLCPs (black carbon and methane).	***Durable partnerships, access to adequate means of implementation, and technology transfer*** will be required to fully achieve these goals.

Transport

The transport sector in the FSM is largely maritime transport between islands, land transport, and internal air transport from the Caroline Islands Air (CIA). The CIA is a National Government owned corporation created under Public Law No 10-72 by the Congress of the FSM. The main purpose of the CIA is to provide regular/charter flight services and cargo throughout the nation, particularly remote islands, acting as a "Freely Associated State Air Carrier" pursuant to the Compact of Free Association. Under the SARS-CoV-2 pandemic, efforts to enhance and improve the Nation's air service were directed to secure connection between main islands, owing to the FSM border closure strategy to combat SARS-CoV-2, and essential services to remote islands.

Land transport generally occurs on the circumferential roads of the main islands of each of the FSM's states, where most of the population lives. This road network is maintained by the states' government, and it is important to the country's economic development as well as for the provisioning of essential services such as access to healthcare, education, places of employment and markets. The FSM's roads are primarily located in coastal areas, thereby extremely vulnerable to climate change risks such as sea level rise, storm surge, and flooding. Considerable financial efforts are being undertaken to improve transport infrastructure in the country:

- the relocation of part of the coastal road in Kosrae, which is at high risk of inundation, with the construction of a 5.8 km inland road between Malem and Utwe municipalities, under the Adaptation Fund project "*Enhancing the climate change resilience of vulnerable island communities in Federated States of Micronesia.*"
- the Priority Road Improvements & Management Enhancements (PRIME) Project, a US$ 40 million investment, funded by the World Bank's International Development Association (IDA), with the goal of rehabilitating the country's deteriorating road infrastructures so as to make them climate-resilient.

Land transport in the FSM is largely dominated by second-hand imported vehicles that are characterized by high fuel consumption and high-level emissions (low efficiency vehicles). There has been a 44% increase in imported vehicles since 2010, with much of the imported vehicles being concentrated in Pohnpei State. The FSM currently lacks national and state laws, or standards, to regulate import of second-hand vehicles, albeit the establishment and enforcement of standards to import highly efficient vehicles can assist the country in further reducing GHG emissions.

FSM is highly dependent on maritime transport for international, inter-state and inter-island commerce, trade and mobility, with a large part of imported good (85% of imports in 2018) coming into the country via sea transport.[69] The maritime connectivity plays a central role in national development, social cohesion, and service delivery, thereby efforts have been put in place to improve sea transportation (i.e., Vaka Motu, from the Okeanos Sustainable Sea Transport Ltd), though the intra-state transport to and from the main and outlying islands is still inadequate in numbers. Domestic shipping is an essential service to guarantee access to education and healthcare for outlying island communities, especially in Chuuk, Pohnpei and Yap, which each consist of several inhabited outlying atoll islands. The FSM intends to address part of these challenges through the implementation of the Maritime Investment Project, funded by the World Bank,[70] which aims to improve the safety, efficiency and climate resilience of maritime infrastructure to natural disasters and climate change impacts in the country. Airports are also examining opportunities to expand and restore their runways to make them more resilient to flooding and related climate impacts. The Pave the Nation program will continue to address each of these issues comprehensively as additional funds become available (NDC, 2022).

The FSM Updated NDC (2022) sets, by 2030, conditional contributions that aim to (i) climate-proof all major island ring roads, airport access roads and arterial roads; and (ii) complete climate-proofing of major ports (including larger and more resilient docks meeting ISPS standards). For this sector the NDC identifies synergies with SDGs 8, 10, 11, 13 and 17 (Table 7).

[69] FSM Division of Statistics, Department of Resources and Development (2020). Statistical news: International merchandise trade statistics Calendar Year 2018. FSMDS Release No: 20.01.
[70] https://projects.worldbank.org/en/projects-operations/project-detail/P163922?lang=en.

Table 7. NDC Transport sector synergies with SDGs (FSM NDC, 2022)

Resilient Transport Systems				
By 2030, climate-proof all major island ring roads, airport access roads and arterial roads				
By 2030 complete climate-proofing of major ports (larger and more resilient docks meeting ISPS standards)				
Synergies with SDGs				
8 DECENT WORK AND ECONOMIC GROWTH	10 REDUCED INEQUALITIES	11 SUSTAINABLE CITIES AND COMMUNITIES	13 CLIMATE ACTION	17 PARTNERSHIPS FOR THE GOALS
Good jobs and economic growth are enhanced through improved access to markets and fewer disruptions to commercial activity due to severe climatic events.	***Inequalities are reduced*** by providing poorer and underserved communities better access to transportation and public services, including health, education and emergency response.	***Sustainable cities and communities*** are enhanced by reliable access to transportation, public services and fewer disruptions due to severe climatic events.	***Climate action*** is enhanced by climate proofing and relocating roads and ports for adaptation purposes.	***Durable partnerships and access to adequate means of implementation*** will be required to implement these contributions.

2.7 Water and Sanitation

The FSM is vulnerable to water shortages, particularly in remote locations and low-lying islands. Across the country, water distribution systems, employing filtration and/or chlorination, are generally found in urban settings rather than rural. In rural areas, communities utilize community tank systems or rely on natural surface waters or shallow wells to extract water.

Water and sanitation control is administered at state level, and the States' Environmental Protection Agencies (EPA) are mandated by law to monitor and enforce water quality standards related to the protection of ground, surface, and marine waters. Access to water varied across and within the states and this is reflected also in the role played by the States' public utilities for water supply and sanitation.

The proportion of households accessing improved drinking water[71] in 2010 was nearly 89%, indicating that about two in every five households have no access to safely managed water[72] (SBOC, Census 2010). Improving access to safely managed water, particularly in the outlying islands and main islands rural communities remains a priority for the country. Insufficient access to clean water is a direct contributor to disease and illness and indirectly affects migration patterns, development, education, and the distribution of aid from international donors (Weinheimer, 2017[73]). Recognizing the vital role that access to safely managed drinking water plays in the survival of outlying islands communities, the FSM has placed a strong focus on increasing water capacity on

[71] Based on the Summary analysis of key indicators for the 2010 FSM Census: improved drinking water includes sources from public water supply, community water supply, household tank, protected well, bottled water, and household water tank.
[72] FSM SBOC (2010). Summary analysis of key indicators from the FSM 2010 Census of Population and Housing. Palikir, FSM
[73] Weinheimer, R. (2017). Freshwater Distribution in Pohnpei, Federated States of Micronesia. GIS in water resources, University of Texas. Retrieved from: https://www.caee.utexas.edu/prof/maidment/giswr2017/TermProject/FinalReports/weinheimerrachel_3953317_44217630_FSM_Final.pdf.

low-lying islands by deploying water harvesting systems (roof guttering, tanks) at different sites. During the 2015/16 El-Niño communities that received water catchments and tanks were less affected by the prolonged drought and accessibility to water was maintained throughout the drought period. Among the several water security projects and programs implemented by the FSM government since the SNC are the European Union funded GCCA: PSIS project in FSM; the North Pacific–Readiness for El Niño (RENI) project, and the Adaptation Fund "Enhancing the Climate Change Resilience of Vulnerable Island Communities in FSM." All these projects have worked, or are working, to increase water capacity in FSM low-lying remote islands by installing household water catchment and storage systems. Additionally, the FSM government adopted and endorsed the UNICEF "Water, Sanitation and Hygiene program" (WASH) which aims to assist towards achieving SDG6.

FSM's states have planned for addressing water security needs in the JSAPs, and approaches for the high islands have also a focus on reducing sources of pollution for surface waterways as well as preserving forest ecosystems.

Since the SNC, access to sewage systems remains limited to urban areas, with rural areas and outlying islands still relying on septic tanks or directly discharging sewage into the environment. The programmed nationwide 2020 census was delayed due to SARS-CoV-2 restrictions in the country; therefore, albeit some improvements may exist locally (e.g., use of compost toilets in some of the outlying islands schools) information at country level on households accessing improved toilet systems and sewage systems has not been updated since the last 2010 census.

2.8 Waste

The FSM governments have taken robust actions to limit inappropriate disposal of solid waste, with each State developing a detailed Solid Waste Management Strategy (SWMS) including action plan items. Waste collection coverage in the country is 29%, with waste collection varying across states (SPREP, 2021[74]). The SWMS action plans include expansion and/or improvement of waste collection services, enhancement of container deposit system, proper management of public landfill sites, proper treatment, and management of waste oil. Solid waste produced in the main islands is disposed of in public landfills that operate implementing the Fukuoka method, except for Chuuk landfill; however, in rural areas and outlying islands open burning and illegal dumping persist. Waste collection service varies from state to state and can be irregular. Operation of waste disposal at states' facilities is either done by the Department of Public Works and Transport or the municipal governments. Reduced use and disposal of plastic items (i.e., plastic bags, Styrofoam) is becoming of paramount importance, and national and states' government have policies and/or regulations that address this rising issue. In 2020, the FSM national government enacted a regulation governing the Prohibition on the importation of one time use disposable Styrofoam and Plastic Food Service Items and Plastic Shopping Bag.[75] Before this nationwide Act, States governments had promulgated regulations to prohibit the use of plastic bags (i.e., Yap, Kosrae and Pohnpei States). Kosrae, Pohnpei and Yap have Container Deposit Legislations for the collection of PET bottles and aluminum cans. The FSM is one of the 14 Pacific countries participating in the PacWaste Plus programme, funded by the European Union and implemented by SPREP, that aims to sustainably manage solid wastes (organic waste, disaster waste, bulky waste, and recyclables) and abate the risks associated with Hazardous wastes (asbestos, healthcare waste, and e-waste).

2.9 Agriculture Forestry and Other Land Use

Agriculture land accounts for nearly 40% of FSM's landscape and is an important expression of FSM's diversity

[74] SPREP (2021). State of environment and conservation in the Pacific Islands: 2020 regional report.
[75] Act for the Prohibition on the Importation, Sale or Distribution of One Time Use Disposable Styrofoam and Plastic Food Service Items and Plastic Shopping Bags (Public Law 21-76, effective 7 February 2020) amends Code Title 25: Environmental Protection, Subtitle I: FSM Environmental Protection Act (as at 2014) to create Chapter 4.

of cultural heritage, contributing significantly to the nation's wealth of biodiversity.[76] In the years, agriculture has been one of the causes of forest loss and land conversion, particularly in Pohnpei where agroforestry expanded rapidly, partially replacing the native forest and secondary vegetation on the mountainous areas. In Yap there are scattered remnants of native forest replaced by a well-developed agroforest system throughout the main islands, these systems are suffering from salt-water intrusion and drought events (in SOE 2019: Donnegan et al. 2011[77]; Falanruw and Ruegorong 2015). The proportion of the FSM population engaged in subsistence agriculture (e.g., agroforestry, home gardens) is as high as 89%, with 40% of households relying on agroforestry production for subsistence production (HIES 2013/14[78]). In the state of Pohnpei, sakau, also known in the Pacific as kava (*Piper methysticum*), is an important crop for sale, consumption, and cultural exchange. In 2013, sakau represented 57% of the Pohnpeian households' income from agricultural sales.

The country is highly vulnerable to the impacts of climate change given its geographical location, climate, topography, geology and economic history. The FSM Infrastructure Development Plan 2016-2025 and Strategic Development Plan 2004-2023 promote the expansion of revenue generation through development opportunities. In light of this, environmental management and land use plans are key to inform sustainable development. Under the FSM Ridge-to-Reef project, Pohnpei has developed an Integrated Environmental Management Plan for the main high island (IEMP) while Kosrae is updating its 2013 Land Use Plan. The IEMP aims to provide a framework for the management of direct, indirect and cumulative environmental and socio-economic impacts or consequences of developments arising under on-going economic development, including approaches to achieve integrated ecosystem management on the high island of Pohnpei. The Kosrae Land Use Plan was initially adopted in 2013 and is now under review. Its main goal is to provide guidelines for the sustainable use of Kosrae natural resources, while identifying the existing uses of land areas and designating Active Use Districts, where certain development and land uses are encouraged, as well as Areas of Particular Concern for protection. Sustainable development and protection of forest and mangrove habitats is of paramount importance for economic development, but also for preserving natural carbon sinks.

The FSM NDC (2022) sets, by 2030, unconditional contributions that aim to (i) develop Integrated Land Management Plans and Shoreline Development Plans to effectively sustain and protect terrestrial and coastal ecosystems; (ii) expand the number of Protected Areas and their coordination through Protected Area Networks; and, aligned to the Micronesia Challenge and the Blue Prosperity Micronesia Program, (iii) effectively manage 50% of marine resources and 30% of terrestrial resources, including restricting commercial fishing in up to 30% of the EEZ. For this sector the NDC identifies synergies with SDGs 1, 2, 3, 8, 13, 14, 15 and 17.

[76] FSM Integrated Agriculture Census (2016). Retrieved from: https://fsm-data.sprep.org/dataset/federated-states-micronesia-integrated-agriculture-census.
[77] Donnegan, Joseph A.; Butler, Sarah L.; Kuegler, Olaf; Hiserote, Bruce A. (2011). Federated States of Micronesia's forest resources, 2006. Resour. Bull. PNW-RB-262. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 50 p.
[78] Division of Statistics, SBOC (2014). Federated States of Micronesia Households Income and Expenditure Survey 2013/2014: main analysis report. FSM Office of Statistics, Budget, Overseas Development Assistance and Compact Management (S.B.O.C), Palikir, Pohnpei, FM.

Chapter 3

Greenhouse Gas Inventory

Photo credit: Micah Seidel, Rutgers University

UNDP

Empowered lives.
Resilient nations.

3.1 Introduction

Brief Background and Process

The National Greenhouse Gas (GHG) Inventory of the Federated States of Micronesia (FSM) has been developed as a part of the Third National Communication (TNC) to the United Nations Framework Convention on Climate Change (UNFCCC), for period 2001-2018. The FSM's national inventory includes greenhouse gas emissions and removals from Energy; Industrial Processes and Product Use (IPPU); Agriculture, Forestry and Other Land Use (AFOLU), and the Waste sector (along with each sector's individual categories and sub-categories) within the national territory and offshore areas over which the country has jurisdiction. This NIR is successive to the first National GHG inventory submitted by FSMs as a part of the initial National Communication (INC)[79] submitted in 1997 (based on 1994 data) and its second GHG inventory under the Second National Communication (SNC)[80] submitted in 2015 (based on 2000 data).

The Third National Communication (TNC), presents a comprehensive description of anthropogenic Greenhouse Gas (GHGs) emissions and removals from FSM for the year 2018 (also include for the period 2001 to 2017) in accordance with the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories,[81] 2006 IPCC Guidelines for Greenhouse Gas Inventories[82] and IPCC Good Practice Guidance (GPG).[83] A summary information table of previous inventory submissions (i.e., for the years 1994 and 2000), as reproduced from previous submissions have also been presented in this report.

Table 1. Summary Second National Greenhouse Gas (GHG) Inventory, 2000

Inventory Year: 2000	**Sectoral Total GHG emissions in Gg**			
Categories	CO_2-equiv	CO_2	CH_4	N_2O
1 - Energy	158.18936	151.915	0.18935	0.00367
2- Industrial Processes and Product Use	0.07125	0.07125	0.00000	0.00000
3 - Agriculture, Forestry, and Other Land Use	0.77265	0.0000	0.02750	0.00001
4 - Waste	14.50491	0.0000	0.06157	0.04823
Total GHG Emissions, excl. Removals	171.53817	151.98625	0.27842	0.05191

[79] First National Communication of FSM Submitted to UNFCCC https://unfccc.int/sites/default/files/resource/Micronesia%20INC.pdf
[80] Second National Communication of FSM Submitted to UNFCCC https://unfccc.int/sites/default/files/resource/fsmnc2.pdf.
[81] https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html.
[82] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.
[83] Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, https://www.ipcc-nggip.iges.or.jp/public/gp/english/index.html.

Table 2. Summary Total National Greenhouse Gas (GHG) Inventory, 1994 and 2000

Greenhouse gas sources and sink categories	CO_2e Emissions (Gg)	CO_2 Emissions (Gg)	CO_2 Removals (Gg)	CH_4 (Gg)	N_2O (Gg)
Total National Emissions and Removals (1994)	184.6341	164.535	-474.11537	0.23374	0.05115
Total National Emissions and Removals (2000)	173.5443	151.986	-568.40867	0.27864	0.05191

The FSM's national GHG inventories for the year 2018 and time series for the year 2001-2017 have been prepared using the Tier1 approach for the applicable Greenhouse Gas (GHGs) as per the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, i.e., sectoral, sub-sectors, and gas type categorization. The sectors and gases analyzed for this NIR include the emissions by sources (excluding removals by sinks) of all anthropogenic GHGs (excluding the precursor gases and gases covered under the Montreal protocol). The NIR estimates the GHG emissions from the following sectors which are relevant to FSM:

1. Energy
2. Industrial Processes and Product Use (IPPU) – Not Occurring in FSM
3. Agriculture, Forestry and Other Land Use (AFOLU)
4. Waste

In the FSM, industrial activities are negligible and GHG emissions occurring from Industrial Processes are zero (and not estimated under this NIR) further fossil fuel is mainly used in the energy sectors hence the use of GHGs in products, and from non-energy uses of fossil fuel carbon is non-existence; hence emissions from IPPU sector are considered as zero.

The reference (top-down) approach has been used to estimate GHG emissions from the energy sector (for the years 2009 to 2018, emissions for the years 2001 to 2008 have not been estimated due to a lack of data availability). The reference approach is based on FSM's energy supply data to calculate the GHG emissions from the combustion of fossil fuels; however, since the reference approach does not distinguish between different source categories within the energy sector, i.e., sub-sectoral level (e.g., Electricity generation, Transportation, Residential and Commercial, Others, etc.) hence estimates available for total GHG emissions from Source category 1A, Fuel Combustion.

In this GHG inventory, emissions from some categories and sub-categories are not estimated ("NE") due to insufficient data, and some not occurring ("NO") or are relevant to the FSM. A summary of the sectors, sub-sectors, and categories and sub-categories "Estimated" and "Not Estimated (NE)" and "Not Occurring (NO)" for the period 2001–2018 is annexed to the report.

The GHG emissions estimated are:

1. Carbon dioxide (CO_2)
2. Methane (CH_4)
3. Nitrous Oxide (N_2O)

Following indirect GHGs are not estimated and reported. Further, these indirect GHG emissions are not accounted for in the aggregated national GHG emissions.

1. Oxides of Nitrogen (NOx)
2. Carbon Monoxide (CO)
3. Non-Methane Volatile Organic Compounds (NMVOC)
4. Sulphur dioxide (SO_2)

The GHG emissions are reported in Giga-grams (Gg) and the aggregated GHG emissions and removals are expressed in CO_2 equivalents (Gg CO_2e or CO_2eq) using the Global Warming Potential (GWP) defined by IPCC Fifth Assessment Report (AR5).[84]

This section also provides a description of the methodologies used, the quality assurance/quality control (QA/QC) measures applied, the results of the key category analysis, and approach-I quantification of the uncertainties associated with the estimates. As a best practice, the FSM has carried out a key category analysis[85] which helped to identify the most relevant GHG inventory categories for the FSM. Furthermore, an uncertainty assessment[86] has been conducted on the estimates of emissions and removals, which identifies the potential for improvement in future inventory.

Training and Capacity Building

The training and Capacity Building program was designed and delivered to the PIU team and other key stakeholders. The overall objective was to develop the capacity, share experiences, and learnings from the previous NIRs, data, and information communication protocols (data collection, archiving, reporting, and quality management in the context of existing national statistical data collection systems) and best practices with the stakeholders; to achieve the necessary level of expertise to develop national GHG inventory through data collection, analysis, monitoring and reporting guidelines, and procedures as required by UNFCCC. The stakeholders were also updated on IPCC 2006 Guidelines, updates, and best practices. The training exercise was focused on the following key areas: (i) GHG estimation methods in the latest IPCC Guidelines (2006 and 2019 enhancement, GPGs); (ii) Application of the IPCC Guidelines to the national circumstances; and (iii) QA/QC and Review processes.

Stakeholder Consultation

Stakeholder consultation was carried out among the stakeholders from government and government departments, public and private sectors, local and international development partners, NGOs, and public groups. The first phase of the stakeholder consultation focused on the key objective of the TNC and NIR project, inception, approach & methodology, and processes. The stakeholders were updated on the key steps of TNC and consulted on various aspects of GHG inventory sectors e.g., data collection process, climate change mitigation, adaptation, and V&A management. The stakeholders were also updated on IPCC 2006 Guidelines and Best Practices to develop the national GHG Inventory.

The second phase of stakeholder consultation involved the presentation of the results, i.e., National GHG Inventory for the period 2001 to 2018, data, standards, and assumptions applied for estimation and compilation of FSM's National GHG inventory, key sector, and categories, data gaps, assumptions, and uncertainties, etc. The objective of this phase was also to validate the assumptions and standards used for GHG inventory and seeks inputs from a wider stakeholder group. An important aspect of the stakeholder consultation was to update on the data gaps, uncertainties, etc. and issues and activities to be considered to improve the quality, completeness, and

---

[84] IPCC Fifth Assessment report, Global Warming Potential (GWP) Values, https://www.ipcc.ch/pdf/assessmentreport/ar5/wg1/WG1AR5_Chapter08_FINAL.pdf (p. 73-79)
[85] IPCC 2006 Guidelines, http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_4_Ch4_MethodChoice.pdf
[86] The IPCC 2006 Guidelines, http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_3_Ch3_Uncertainties.pdf.

transparency of GHG inventory and updates on the national GHG inventory improvement plan (NIIP).

Quality Assurance / Quality Control and Review Mechanism

A quality assurance/quality control (QA/QC) and review mechanism was an integral part of the process and was devised in order to improve transparency, consistency, comparability, completeness, and accuracy of third national communication and national greenhouse gas inventory. An internal QA/QC plan was developed and roles and responsibilities were defined for the GHG Inventory Team Members. The QA/QC process and review mechanism have been implemented at all levels of data collection, inventory preparation, and reporting.

The inventory team routinely conducted checks on the consistency of the data and information provided by the different stakeholders (line ministries, government departments, Organizations, Public and private sector, etc.), to ensure data integrity, correctness, and completeness. In case of discrepancy or incompleteness, the inventory team consulted the relevant stakeholders and experts to reduce the data uncertainty, appropriate corrections, and address errors and omissions. The sub-sectoral and sectoral calculations of GHGs were shared with the experts for technical review of categories and sub-category activity data, emission factors, estimation parameters, and calculation methods. The inputs provided by the experts were addressed and the GHG emission reduction calculation was revised. On finalization of the GHG Inventory calculations, the draft report was prepared and shared with the key Stakeholders.

Further, the draft report and GHG inventory calculations were presented during the stakeholder consultation to seek input and finalize the report. The main outcomes of QA/QC and review process were overall improvement in the quality of data collection, calculations, reporting and inclusion of the key criteria analysis, uncertainty estimates, and subsequent improvements in the future GHG Inventory, i.e., National Inventory Improvement Plan (NIIP).

3.2 National GHG Inventory: 2001–2018

Overview

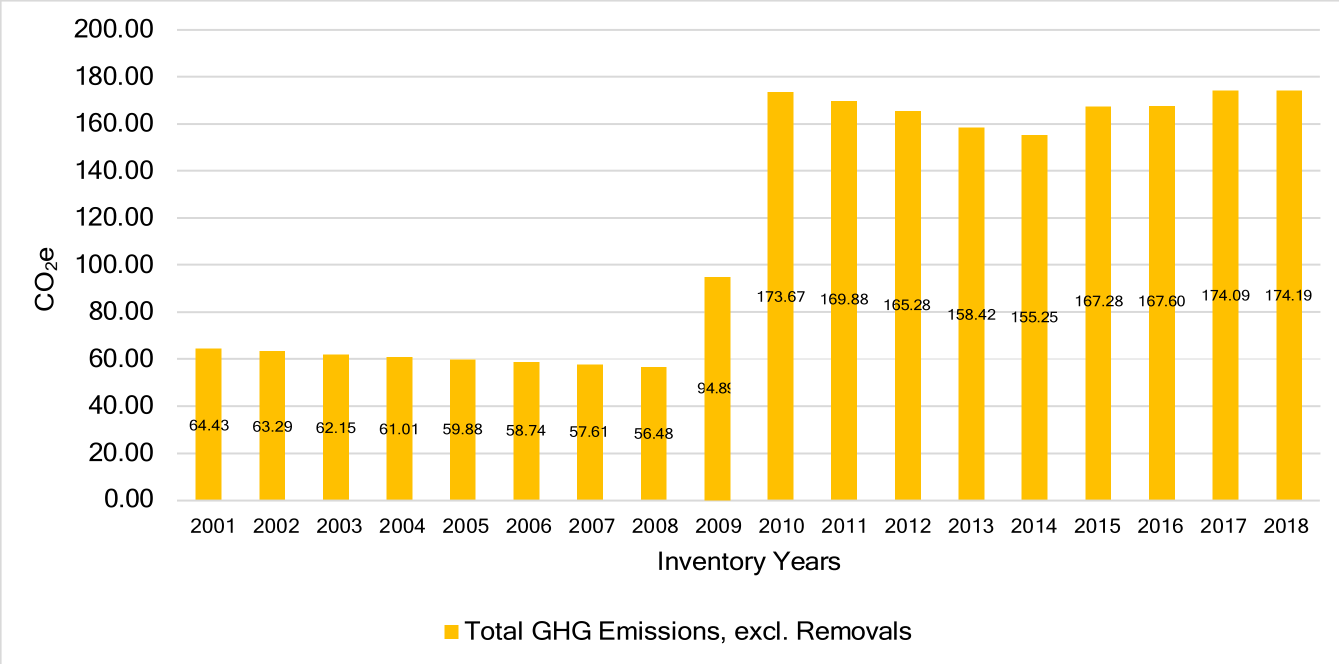
FSM's total GHG emissions for 2001–2018 has been estimated based on the methodologies discussed in the previous section of the report and are presented hereunder in the following section. In 2018, the FSM's total GHG emissions (excluding removals) was 174.19 Gg CO_2e (in comparison to 184.63 Gg CO_2e estimated for year 1994 under the first national communication and 173.52 Gg CO_2e estimated for year 2000 under the second national communication). This comprises direct CO_2 emission 118.52 Gg, CH_4 emission 1.72 Gg and N_2O emissions 0.028 Gg during 2018. The emissions of other indirect GHG like perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and Sulphur hexafluoride (SF_6) are not estimated due to limited application and no manufacturing of the products containing these gases. In absolute terms, FSM's total GHG (CO_2e) emissions was around 0.0000031% of the total Global GHG emissions for year 2018. The global per capita GHG emissions (in terms of tonnes of CO_2e per person) for the year 2018 were about 7.274 tonnes of CO_2e per person per year (Considering Global population for 2018 was 7.602 billion persons[87]); whereas FSM's per capita GHG emissions was around 1.67 tonnes of CO_2e per person per year for the same period.

Total GHG Emissions

The FSM's total GHG emissions in Gg CO_2e (excluding removals) for the inventory years 2001-2018 are presented as following:

[87] World Bank Open Data, Population (Total) Indicator 2018, https://data.worldbank.org/indicator/SP.POP.TOTL

Figure 1. FSM's GHG Emission (excluding removals), Gg CO_2e: 2001–2018



Note: The GHG emissions from Energy Sector was not estimated for the inventory years 2001-2008, due lack of energy data availability.

Table 3. FSM's GHG Emission (excluding removals), Gg CO_2e: 2001–2018

Inventory Year	1 - Energy	2 - IPPU	3 - AFOLU	4 - Waste	Total GHG Emissions (excl. Removals)
	Gg CO_2eq.				
2001	NE	NE	35.12	29.31	64.43
2002	NE	NE	34.08	29.20	63.29
2003	NE	NE	33.04	29.10	62.15
2004	NE	NE	32.01	29.01	61.01
2005	NE	NE	30.97	28.91	59.88
2006	NE	NE	29.93	28.81	58.74
2007	NE	NE	28.89	28.72	57.61
2008	NE	NE	27.85	28.63	56.48
2009	39.73	NE	26.82	28.34	94.89

Inventory Year	1 - Energy	2 - IPPU	3 - AFOLU	4 - Waste	Total GHG Emissions (excl. Removals)
2010	119.64	NE	25.78	28.26	173.67
2011	116.83	NE	24.74	28.30	169.88
2012	113.23	NE	23.70	28.35	165.28
2013	108.34	NE	22.66	27.41	158.42
2014	105.69	NE	22.11	27.46	155.25
2015	115.98	NE	24.20	27.10	167.28
2016	114.17	NE	26.29	27.15	167.60
2017	119.79	NE	27.10	27.19	174.09
2018	118.52	NE	28.35	27.24	174.11

Figure 2. FSM's GHG Emission (excluding removals) by Gas (Gg): 2001–2018

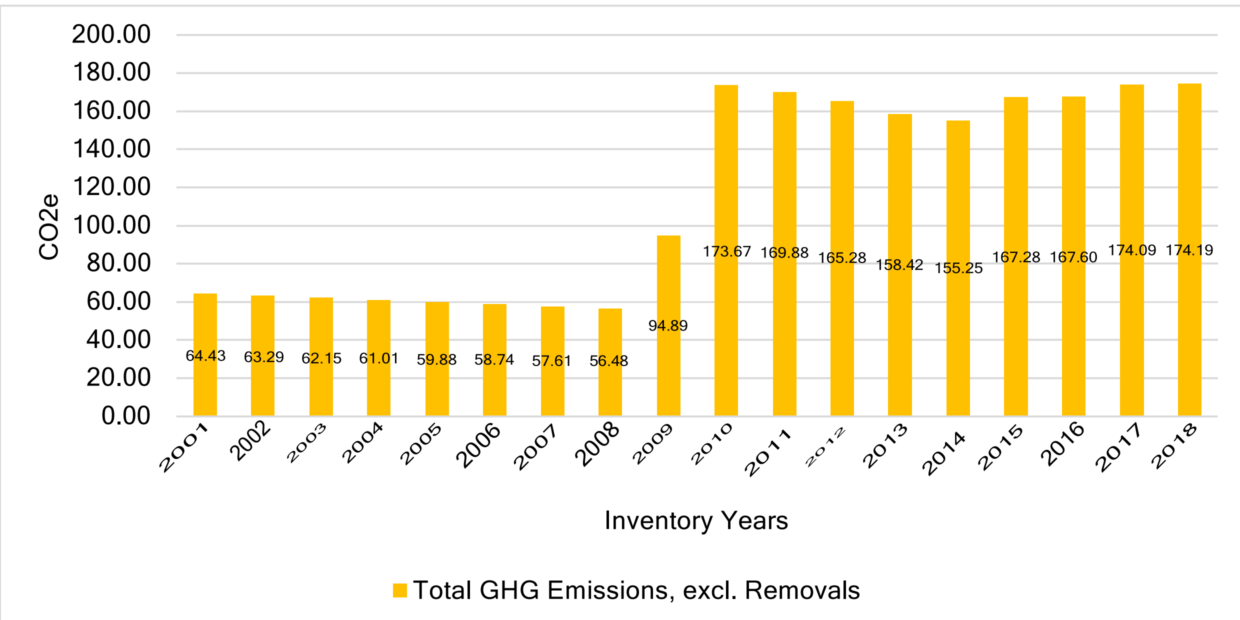
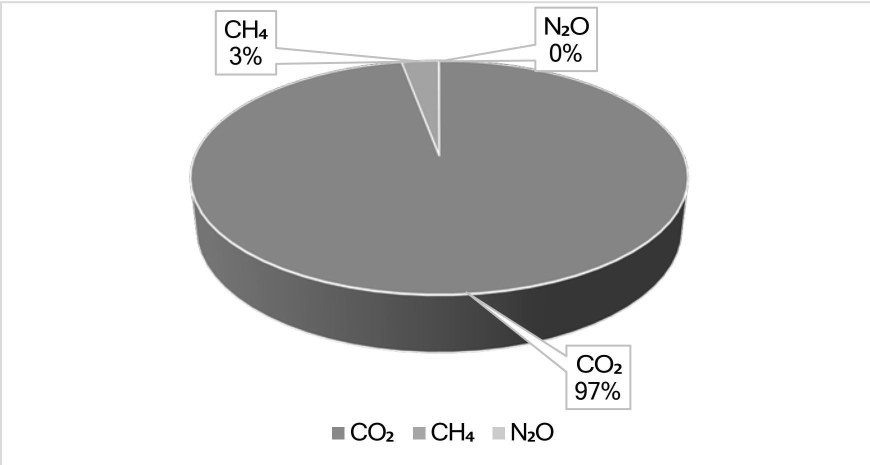


Table 4. FSM's GHG Emission (excluding removals) by Gas (Gg): 2001–2018

Year	CO_2eq.	CO_2	CH_4	N_2O
2001	64.43	0.00	2.01	0.030
2002	63.29	0.00	1.98	0.030
2003	62.15	0.00	1.95	0.029
2004	61.01	0.00	1.91	0.028
2005	59.88	0.00	1.88	0.027
2006	58.74	0.00	1.85	0.027
2007	57.61	0.00	1.81	0.026
2008	56.48	0.00	1.78	0.025
2009	94.89	39.73	1.74	0.024
2010	173.67	119.64	1.71	0.024
2011	169.88	116.83	1.68	0.023
2012	165.28	113.23	1.65	0.022
2013	158.42	108.34	1.59	0.021
2014	155.25	105.69	1.56	0.022
2015	167.28	115.98	1.61	0.024
2016	167.60	114.17	1.67	0.025
2017	174.09	119.79	1.69	0.027
2018	174.11	118.52	1.72	0.028
Average	115.78	59.55	1.77	0.026

Figure 3. FSM's GHG Emission (excluding removals) by Gas (Gg): Average 2001-2018



The total GHG emissions from FSM is increasing during the inventory years 2001-2018, an indicative increase in the CO_2 emission followed by CH_4 and N_2O emissions. CO_2 emissions are mainly attributed to the fossil fuel combustion activities, while CH_4 and N_2O emissions are from agriculture-livestock (Enteric fermentation, Manure management and Aggregate sources and non-CO_2 emissions sources on land) and Waste Sector (Solid waste and waste water) respectively.

GHG Emissions by Sector

The main GHG emission sectors and sub-sectors in FSM are:

- Energy Sector
  - Fuel Combustion Activities (1.A)
- Agriculture, Forestry, and Other Land Use
  - Livestock (3.A)
  - Aggregate sources and non-CO_2 emissions sources on land (3.C)
- Waste
  - Solid Waste
    - Solid Waste Disposal (4.A)
  - Wastewater Treatment and Discharge (4.D)
    - Domestic Waste Water

The listed sector and sub-sectors are sources of direct CO_2 emission, CH_4 emission and N_2O emissions and emissions of precursor gases (NOx, SOx and NMVOC); further the other indirect GHGs like perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and Sulphur hexafluoride (SF_6) are not estimated due to limited application and no manufacturing of the products containing these gases in FSM.

The total GHG emissions for the year 2001-2018 (excluding removals) is summarized in the table below:

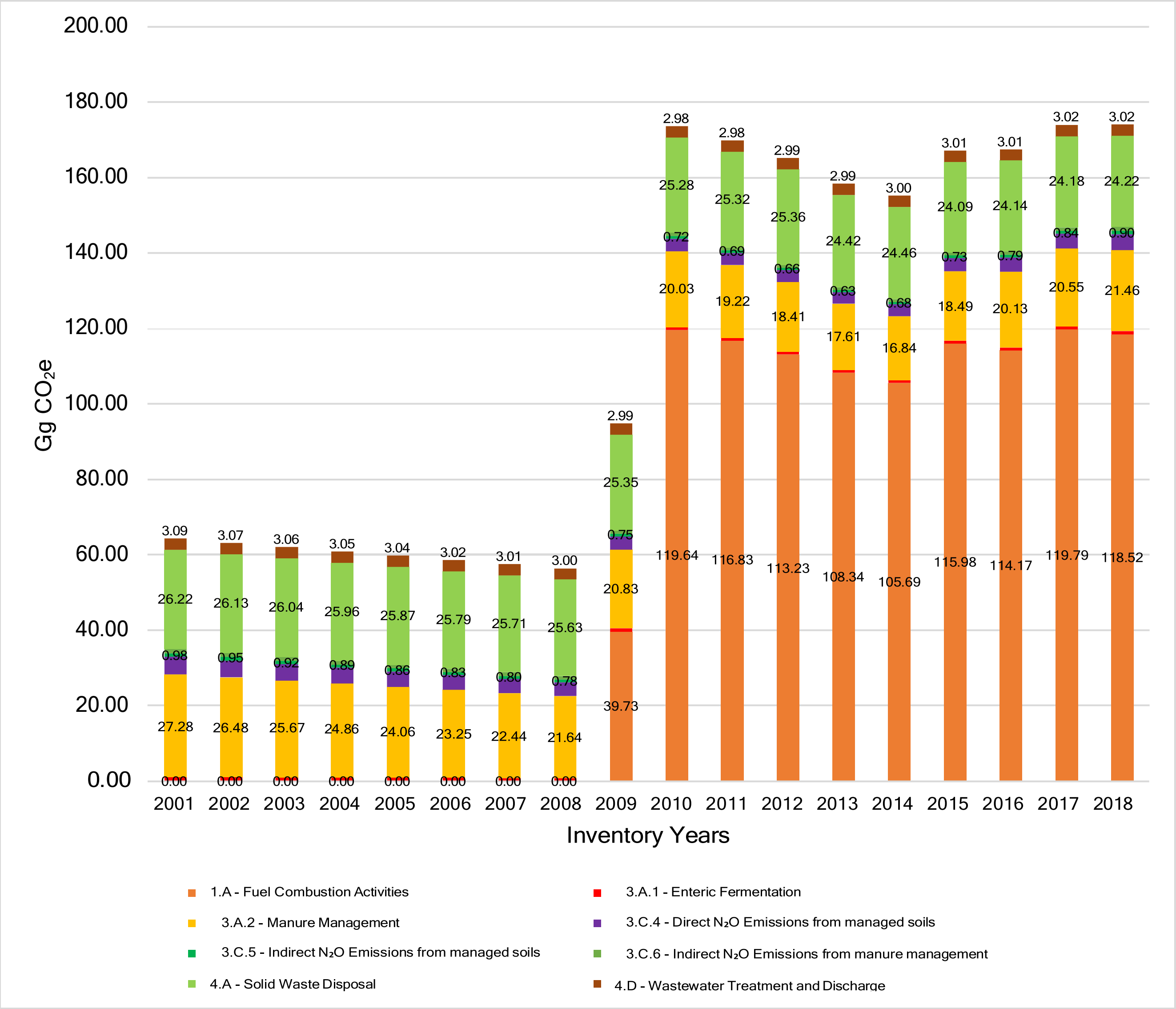
Table 5. FSM's Total GHG Emission (Gg CO_2e): 2001–2018

Inventory Year: 2001-2018	Net CO_2 Emissions (CO_2 Equivalents Gg)																	
Categories	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1 - Energy	NE	NE	NE	NE	NE	NE	NE	NE	39.73	119.64	116.83	113.23	108.34	105.69	115.98	114.17	119.79	118.52
1.A Fuel Combustion Activities	NE	NE	NE	NE	NE	NE	NE	NE	39.73	119.64	116.83	113.23	108.34	105.69	115.98	114.17	119.79	118.52
2 Industrial Processes and Product Use	NE																	
3 - Agriculture, Forestry, and Other Land Use	35.12	34.08	33.04	32.01	30.97	29.93	28.89	27.85	26.82	25.78	24.74	23.70	22.66	22.11	24.20	26.29	27.10	28.43
3.A - Livestock	28.42	27.58	26.74	25.90	25.06	24.22	23.38	22.54	21.70	20.86	20.02	19.18	18.34	17.54	19.26	20.97	21.40	22.35
3.C - Aggregate sources and non-CO2 emissions sources on land	6.70	6.50	6.30	6.11	5.91	5.71	5.51	5.31	5.12	4.92	4.72	4.52	4.32	4.56	4.94	5.32	5.70	6.08
4 - Waste	29.31	29.20	29.10	29.01	28.91	28.81	28.72	28.63	28.34	28.26	28.30	28.35	27.41	27.46	27.10	27.15	27.19	27.24
4.A - Solid Waste Disposal	26.22	26.13	26.04	25.96	25.87	25.79	25.71	25.63	25.35	25.28	25.32	25.36	24.42	24.46	24.09	24.14	24.18	24.22
4.D - Wastewater Treatment and Discharge	3.09	3.07	3.06	3.05	3.04	3.02	3.01	3.00	2.99	2.98	2.98	2.99	2.99	3.00	3.01	3.01	3.02	3.02
Total GHG Emissions, excl. Removals	64.43	63.29	62.15	61.01	59.88	58.74	57.61	56.48	94.89	173.67	169.88	165.28	158.42	155.25	167.28	167.60	174.09	174.19

GHG Emissions by Sub-sector and Categories

The FSM's Sub-sectoral GHG emissions during the inventory years 2001-2018, presented here:

Figure 4. FSM's Sub-Sector-wise GHG Emissions- excluding removals (Gg CO_2e): 2001-2018



The FSM's sub-sector wise GHG emissions indicates that, the key GHG emissions contributions are from 1.A - Fuel Combustion Activities (electricity generation, transport and others), 3.A – Livestock (3.A.1 - Enteric Fermentation and 3.A.2 - Manure Management), 3.C.4 - Direct N_2O Emissions from managed soils, 3.C.5 - Indirect N_2O Emissions from managed soils, 3.C.6 - Indirect N_2O Emissions from manure management, 4.A - Solid Waste Disposal, and 4.D - Wastewater Treatment and Discharge.

The sub-sector wise GHG emissions shows that, the GHG emissions from solid waste disposal and manure management activities are reducing year on year basis. This is mainly attributed due to the decline in livestock population and rehabilitation and upgrading of the some of the waste disposal sites from unmanaged to semi-aerobic process. The average emissions from these two subsectors are 21.8% and 18.7% respectively. Followed by Direct N_2O Emissions from managed soils 3.2%, Wastewater Treatment and Discharge 2.6%, Enteric Fermentation 0.8%, Indirect N_2O Emissions from manure management 0.8% and Indirect N_2O Emissions from managed soils 0.7%. A detailed analysis of each of the sub-sectors is provided in the later sections of the report. The following graph present the average emissions from the each of subsector.

Figure 5. FSM's Sub-Sector-wise Average GHG Emissions (excluding removals): 2001-2018

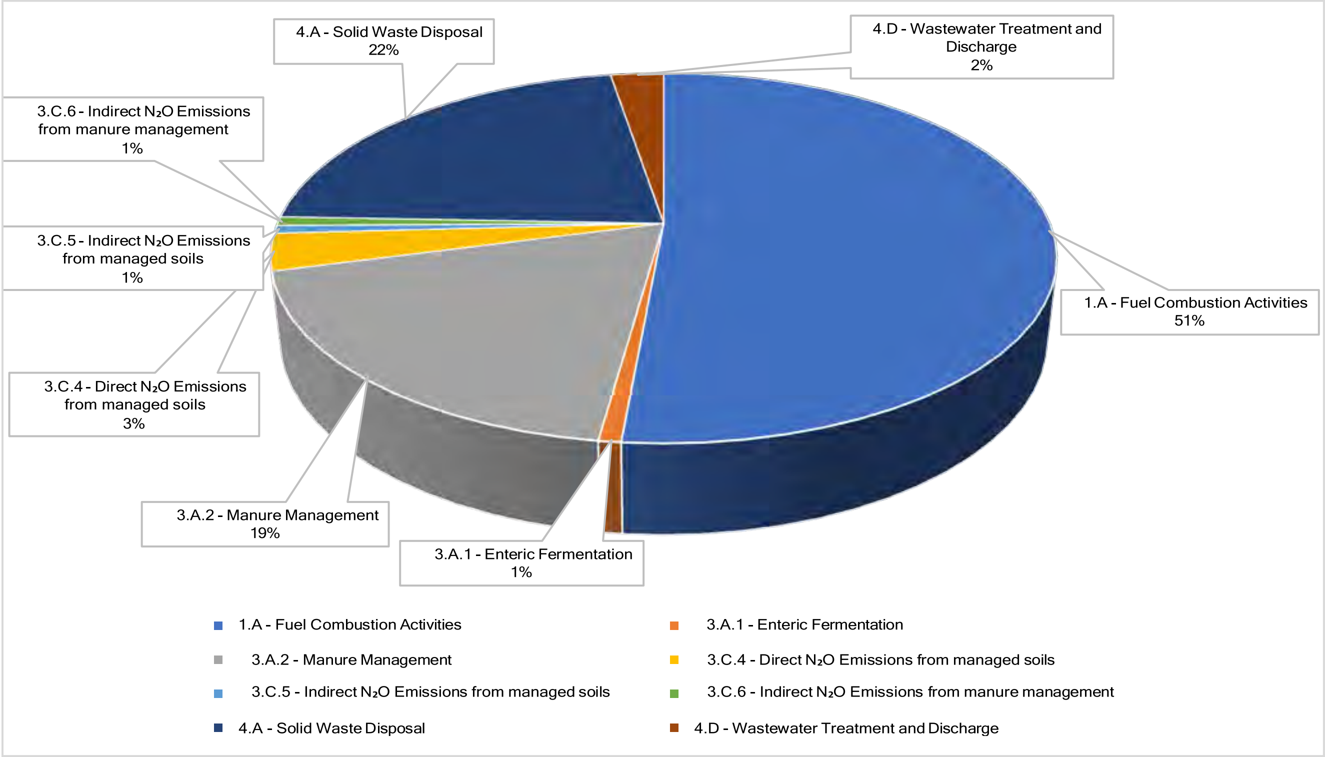


Table 6. FSM's Sub-Sectoral GHG Emission (excluding removals), Gg CO_2e: 2001-2018

Inventory Year: 2001-2018	Net CO_2 Emissions, (CO_2 Equivalents Gg)																	
Categories	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1.A - Fuel Combustion Activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.73	119.64	116.83	113.23	108.34	105.69	115.98	114.17	119.79	118.52
3.A.1 - Enteric Fermentation	1.14	1.10	1.07	1.04	1.00	0.97	0.94	0.90	0.87	0.83	0.80	0.77	0.73	0.70	0.77	0.84	0.85	0.89
3.A.2 - Manure Management	27.28	26.48	25.67	24.86	24.06	23.25	22.44	21.64	20.83	20.03	19.22	18.41	17.61	16.84	18.49	20.13	20.55	21.46
3.C.4 - Direct N_2O Emissions from managed soils	4.60	4.46	4.33	4.19	4.05	3.92	3.78	3.65	3.51	3.38	3.24	3.10	2.97	3.19	3.45	3.70	3.96	4.22
3.C.5 - Indirect N_2O Emissions from managed soils	0.98	0.95	0.92	0.89	0.86	0.83	0.80	0.78	0.75	0.72	0.69	0.66	0.63	0.68	0.73	0.79	0.84	0.90
3.C.6 - Indirect N_2O Emissions from manure management	1.12	1.09	1.06	1.02	0.99	0.96	0.92	0.89	0.86	0.83	0.79	0.76	0.73	0.69	0.76	0.83	0.90	0.96
4.A - Solid Waste Disposal	26.22	26.13	26.04	25.96	25.87	25.79	25.71	25.63	25.35	25.28	25.32	25.36	24.42	24.46	24.09	24.14	24.18	24.22
4.D - Wastewater Treatment and Discharge	3.09	3.07	3.06	3.05	3.04	3.02	3.01	3.00	2.99	2.98	2.98	2.99	2.99	3.00	3.01	3.01	3.02	3.02
Total GHG Emissions, excl. Removals	64.43	63.29	62.15	61.01	59.88	58.74	57.61	56.48	94.89	173.67	169.88	165.28	158.42	155.25	167.28	167.60	174.09	174.19

GHG Emissions by Gases

The gas-by-gas emissions for FSM inventory years 2001-2018 include three main Greenhouse gases viz Carbon dioxide (CO_2), Methane (CH_4) and Nitrous-oxide (N_2O). The emissions of other GHGs like hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and Sulphur hexafluoride (SF_6) have not been estimated as due to the reasons and limitation discussed in the previous section. Further, the emissions from precursor gases like Carbon Monoxide (CO), Nitrogen Oxides (NOx) and non-Methane Volatile Organic Compounds (NMVOC) and other gases not controlled by the Montreal Protocol, such as Sulphur Oxides (SOx) have also not been estimated and analyzed due to the lack of detailed activity data and associated uncertainty in the estimation. However, the TNC team envisages to improve the quality of data collected and estimate the emissions form these precursor gases in the future inventories and included this in the national inventory improvement plan (NIIP).

The dominant GHG emission in FSM is carbon dioxide (CO_2) which emits mainly from fossil fuel combustion activities for power generation, transportation. Next main GHG is Methane (CH_4) and it mainly occurs from Livestock, Aggregate sources and non-CO_2 emissions sources on land and Solid Waste and Waste water disposal and treatment activities. This is followed by N_2O emissions mainly from livestock, Aggregate sources and non-CO_2 emissions sources on land and waste water sub-sector.

Gas wise GHG emissions in FSM during the inventory years 2001-2018 are presented in the table below and discussed in detail in the following section:

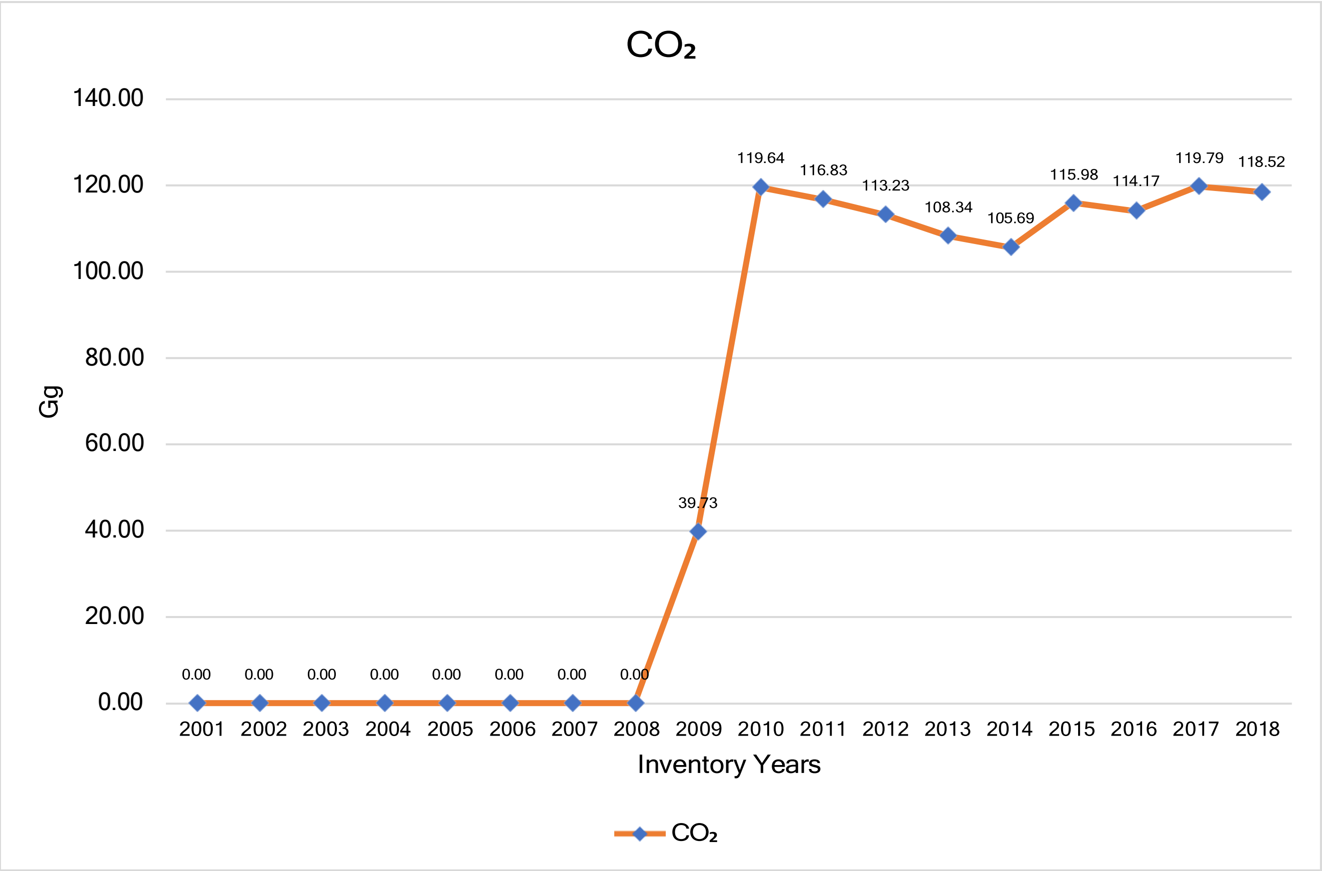
Table 7. FSM's Gas-wise GHG Emission (excluding removals), Gg: 2001-2018

Year	CO_2	CH_4	N_2O
2001	NE	2.01	0.030
2002	NE	1.98	0.030
2003	NE	1.95	0.029
2004	NE	1.91	0.028
2005	NE	1.88	0.027
2006	NE	1.85	0.027
2007	NE	1.81	0.026
2008	NE	1.78	0.025
2009	39.73	1.74	0.024
2010	119.64	1.71	0.024
2011	116.83	1.68	0.023
2012	113.23	1.65	0.022
2013	108.34	1.59	0.021
2014	105.69	1.56	0.022
2015	115.98	1.61	0.024

Year	CO_2	CH_4	N_2O
2016	114.17	1.67	0.025
2017	119.79	1.69	0.027
2018	118.52	1.72	0.028
Average	59.55	1.77	0.026
% Share	97%	3%	0.042%

Carbon dioxide (CO_2)

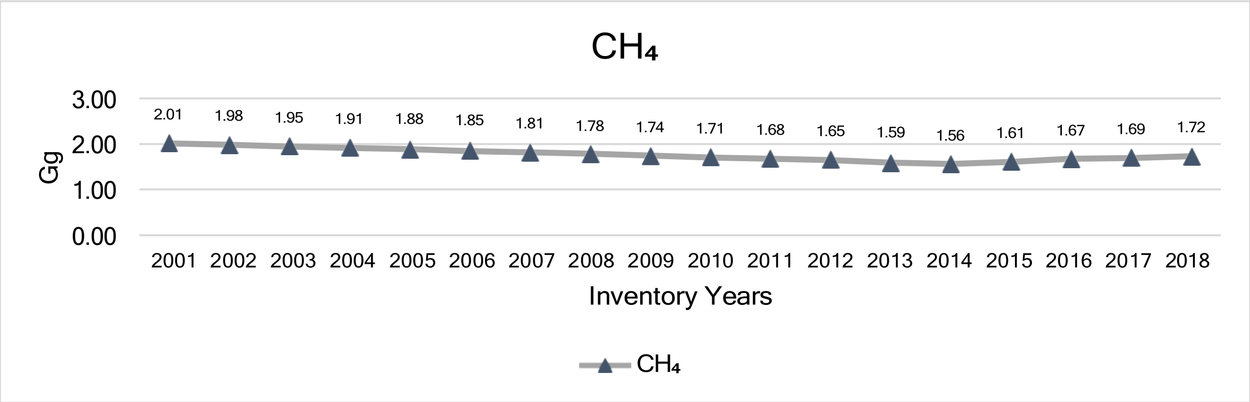
Figure 6. FSM's Total CO_2 emissions in Gg: 2001-2018



The net CO_2 emissions in FSM is estimated for the period 2007-2015, the energy sector is the main source of CO_2 emissions in accounts for entire CO_2 emissions in FSM. The net CO_2 emissions shows an increasing trend and has increased from 39.73 Gg CO_2e in 2009 to 119.79 Gg CO_2e in 2018. During the years 2001-2018, the net CO_2 emissions could not be estimated due to lack of formal data on fuel imported into the country.

Methane (CH_4)

Figure 7. FSM's Total Methane (CH4) emissions in Gg – 2001-2018



The CH_4 emission trend shown a declining trend over until the year 2014 and thereafter it again starts increasing till 2018. The CH_4 emissions in FSM reached to 1.75 Gg in 2018 declining from 2.01 Gg in 2011, representing 14.42% decrease during the inventory period. Majority of the CH_4 emissions (about 54%) in FSM comes from Waste sector (Solid waste- MSW and Domestic waste water). Whereas, the remaining 46% of CH_4 emissions is due to agriculture sector, mainly Livestock- enteric fermentation and manure management. The decrease in CH_4 emissions is mainly attributed due to a decrease in the population of Livestock's and due to rehabilitation and upgrading of the some of the waste dumpsites from unmanaged to semi-aerobic site.

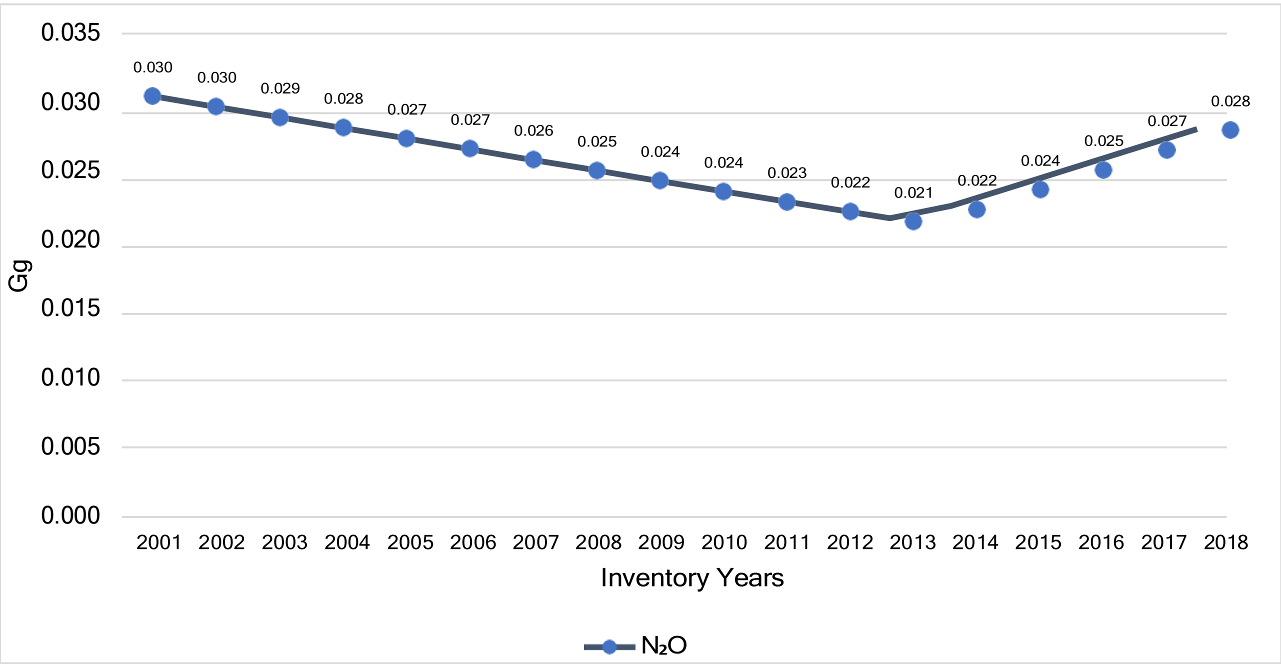
Table 8. FSM's Sub-sector wise CH_4 Emission Gg: 2001-2018

Year	3.A.1 - Enteric Fermentation	3.A.2 - Manure Management	4.A - Solid Waste Disposal	4.D - Wastewater Treatment and Discharge	Total CH_4 Emissions
2001	0.041	0.974	0.936	0.061	2.013
2002	0.039	0.946	0.933	0.061	1.979
2003	0.038	0.917	0.93	0.061	1.946
2004	0.037	0.888	0.927	0.061	1.913
2005	0.036	0.859	0.924	0.06	1.879
2006	0.035	0.83	0.921	0.06	1.846
2007	0.033	0.802	0.918	0.06	1.813
2008	0.032	0.773	0.915	0.06	1.78
2009	0.031	0.744	0.905	0.059	1.74
2010	0.03	0.715	0.903	0.059	1.707
2011	0.029	0.686	0.904	0.059	1.679
2012	0.027	0.658	0.906	0.059	1.65
2013	0.026	0.629	0.872	0.059	1.587

Year	3.A.1 - Enteric Fermentation	3.A.2 - Manure Management	4.A - Solid Waste Disposal	4.D - Wastewater Treatment and Discharge	Total CH_4 Emissions
2014	0.025	0.602	0.874	0.06	1.56
2015	0.027	0.66	0.861	0.06	1.608
2016	0.03	0.719	0.862	0.06	1.671
2017	0.031	0.734	0.864	0.06	1.688
2018	0.032	0.766	0.865	0.06	1.723
Average	0.032	0.772	0.901	0.06	1.766

Nitrous Oxide (N_2O)

Figure 8. FSM's Total Nitrous Oxide (N_2O) emissions in Gg – 2001-2018



The net N_2O emissions in FSM follows the same trend as that of CH_4 emissions. N_2O emissions reached to 0.028 Gg in 2018 declining from 0.030 Gg in 2011, representing a decrease of about 6.67% during the inventory period. The average contribution of N_2O emissions on total GHG emissions of FSM is negligible of about 0.042%. Approximately 80% of the FSM's total N_2O emissions comes from contributed agriculture sector (Aggregate sources and non-CO_2 emissions sources on land). Whilst, the remaining 20% of N_2O emission is comes from waste sector (Domestic wastewater Treatment and Discharge). The rationale behind the decreasing N_2O emission trend is same as of the CH_4 emissions.

Table 9. FSM's Subsector wise N_2O Emission Gg: 2001–2018

Year	3.C.4 - Direct N_2O Emissions from managed soils	3.C.5 - Indirect N_2O Emissions from managed soils	3.C.6 - Indirect N_2O Emissions from manure management	4.D - Wastewater Treatment and Discharge	Total N_2O Emissions
2001	0.0174	0.0037	0.0042	0.0052	0.0305
2002	0.0168	0.0036	0.0041	0.0052	0.0297
2003	0.0163	0.0035	0.004	0.0051	0.0289
2004	0.0158	0.0034	0.0039	0.0051	0.0282
2005	0.0153	0.0033	0.0037	0.0051	0.0274
2006	0.0148	0.0031	0.0036	0.0051	0.0266
2007	0.0143	0.003	0.0035	0.0051	0.0259
2008	0.0138	0.0029	0.0034	0.005	0.0251
2009	0.0133	0.0028	0.0032	0.005	0.0243
2010	0.0127	0.0027	0.0031	0.005	0.0236
2011	0.0122	0.0026	0.003	0.005	0.0228
2012	0.0117	0.0025	0.0029	0.005	0.0221
2013	0.0112	0.0024	0.0027	0.005	0.0213
2014	0.012	0.0026	0.0026	0.005	0.0222
2015	0.013	0.0028	0.0029	0.005	0.0237
2016	0.014	0.003	0.0031	0.005	0.0251
2017	0.0149	0.0032	0.0034	0.0051	0.0266
2018	0.0159	0.0034	0.0036	0.0051	0.028
Avg.	0.0142	0.003	0.0034	0.0051	0.0257

Other GHGs (PFCs, HFCs and SF_6)

Emissions from Other indirect GHGs like Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), and Sulphur hexafluoride (SF_6) are not estimated and reported under this inventory. This is due to limited applications and no manufacturing of the products containing other GHGs in FSM.

Precursor and Indirect Emission (NOx, CO, NMVOC and SO_2)

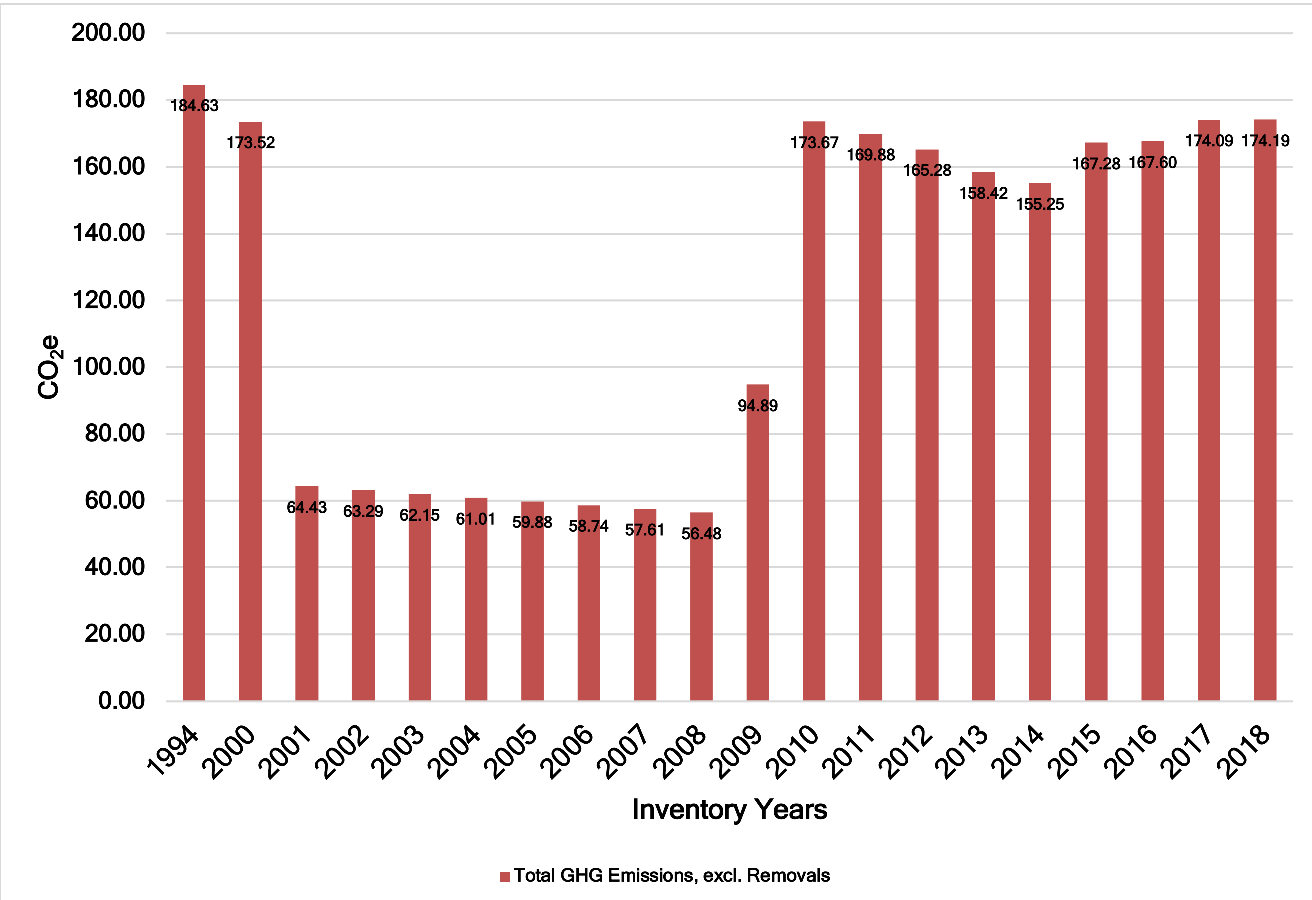
The other indirect emissions of NOx, CO, NMVOC and SO_2 occurs in FSM. However, they are not main source of the GHGs and have very negligible quantum. Further due to lack of data and high uncertainty involved in estimation of emissions of these gases, they are not estimated under this inventory for the years 2001–2018.

3.3 GHG Emission Trend Analysis: 1994–2018

GHG Emission Trend: 1994-2018

This section presents the trend analysis for key emission-intensive sectors in FSM (namely Energy, AFOLU, and Waste) for the inventory period 1994 to 2018.

Figure 9. FSM's Total GHG emissions (excluding removals) in Gg CO_2e: 1994-2018



FSM's total GHG emissions reached to 174.19 Gg CO_2e in 2018 from 184.63 Gg CO_2e in 1994, representing decline in emission levels by about 5.65% over 24 years. The rationale behind the sudden dip in the emission levels during the years 2001 to 2008 is mainly due to unavailability of formal data on fuel imported into the country. Further, the dip in emission level during the years 2010 to 2014 is attributed due to slower economy growth during these years. The 1994 and 2000 GHG inventory covered all the key IPCC sectors, i.e., Energy, IPPU, AFOLU, IPPU and Waste sector. However, the current inventory for the period 2001–2018 does not include emissions from the IPPU sector due to lack of information.

Sectoral GHG Emission Trend: 1994-2018

This section presents the GHG emission trends in FSM's key GHG emission sector of, i.e., Energy, Agriculture (Livestock and Aggregate sources and non-CO_2 emissions sources on land) and Waste (Solid waste- MSW and Domestic waste water) for more categoric review and analysis of GHG emission trends in FSM.

Figure 10. FSM's total GHG emissions by sectors (excluding removals) in Gg CO_2e: 1994-2018

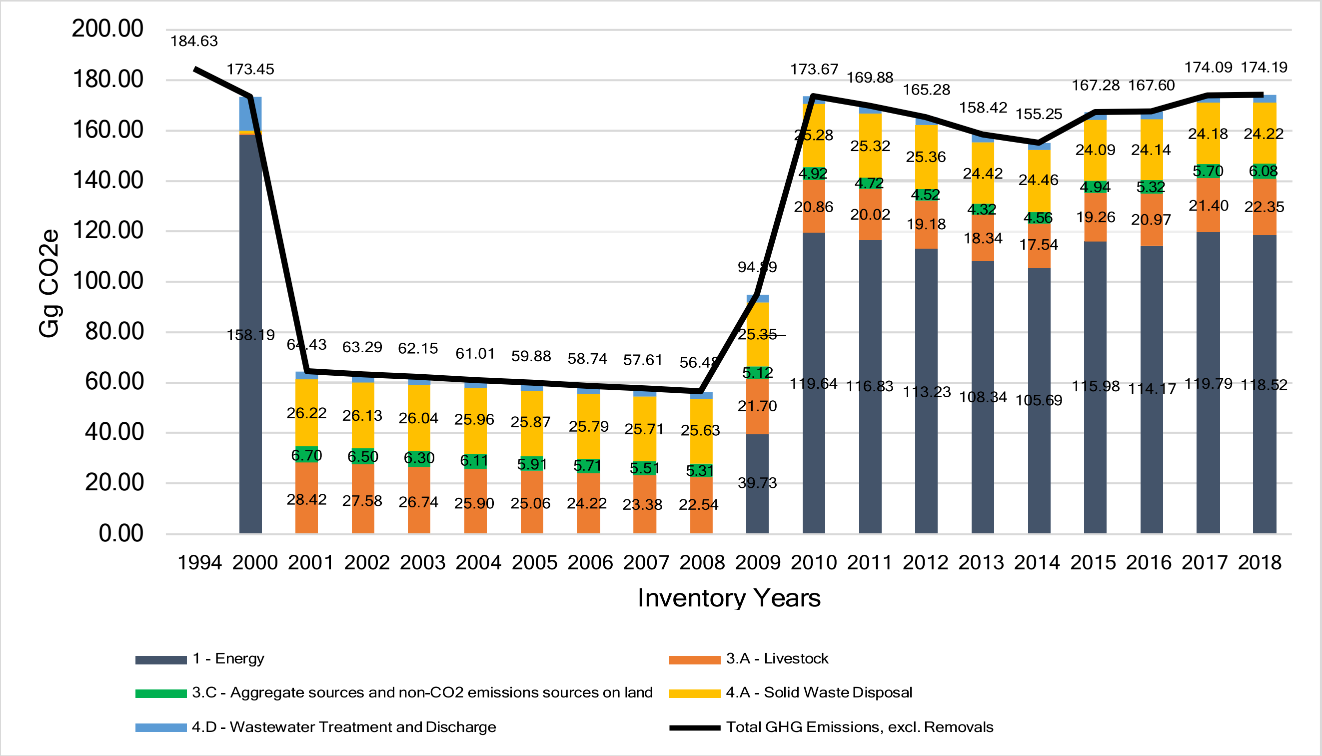
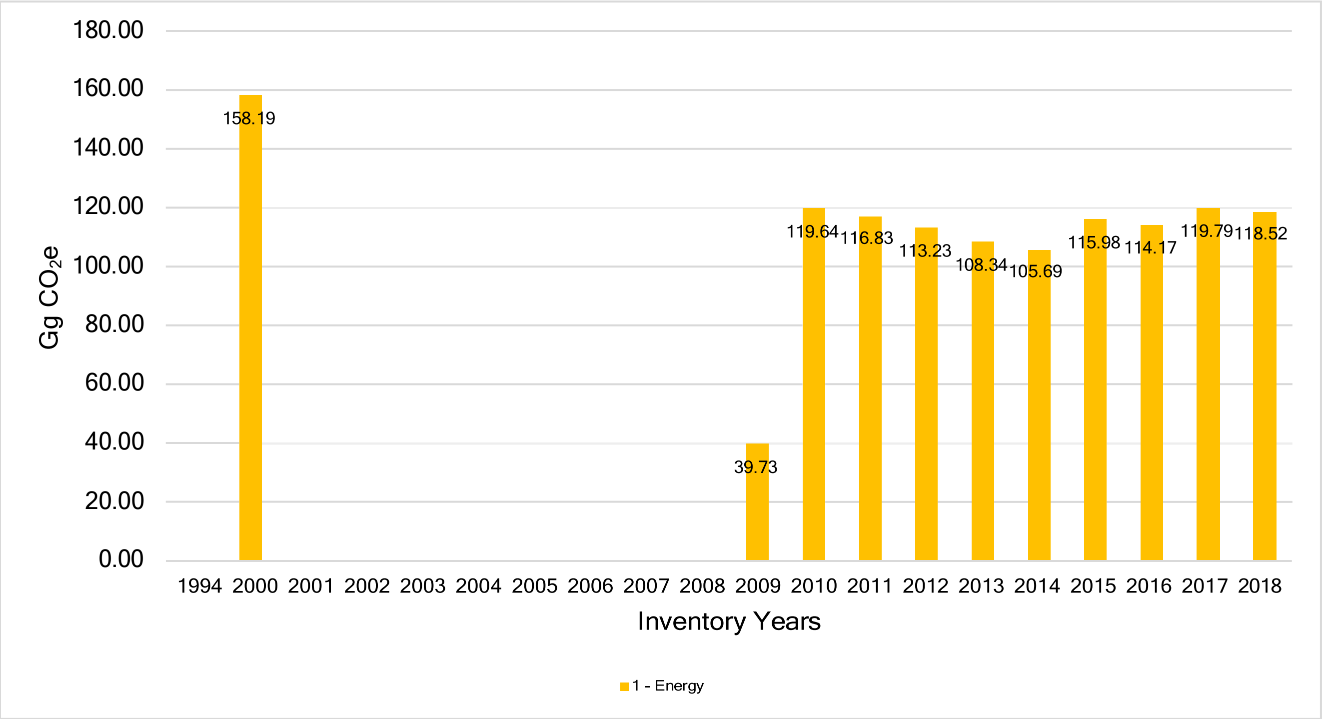
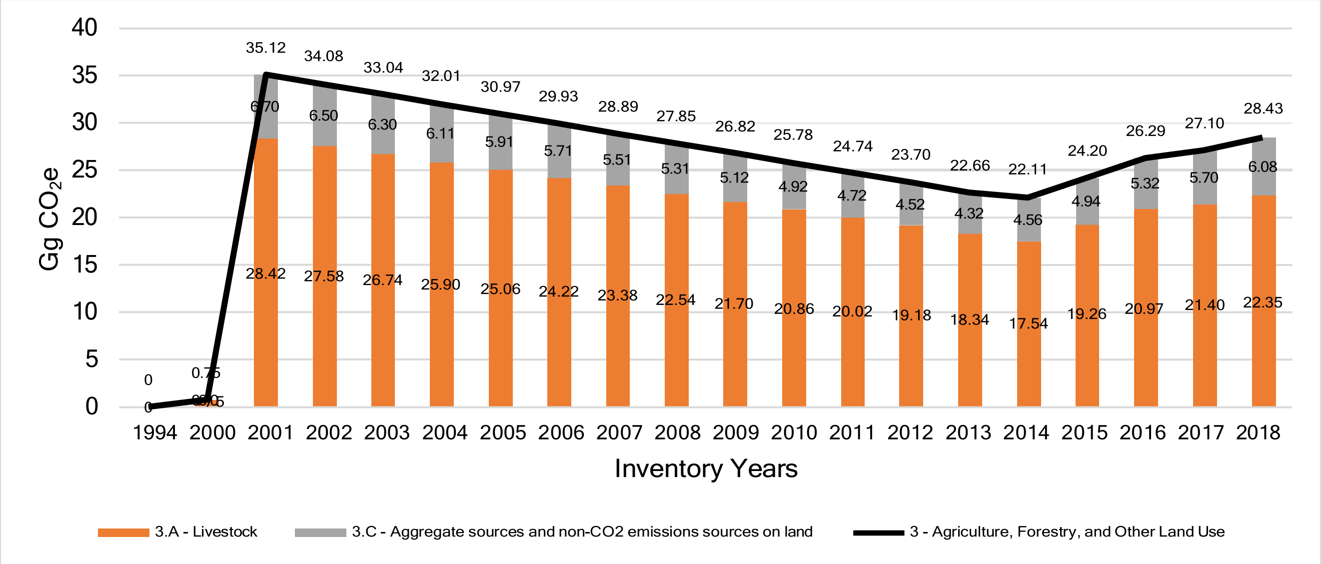


Figure 11. FSM's Energy sector total GHG emissions in Gg CO2e: 1994-2018



The estimated total energy sector GHG emission reached to 118.52 Gg CO_2e in 2018 from 158.19 Gg CO_2e in 1994, representing a decline in emissions by about 25%. Energy sector emissions is analogous to the quantity of fuel imported in to the country.

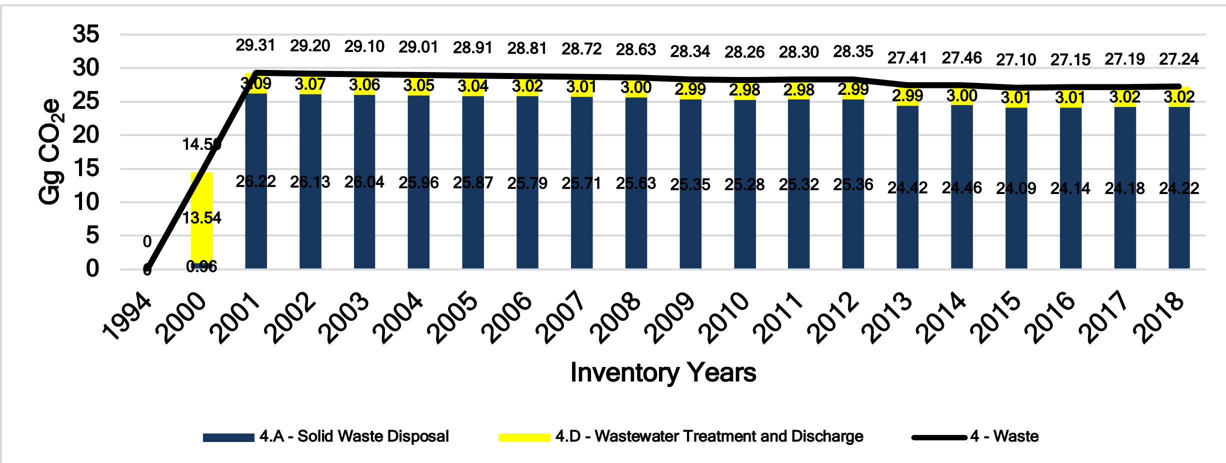
Figure 12. FSM's AFOLU sector total GHG emissions (excl. removals) in Gg CO_2e: 1994-2018



FSM's total GHG emissions from Agriculture sector totaled 28.43 Gg CO_2e in 2018. The emissions from "Livestock" and "Aggregate sources and non-CO_2 emissions sources on land" sub-sector in FSM shows a decreasing trend until the year 2014 and thereafter increases slightly during the end years, i.e., during 2015 to

2018. Livestock sector emissions reached to 22.35 Gg CO_2e in 2018 from 0.75 Gg CO_2e in 2000. Livestock production (pigs and poultry) is important throughout FSM, particularly for subsistence and cultural use. Most of the livestock in FSM are raised for home consumption, however a significant proportion is used for ceremonial and cultural purposes, such as weddings, funerals and feasts of celebration. However, there is a lack of modern scientific manure management systems and most of the livestock are free ranging due to which the emissions form the both "livestock" and "Aggregate sources and non-CO_2 emissions sources on land" sub-sector has the significant share in the total GHG emissions from FSM.

Figure 13. FSM's Waste sector total GHG emissions (excl. removals) in Gg CO_2e: 1994-2018

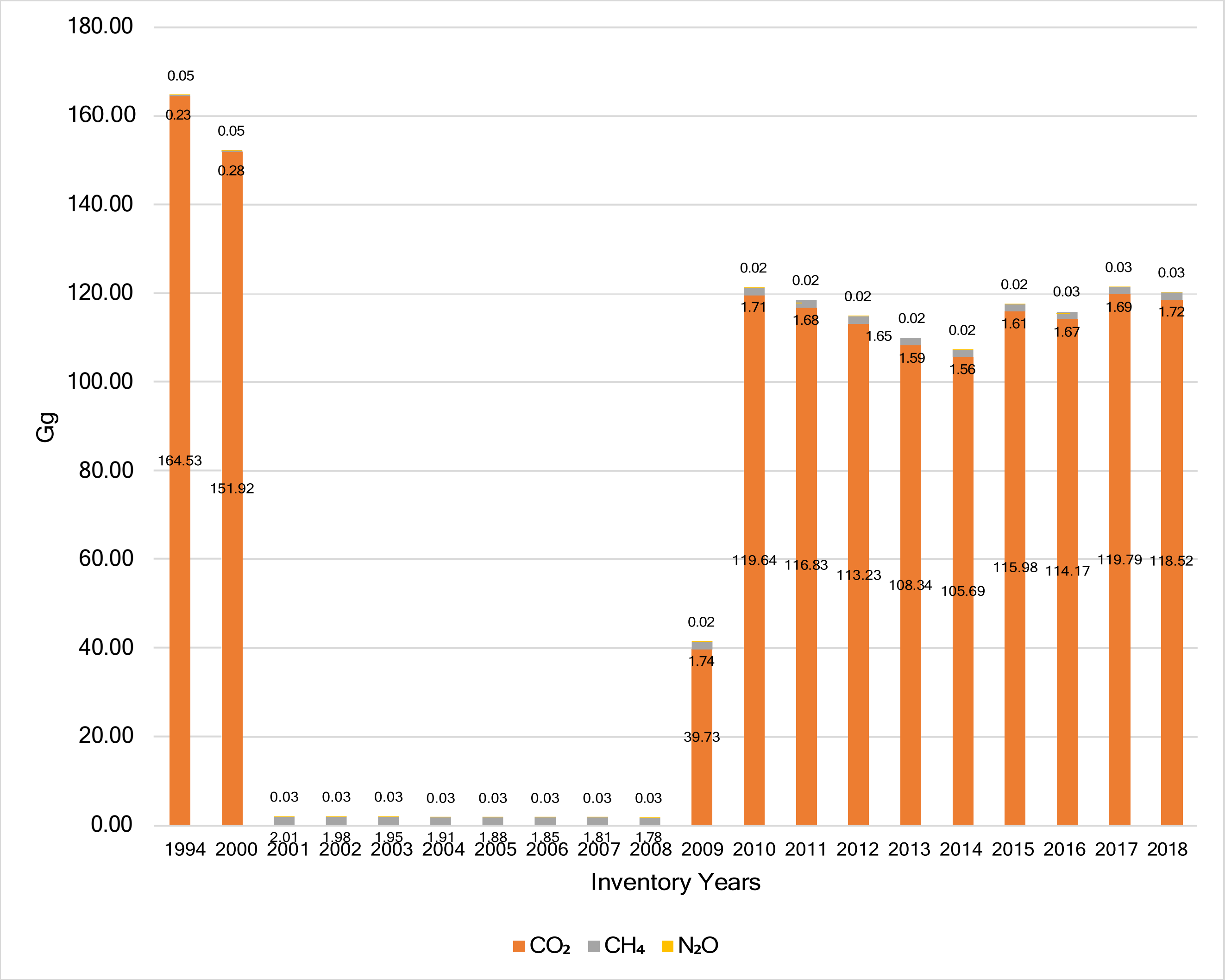


The Waste sector emissions in FSM reached to 27.24 Gg CO_2e from 14.50 Gg CO_2e in 1994. Waste sector emissions. The waste sector emissions show a decreasing trend during the inventory years 2001 to 2018. This is mainly due to decrease in the reported population of the country between years 2000 to 2010 and some of the waste disposal sites were rehabilitated and upgraded to semi-aerobic type from anaerobic.

Gas-wise Emission Trend: 1994-2018

This section presents the Gas wise emission trend in FSM during 1994 to 2018. The CO_2 emissions is mainly due to fuel combustion activities. Whilst, CH_4 and N_2O emissions are contributed from Agriculture sector (Livestock and Aggregate sources and non-CO_2 emissions sources on land) and Waste sector (Solid waste- MSW and Waste water treatment- Domestic).

Figure 14. FSM's Gas-wise emissions in Gg: 1994-2018



The CO_2 emissions trend analysis indicates that's the emission levels of CO_2 in FSM have decreased to 118.52 Gg to 164.53 Gg during the period 1994 to 2018, representing a decline of about 28% approximately. CH_4 emissions shows a significant increase of over 637% during the period 1994- 2018, increasing to 1.72 Gg in 2018 from 0.23 Gg in 1994. Whereas, the N_2O emission trend shows a decreasing trend, indicating a decrease of about 45%, reaching to 0.028 Gg in 2018 from 0.051 Gg in 1994.

3.4 GHG Emission Sector Analysis: 2001–2018

The following section present the analysis of FSM's key GHG emission sectors, i.e., Energy, AFOLU and Waste Sector for years 2001 to 2018.

Energy Sector

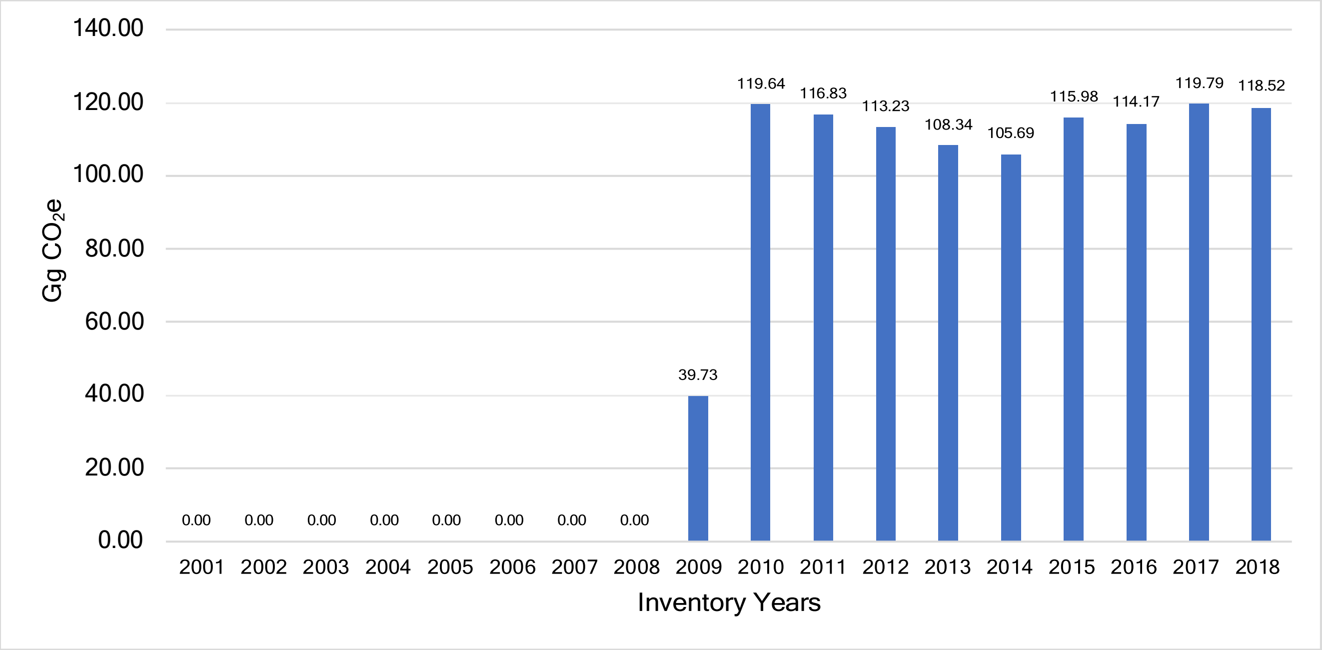
The Energy sector in FSM is the major emission contributing sector to the FSM's total GHG emissions. The energy sector in FSM is heavily dependent on imported of fossil fuel to sustain its economy and meeting its energy requirements. In 2008, Federated States of Micronesia (FSM) Petroleum Corporation (FSMPC), a government-owned enterprise, was established and took over from Mobil, the responsibility for fuel supply in all the states, i.e., Pohnpei, Kosrae, Yap and Chuuk. Bulk fuel supplies come directly from Guam and Singapore and are shipped directly into the 4 main sea ports by tanker and then is distributed through tankers in all the FSM states. There is limited information available on the category and sub-category wise (end) use of the imported fuels; further, no reliable data was available on imported quantity for the years 2001-2008. Hence, it was not feasible to estimate energy sector emissions using the sectoral approach. To this end, the energy sector emissions have been estimated using the IPCC reference approach for the years 2009 to 2018.

The estimated energy sector emissions for the inventory period using Reference approach have been presented in the following table and figure.

Table 10. FSM's Energy Sector GHG emissions Gg CO_2e: 2001-2018

Inventory Year: 2001-2018	Net CO_2 Emissions, (CO_2 Equivalents Gg)																	
Categories	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1 - Energy	NE								39.73	119.64	116.83	113.23	108.34	105.69	115.98	114.17	119.79	118.52
% Share in total GHG emissions	-	-	-	-	-	-	-	-	42%	69%	69%	69%	68%	68%	69%	68%	69%	68%

Figure 15. FSM's Energy Sector GHG emissions Gg: 2001-2018



The energy sector accounted for 118.52 Gg CO_2e in 2018, contributing about 68% of the total GHG emissions in the country. The emission level increases from 39.73 Gg CO_2e in 2009 to 119.64 Gg CO_2e in 2010 and decreases thereafter until 2014. The decrease in emission level during the period 2010 to 2014 is mainly attributed to slower economic growth during these years. Emission level increases year from 2015 onwards followed by a marginal dip in 2016. The quantity of diesel fuel imported in to the country has increased marginally over the years. This is attributed due to the increase in renewable energy for electricity generation. Gasoline and Jet kerosene imports has increase significantly during the inventory period. Following table and figure presents a summary of total fuel imported in to the country during the inventory year 2001-2018.

Figure 16. FSM's Fuel Import ('000 US Gallons): 2009-2018

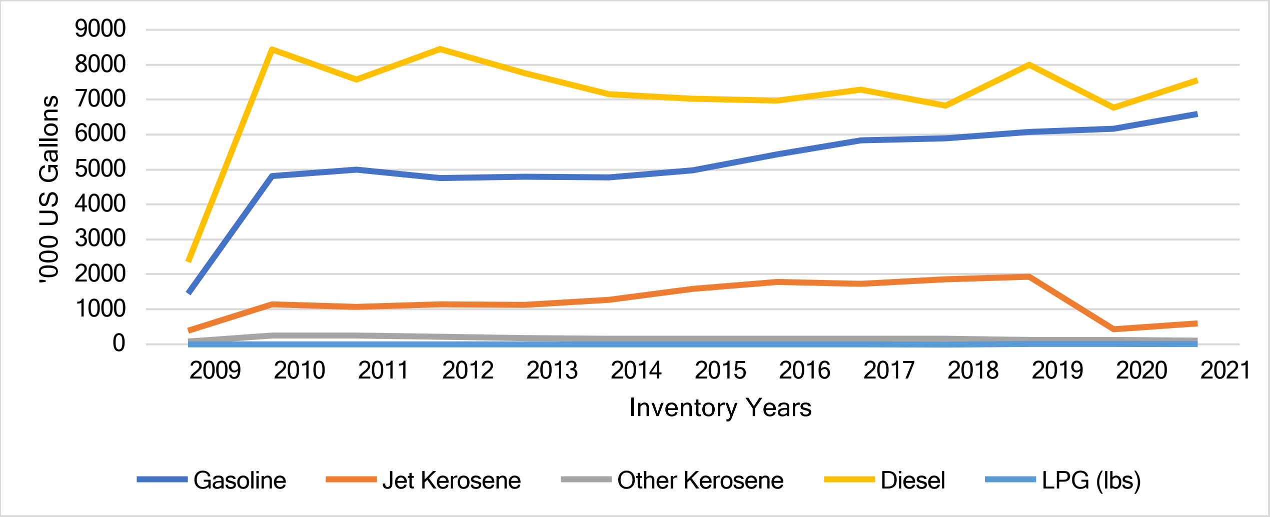


Table 11. FSM's total fuel import quantity: 2009-2018

Year	Gasoline	Jet Kerosene	Other Kerosene	Diesel	LPG
	US Gallons	US Gallons	US Gallons	US Gallons	lbs
2009	1441755	389088	77963	2348861	0
2010	4802498	1152900	248305	8436518	0
2011	4991095	1064988	242687	7570898	0
2012	4757476	1140690	205745	8445833	0
2013	4793000	1134100	176808	7760033	0
2014	4775736	1278479	161968	7150328	0
2015	4967209	1593628	151208	7023881	0
2016	5428907	1792873	150467	6966299	0
2017	5831519	1726207	155290	7285021	0
2018	5886967	1853876	150482	6824830	93
2019	6073106	1932976	129320	7989110	2969
2020	6162546	431384	118561	6762201	5977
2021	6588128	594702	108518	7561368	7209

Industrial Processes and Product Use (IPPU)

The GHG emissions occurring from industrial processes, from the use of greenhouse gases in products, and from non-energy uses of fossil fuel carbon are estimated under this sector. In FSM, there were no heavy industry and neither the country exported any products in large quantities during the inventory period 2001-2018. However, emissions from industrial processes mainly 'Lime production' takes place in FSM but due to lack of data the emissions levels from this source category are not estimated. Further, this sector also comprises emissions from solvent and other product use containing volatile compounds, primarily Non-Methane Volatile Organic Compounds (NMVOC). In FSM, there were some food Industries like breadmaking and other food production process (e.g., meat, fish and non-alcoholic beverages) at the time of inventory period. Food Industries are source of NMVOC emissions, but lack of data on quantity of production of these food item and beverages it was not possible to estimate NMVOC emissions from this source category for this inventory period. FSM also imports small quantities of products like solvents, fire extinguishers, refrigerants and ODS but due lack of data on quantity of products imported in to the country the GHG emissions from this source are also not estimated for this inventory period.

Agriculture, Forestry, and Other Land Use (AFOLU)

Agriculture in FSM is carried out at subsistence level and it is a major source of methane emissions, after Waste sector in FSM. Emissions the Forestry and Other Land Use have not been estimated in this inventory. The emissions from the following sub-sectors and categories are estimated under this inventory.

- Livestock

- Enteric Fermentation
- Manure Management

- Aggregate sources and non-CO_2 emissions sources on land

Methane emissions due to livestock farming have significance in FSM. While, N_2O emissions from manure management systems are not occurring in FSM since most of the livestock are free ranging and no commercial livestock operations utilize the manure in such manner. The Livestock population data used for estimating GHG emissions for the inventory period 2001-2018 is estimated based on the Federated States of Micronesia 2013-14 HIES report[88] and FSM Integrated Agriculture Census 2016.[89] The data for the missing years have been estimated using Extrapolation and interpolation techniques in accordance with the IPCC good practice guidance (GPG). Rice cultivation and liming is not practiced in the country which disregards it as a source of emissions. The emissions from field burning of agricultural residues, use of urea and other synthetic fertilizers have not been estimated for the inventory period 2001-2018 due to lack of data. Direct and Indirect N_2O emissions have been estimated and are mainly attributed due to deposit of urine and manure on pasture, range and paddock by grazing animals.

The emissions from agriculture sector in FSM is the third largest contributor and account for average about 24% of FSM's total GHG emissions for the years 2001-2018. As can be seen from the following table and figure, the GHG emissions from agriculture sector have declined during the inventory period. This decrease is mainly attributed due to the decline in livestock population. Agriculture sector emissions (excluding removals) reached to 28.43 Gg in 2018 from 35.12 Gg CO_2e in 2001, representing a decrease in emissions of about 19% approximately.

[88] Federated States of Micronesia 2013-14 HIES report, https://sdd.spc.int/digital_library/federated-states-micronesia-2013-14-hies-report.
[89] FSM Integrated Agriculture Census 2016, https://www.spc.int/DigitalLibrary/Doc/SDD/Census/FM/FSM_2016_IAC_200120.pdf.

Table 12. FSM's AFOLU Sector GHG Emission in Gg CO_2e (excluding Removal): 2001-2018

Inventory Year: 2001-2018	Net CO_2 Emissions, (CO_2 Equivalents Gg)																	
Categories	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
3 - Agriculture, Forestry, Other Land Use	35.12	34.08	33.04	32.01	30.97	29.93	28.89	27.85	26.82	25.78	24.74	23.70	22.66	22.11	24.20	26.29	27.10	28.43
3.A - Livestock	28.42	27.58	26.74	25.90	25.06	24.22	23.38	22.54	21.70	20.86	20.02	19.18	18.34	17.54	19.26	20.97	21.40	22.35
3.A.1 - Enteric Fermentation	1.14	1.10	1.07	1.04	1.00	0.97	0.94	0.90	0.87	0.83	0.80	0.77	0.73	0.70	0.77	0.84	0.85	0.89
3.A.2 - Manure Management	27.28	26.48	25.67	24.86	24.06	23.25	22.44	21.64	20.83	20.03	19.22	18.41	17.61	16.84	18.49	20.13	20.55	21.46
3.C - Aggregate sources and non-CO_2 emissions sources on land	6.70	6.50	6.30	6.11	5.91	5.71	5.51	5.31	5.12	4.92	4.72	4.52	4.32	4.56	4.94	5.32	5.70	6.08
3.C.4 - Direct N_2O Emissions from managed soils	4.60	4.46	4.33	4.19	4.05	3.92	3.78	3.65	3.51	3.38	3.24	3.10	2.97	3.19	3.45	3.70	3.96	4.22
3.C.5 - Indirect N_2O Emissions from managed soils	0.98	0.95	0.92	0.89	0.86	0.83	0.80	0.78	0.75	0.72	0.69	0.66	0.63	0.68	0.73	0.79	0.84	0.90
3.C.6 - Indirect N_2O Emissions from manure management	1.12	1.09	1.06	1.02	0.99	0.96	0.92	0.89	0.86	0.83	0.79	0.76	0.73	0.69	0.76	0.83	0.90	0.96
AFOLU Sector Total (excluding removals)	35.12	34.08	33.04	32.01	30.97	29.93	28.89	27.85	26.82	25.78	24.74	23.70	22.66	22.11	24.20	26.29	27.10	28.43

Figure 17. FSM's AFOLU Sector GHG Emission in Gg CO_2e (excluding Removal): 2001-2018

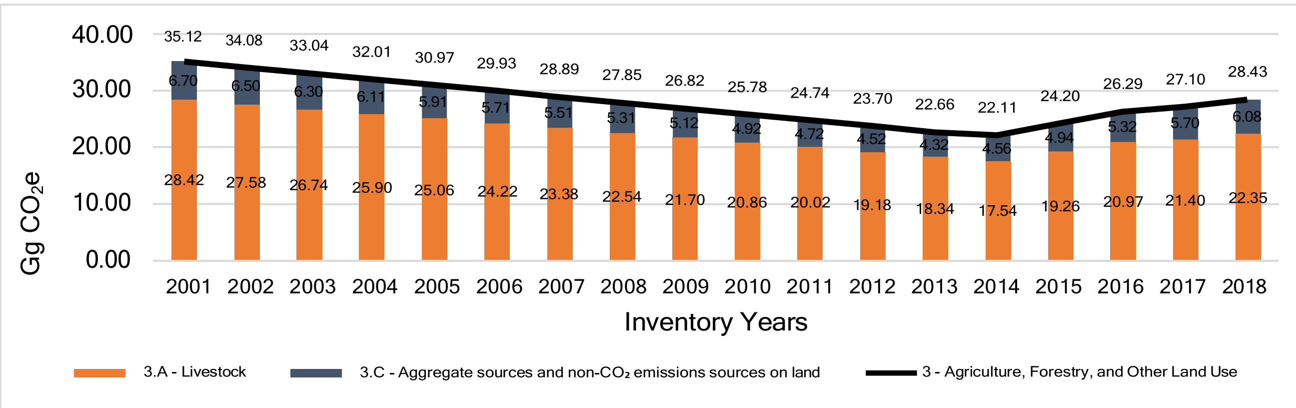
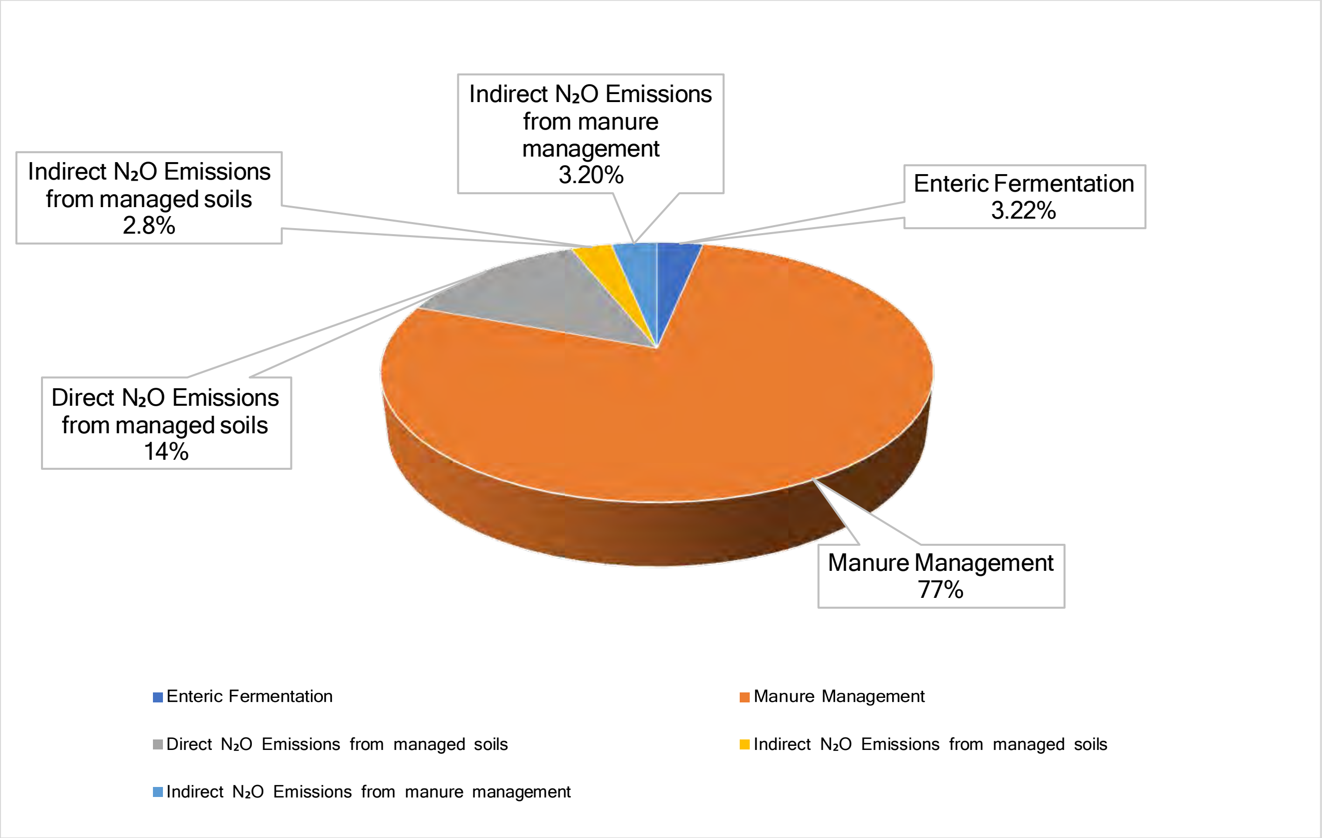


Figure 18. FSM's AFOLU Sector GHG Emission Share (excluding Removal): 2001-2018



Major share of GHG emissions in FSM's agriculture sector comes from Livestock farming, mainly manure management (77%) and Enteric fermentation (3%). While, the rest comes from Direct N_2O emissions from managed soil (14%) and Indirect N_2O emissions from managed soils and manure management (2.8% and 3.2% respectively). The sub-sector analysis in the subsequent sections entails detailed discussion on these GHG emission contributing sub-sectors and categories.

Livestock

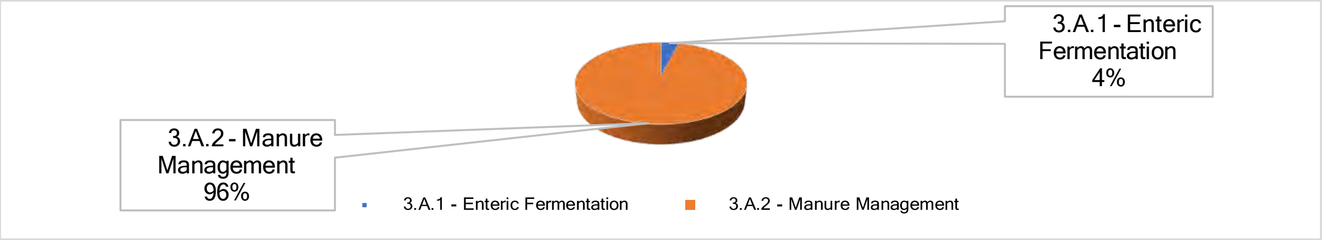
Livestock farming is an important throughout FSM, particularly for subsistence and cultural use.[90] About 61% of the household possessed some form of livestock in 2016 (mainly poultry or pigs). Poultry and Pigs are generally raised in FSM. Pigs are nearly raised by every family for ceremonial and cultural purposes, such as weddings, funerals and feasts for celebration. However, FSM's livestock population has been declining year on year. There is very limited data available on total livestock population and livestock farming practices in FSM. The data used for the inventory period 2001-2018 have been estimated based on the Integrated Agriculture census 2016 and Household Income and Expenditure Survey Report 2013-2014.[91] The following table presents the livestock population data used for estimating GHG emissions from Livestock sub-sector.

[90] Federated States of Micronesia Integrated Agriculture Census 2016, https://fsm-data.sprep.org/dataset/federated-states-micronesia-integrated-agriculture-census.
[91] Federated States of Micronesia 2013-14 HIES report, https://sdd.spc.int/digital_library/federated-states-micronesia-2013-14-hies-report.

Table 13. Livestock Population in FSM: 2001-2018

Year	Pigs	Chicken
2001	40600	-
2002	39400	-
2003	38200	-
2004	37000	-
2005	35800	-
2006	34600	-
2007	33400	-
2008	32200	-
2009	31000	-
2010	29800	-
2011	28600	-
2012	27400	-
2013	26200	-
2014	25000	79900
2015	27450	75350
2016	29900	70800
2017	30525	66250
2018	31880	61700

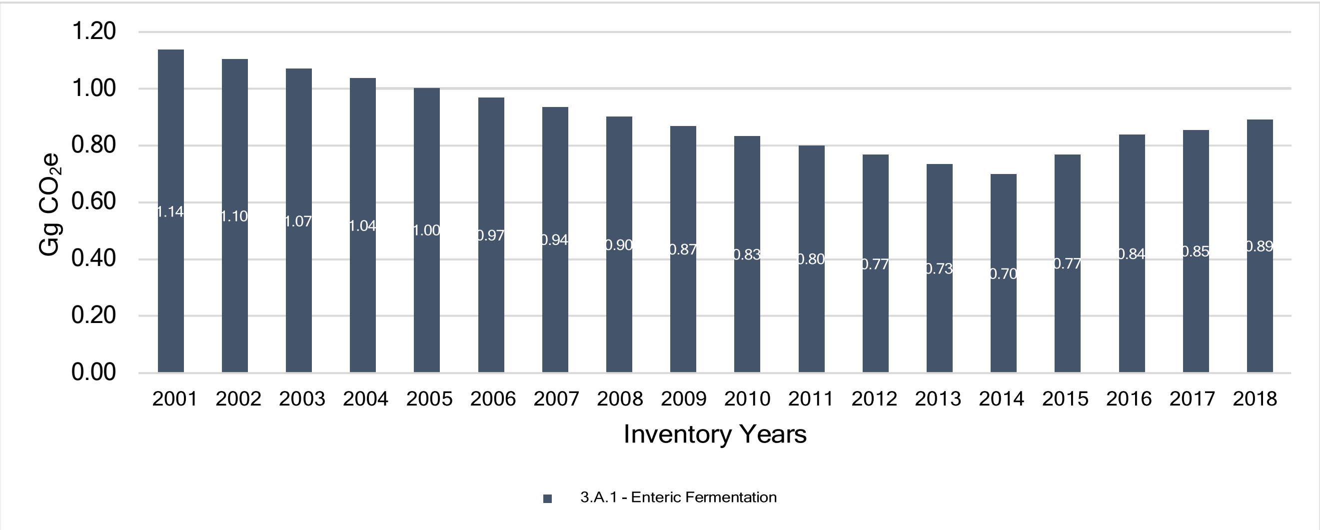
Figure 19. FSM's Livestock sub-sector GHG Emission Share (excluding Removal): 2001-2018



Enteric Fermentation

Methane is produced in herbivorous animals as a by-product of enteric fermentation, a digestive process by which carbohydrates are broken down by micro-organisms into simple molecules for absorption into the bloodstream. Ruminant livestock (e.g., cattle, goat, sheep) are major sources of methane and moderate amounts produced from non-ruminant livestock (e.g., pigs, horses). This methane when released adds to GHG emission in the atmosphere. Enteric fermentation contributes to about 4% of the GHG emissions from Livestock sub-sector. The GHG emissions contributions from Enteric Fermentation declined from 1.14 Gg CO_2e in 2001 to 0.89 Gg CO_2e in 2018.

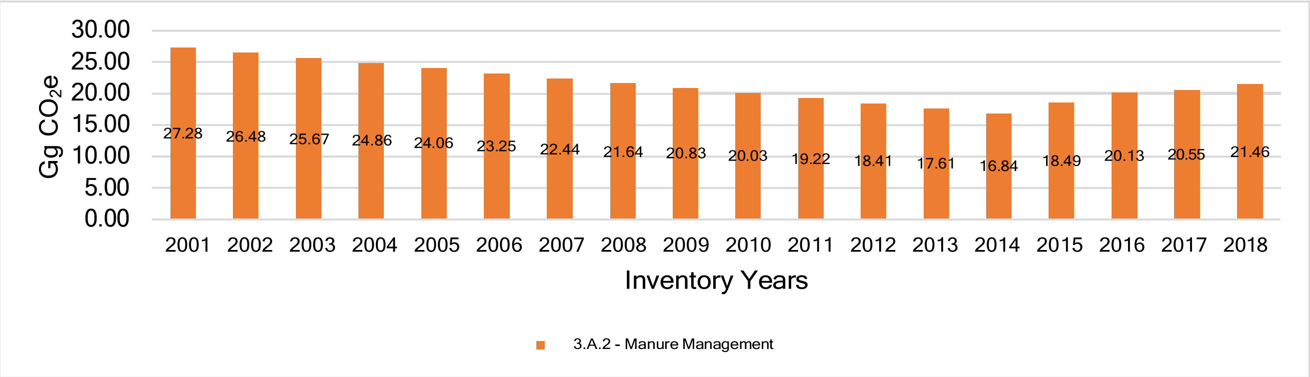
Figure 20. GHG emissions from Enteric Fermentation in Gg CO_2e: 2001-2018



Manure Management

Manure management contributes to about 96% of the GHG emissions from Livestock sub-sector in FSM. GHG emissions contributions from Manure management has reduced from 27.28 Gg CO_2e in 2001 to 21.46 Gg CO_2e in 2018. This represents a decrease in emission contributions of about 21% during the inventory years 2001-2018. This can be further reduced if modern/ scientific manure management systems are introduced in to the country.

Figure 21. GHG emissions from Manure Management in Gg CO_2e: 2001-2018



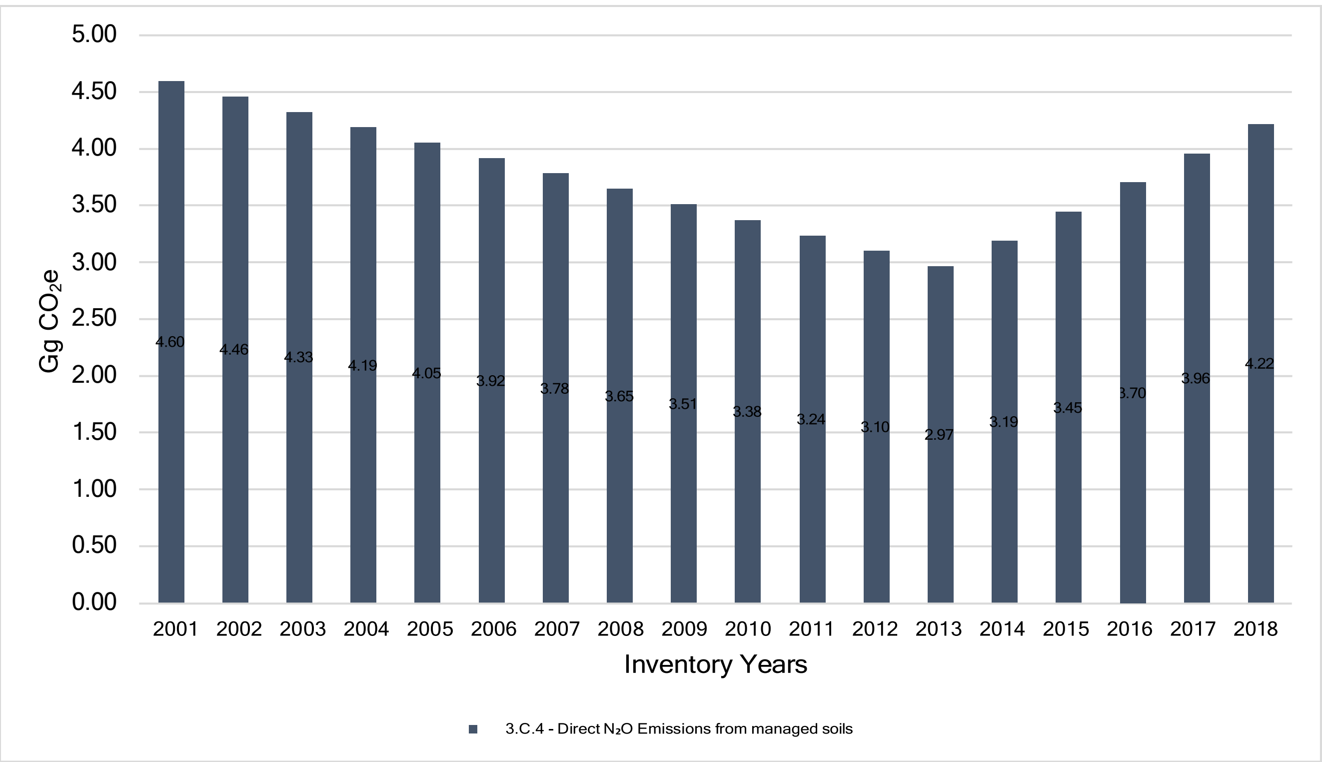
Aggregate Sources and Non-CO_2 Emissions Sources on Land

The N_2O emissions from soils mainly occurs from two pathways- direct and indirect. Direct N_2O emissions to estimated using net N additions to soils (synthetic or organic fertilizers, deposited manure, crop residues, etc.) and mineralization of N in soil due to cultivation/land-use change on mineral soils. Indirect N_2O emissions occurs from two pathways. The first of these pathways is through the volatilization of N as NH_3 and oxides of N (NOx), and the deposition of these gases and their products NH_4^+ and NO_3^- onto soils and the surface of lakes and other waters. The second pathway is the leaching and runoff from land of N from synthetic and organic fertilizer additions, crop residues, mineralization of N associated with loss of soil C in mineral and drained/managed organic soils through land-use change or management practices, and urine and dung deposition from grazing animals. Due to limited data availability on usage of fertilizers in FSM, only emissions from animal manure are taken into account. This sub-sector contributes about 20% of the total GHG emissions from AFOLU sector.

Direct N_2O Emissions from managed soils

The Direct N_2O emissions from managed soils occurring due to urine and dung N deposited on pasture, range and paddock by grazing animals (F_{PRP}) have been estimated for the inventory years 2001-2018. The emissions from this category reached to 4.22 Gg CO_2e in 2018 decreasing from 4.60 Gg CO_2e in 2001.

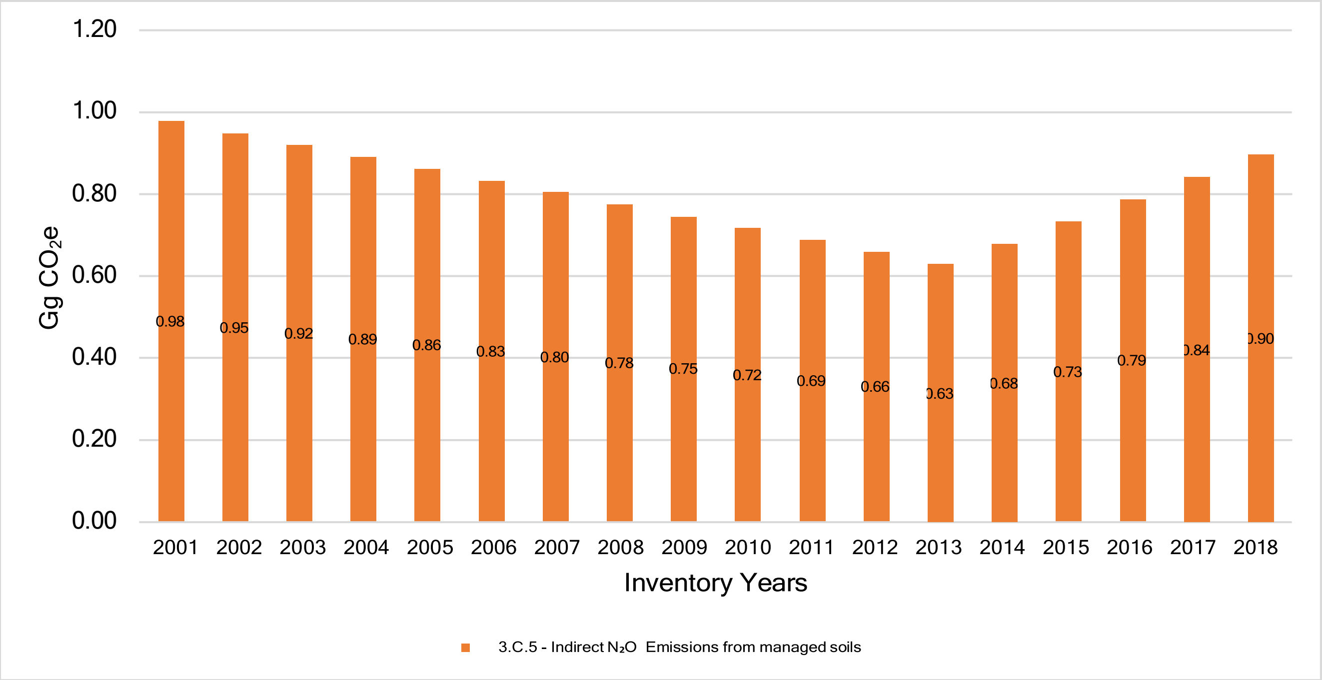
Figure 22. GHG emissions from Direct N_2O Emissions from managed soils in Gg CO_2e: 2001-2018



Indirect N_2O Emissions from Managed Soils

Under this category emissions due to the volatilization of N as NH_3 and oxides of N (NOx), and the deposition of these gases and their products NH_4^+ and NO_3^- onto soils and the surface of lakes and other waters are estimated. The GHG emissions from this category decreased to 0.90 Gg CO_2e in 2018 from 0.98 Gg CO_2e in 2001.

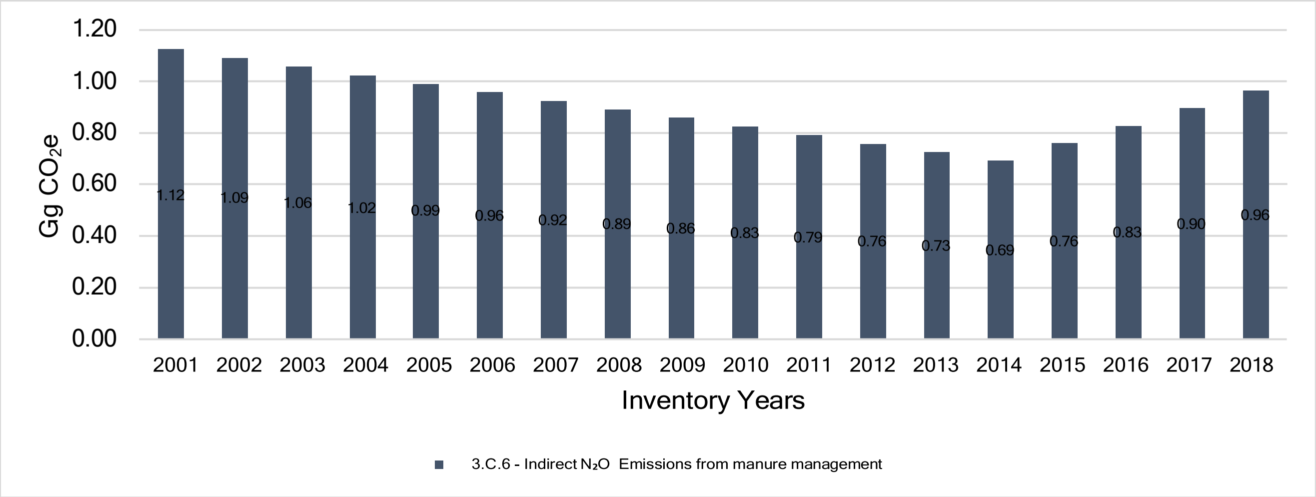
Figure 23. GHG emissions from Indirect N_2O Emissions from managed soils in Gg CO_2e: 2001-2018



Indirect N_2O Emissions from Manure Management

Under this category indirect N_2O emissions from manure management occurring through NH_3 volatilization and leaching of N during storage and handling of animal manure are estimated. The GHG emissions from this category decreased from 0.96 Gg CO_2e in 2018 from 1.12 Gg CO_2e in 2001.

Figure 24. GHG emissions from Indirect N_2O Emissions from Manure Management in Gg CO_2e: 2001-2018



Waste Sector

The waste sector includes mainly Solid waste and Wastewater and mainly responsible for emission of Methane and Nitrous oxide from the following two categories:

- Solid Waste Management and Disposal
- Domestic and Commercial Wastewater Discharge

Figure 25. FSM's Waste sector Emissions in Gg CO_2e: 2001-2018

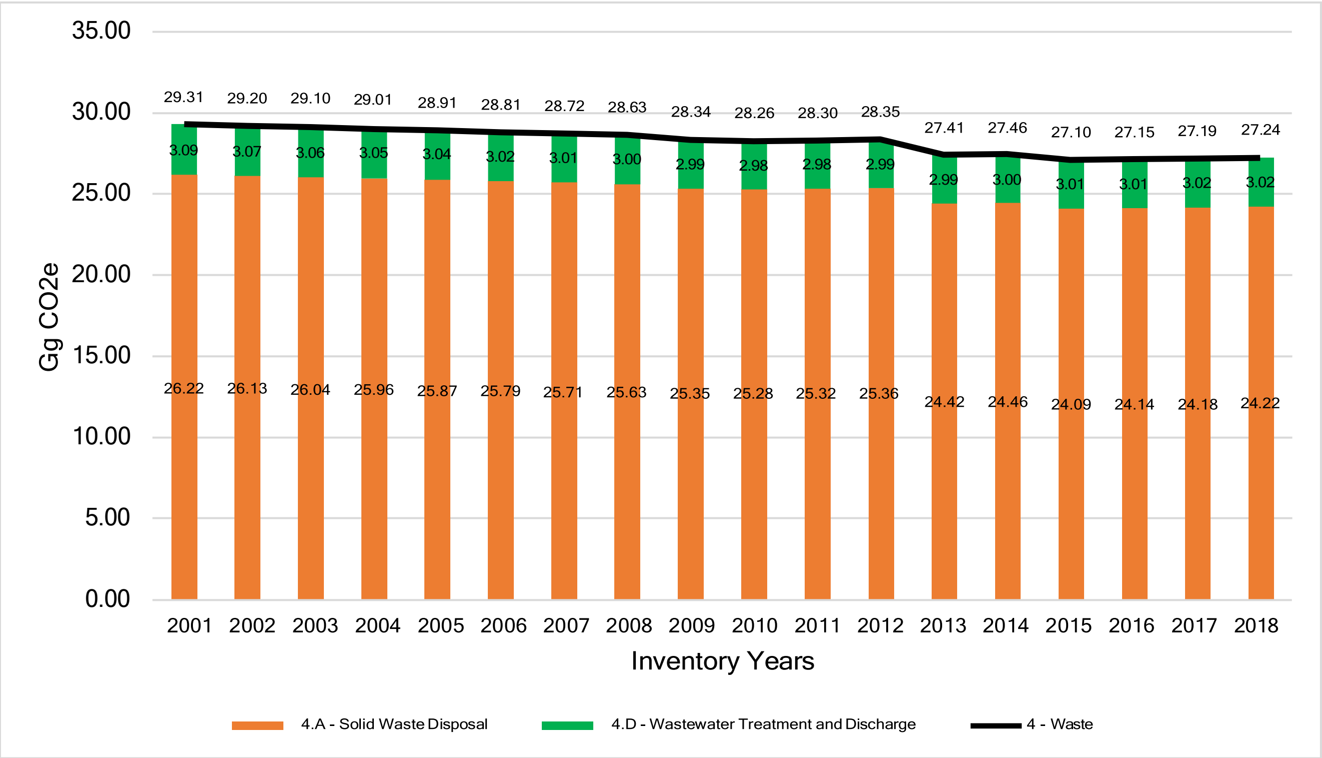


Table 14. FSM's Waste sector Emissions in Gg CO_2e: 2001-2018

Inventory Year: 2001-2018	Net CO_2 Emissions, (CO_2 Equivalents Gg)																	
Categories	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
4 - Waste	29.31	29.20	29.10	29.01	28.91	28.81	28.72	28.63	28.34	28.26	28.30	28.35	27.41	27.46	27.10	27.15	27.19	27.24
4.A - Solid Waste Disposal	26.22	26.13	26.04	25.96	25.87	25.79	25.71	25.63	25.35	25.28	25.32	25.36	24.42	24.46	24.09	24.14	24.18	24.22
4.D - Wastewater Treatment and Discharge	3.09	3.07	3.06	3.05	3.04	3.02	3.01	3.00	2.99	2.98	2.98	2.99	2.99	3.00	3.01	3.01	3.02	3.02

Table 15. Waste Sector GHG Emissions (Gg): 2001-2018

	Units	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total CH_4 emissions (MSW)	(Gg)	0.936	0.933	0.930	0.927	0.924	0.921	0.918	0.915	0.905	0.903	0.904	0.906	0.872	0.874	0.861	0.862	0.864	0.865
Total CH_4 emissions (WW)	(Gg)	0.061	0.061	0.061	0.061	0.060	0.060	0.060	0.060	0.059	0.059	0.059	0.059	0.059	0.060	0.060	0.060	0.060	0.060
Total CH_4 emissions (Waste Sector)	(Gg)	0.998	0.994	0.991	0.988	0.984	0.981	0.978	0.975	0.965	0.962	0.964	0.965	0.932	0.933	0.920	0.922	0.923	0.925
Total N_2O emissions	(Gg)	0.005175	0.005154	0.005132	0.005112	0.005091	0.005071	0.005052	0.005032	0.005013	0.004995	0.005003	0.005012	0.005021	0.005029	0.005038	0.005047	0.005056	0.005065
CO_2e	(Gg)	29.31	29.20	29.10	29.01	28.91	28.81	28.72	28.63	28.34	28.26	28.30	28.35	27.41	27.46	27.10	27.15	27.19	27.24

Figure 26. Waste Sector Emissions Gg CH_4 and N_2O: 2001–2018

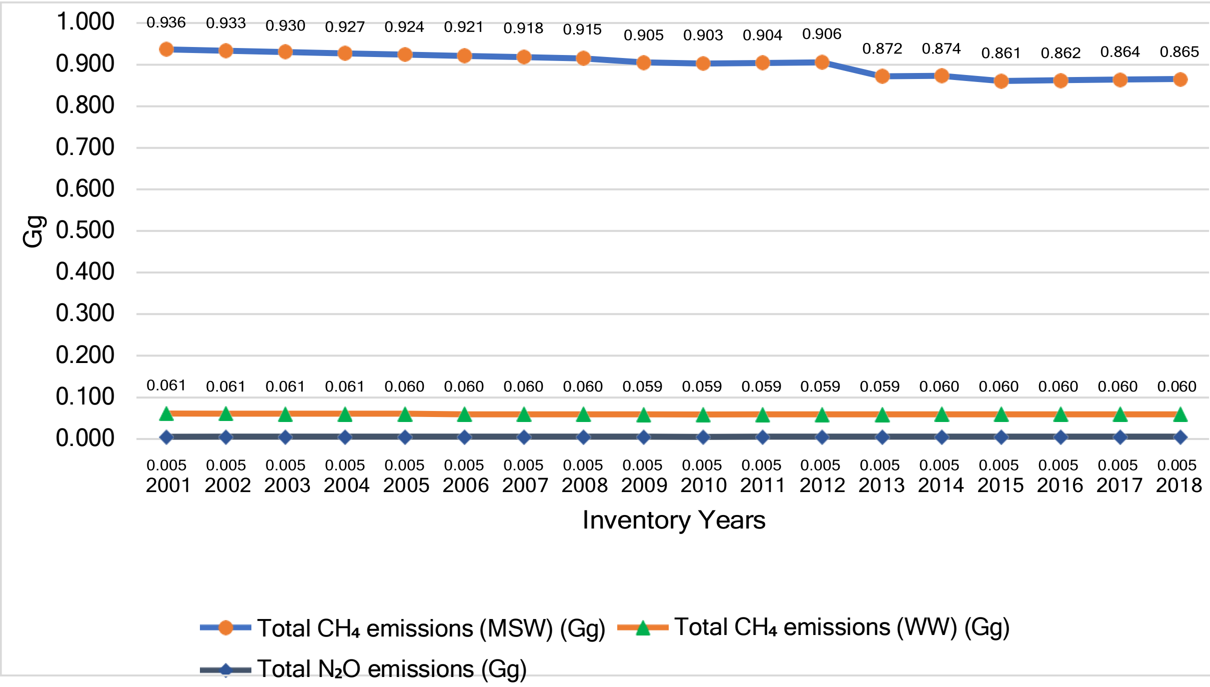


Figure 27. Waste Sector Emissions Gg CH_4: 2001–2018

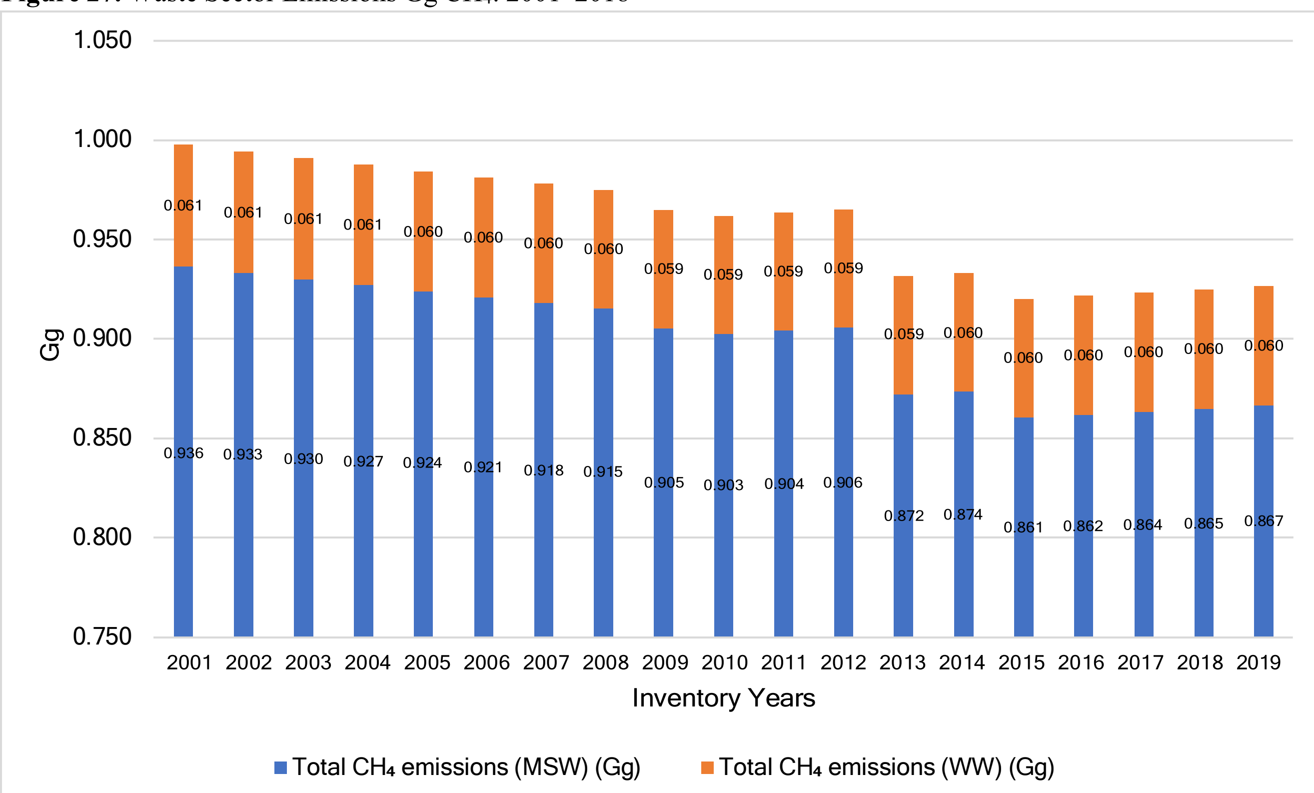


Figure 28. Waste Sector Emissions Gg N_2O: 2001-2018

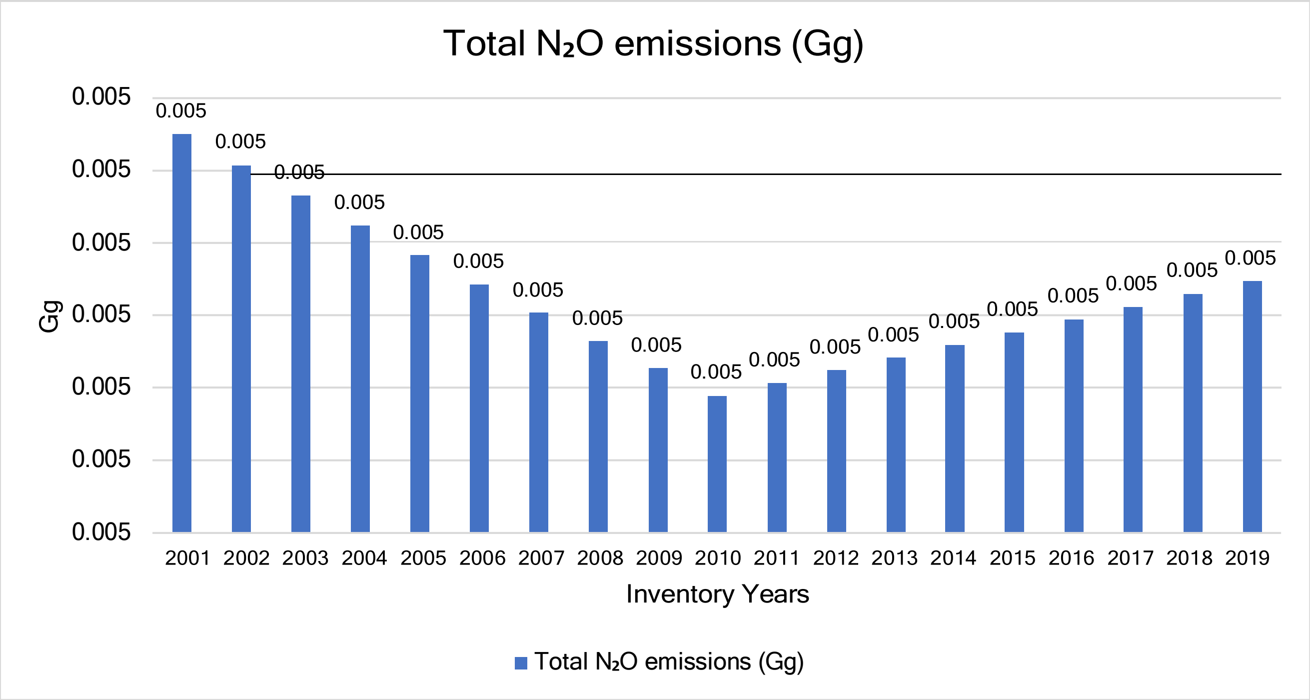


Table 16. Waste Sector Emissions Gg N_2O: 2001-2018

Years	Total N_2O emissions (Gg)
2001	0.005175
2002	0.005154
2003	0.005132
2004	0.005112
2005	0.005091
2006	0.005071
2007	0.005052
2008	0.005032
2009	0.005013
2010	0.004995
2011	0.005003
2012	0.005012
2013	0.005021
2014	0.005029
2015	0.005038
2016	0.005047
2017	0.005056
2018	0.005065

GHG emissions from Solid waste disposal and Wastewater treatment and discharge are discussed in more detail in the subsequent sections for the inventory years 2001-2018. It is to be noted that the biological waste treatment and incineration of solid waste are not considered under this inventory.

Solid Waste Disposal - Municipal Solid Waste (MSW)

The key source of methane emissions from solid waste management and disposal includes emissions from anaerobic decomposition of waste disposed at the various landfills and open dump sites in all the states, i.e., Yap, Chuuk, Pohnpei, and Kosrae. Solid waste disposal is one of the major concerns for FSM and constitutes about 21.8% of total GHG emissions from the country and 89% of total GHG emission from waste sector. In FSM the methods of waste disposal vary from state to state and ranges from open dumps to semi-aerobic Fukuoka Landfill. The main waste disposal facilities in each state are shown in the following table.

Table 17. Information on landfill sites and open dumps in all states: 2001-2018

Information on Landfill sites and open dumps	
Yap State	Yap main public landfill, Colonia area: converted to Semi-aerobic and Operational since 2015 Major community dump sites: (i) Fanif municipality Rumuu village (ii) Tomil municipality Dechmur village (iii) Gagil municipality Makiy village (iv) Gagil municipality Gachpar village (v) Gagil municipality Wanyan village.
Chuuk State	No dedicated landfill site until 2016. Marina Interim Dump site (MID) started operation from 2016 January
Pohnpei State	Dekehtik landfill site started operation in 1997 and converted to Semi-aerobic in 2013.
Kosrae State	Tofol Landfill site (Semi-aerobic type): Landfilling commenced in 2009. Open dumpsites exist in other municipalities with states. However, their names and location are not available.

Land acquisition and cost-effective waste collection and transportation services has been and continues to remain a major challenge. The government of FSM with support and assistance from Japan International Cooperation Agency (JICA) is continuously making efforts to improve the solid waste management situation in the country.

The GHG emissions have been calculated as per the Tier 1 method: Based on the IPCC First Order Decomposition (FOD) method, using mainly default activity data and default parameters. In the absence of actual monitored data, the MSW generation in FSM is estimated from the total population in each state, i.e., Yap, Chuuk, Pohnpei, Kosrae and using average waste generation rate of 0.5-0.9 kg/person/day. The waste composition was taken from the States Solid Waste Management Strategy reports of each state. The MSW generation and waste composition considered for the inventory calculation is provided in following table and figure.

Table 18. Solid Waste (MSW) Generation in FSM (Ton): 2001-2018

Years	Population				Total Population	Total Solid Waste (MSW) gene-rated-Ton	Total Waste disposed at managed sites (landfill) -Ton	Total Waste disposed at un-managed sites (landfill, open dumping) - Ton	Total No. of landfill	Total No. Uncontrolled waste dumps
	Yap	Chuuk	Pohnpei	Kosrae						
2001	11255	53079	34653	7572	106559	26236	0	26236	1	7
2002	11269	52568	34821	7459	106117	26145	0	26145	1	7
2003	11283	52062	34990	7348	105683	26057	0	26057	1	7
2004	11297	51561	35160	7239	105257	25970	0	25970	1	7
2005	11311	51065	35331	7131	104838	25884	0	25884	1	7
2006	11325	50573	35502	7025	104425	25801	0	25801	1	7
2007	11339	50086	35674	6920	104019	25719	0	25719	1	7
2008	11353	49604	35847	6817	103621	25638	0	25638	1	7
2009	11367	49127	36021	6716	103231	25560	0	25560	2	7
2010	11377	48654	36196	6616	102843	25482	0	25482	2	7
2011	11397	48739	36259	6628	103023	25526	0	25526	2	7
2012	11417	48824	36322	6639	103202	25571	0	25571	2	7
2013	11437	48909	36386	6651	103383	25616	0	25616	3	7
2014	11457	48994	36449	6662	103562	25660	0	25660	3	7
2015	11477	49080	36513	6674	103744	25705	0	25705	3	7
2016	11497	49165	36576	6686	103924	25750	0	25750	4	6
2017	11517	49251	36640	6697	104105	25794	0	25794	4	6
2018	11537	49337	36704	6709	104287	25839	0	25839	4	6

Years	Population				Total Population	Total Solid Waste (MSW) gene-rated-Ton	Total Waste disposed at managed sites (landfill) -Ton	Total Waste disposed at un-managed sites (landfill, open dumping) - Ton	Total No. of landfill	Total No. Uncontrolled waste dumps
MSW Generation rate (Kg/capita/day)	0.834	0.582	0.743	0.773						

Figure 29. MSW Characterization (wt%) – Yap State

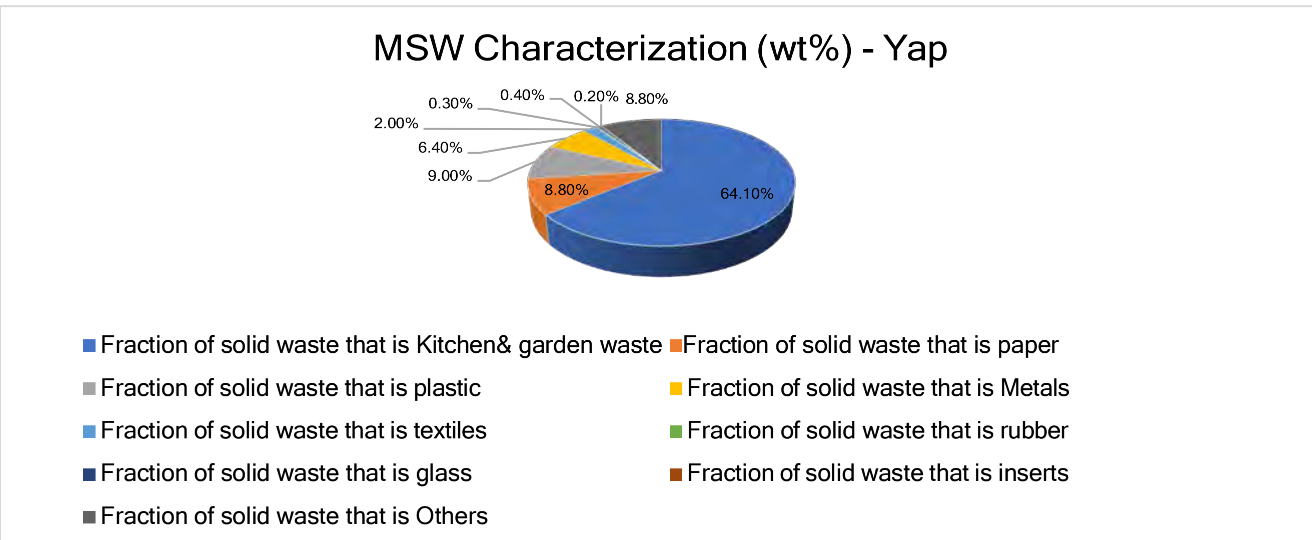


Figure 30. MSW Characterization (wt%) – Chuuk State

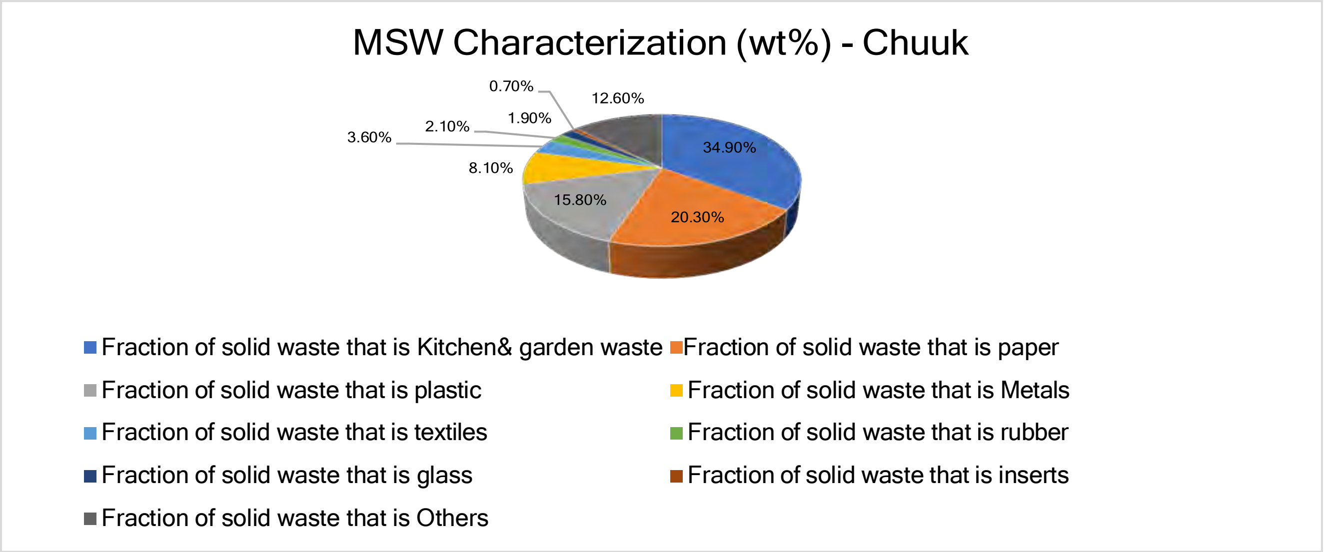


Figure 31. MSW Characterization (wt%) – Pohnpei State

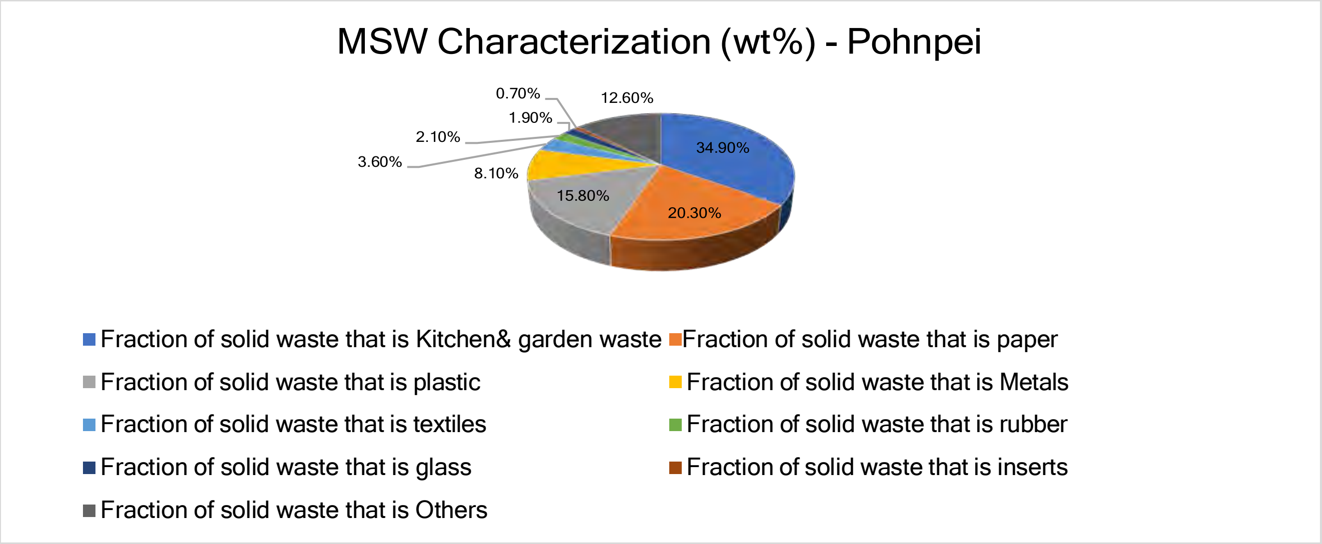


Figure 32. MSW Characterization (wt%) – Kosrae State

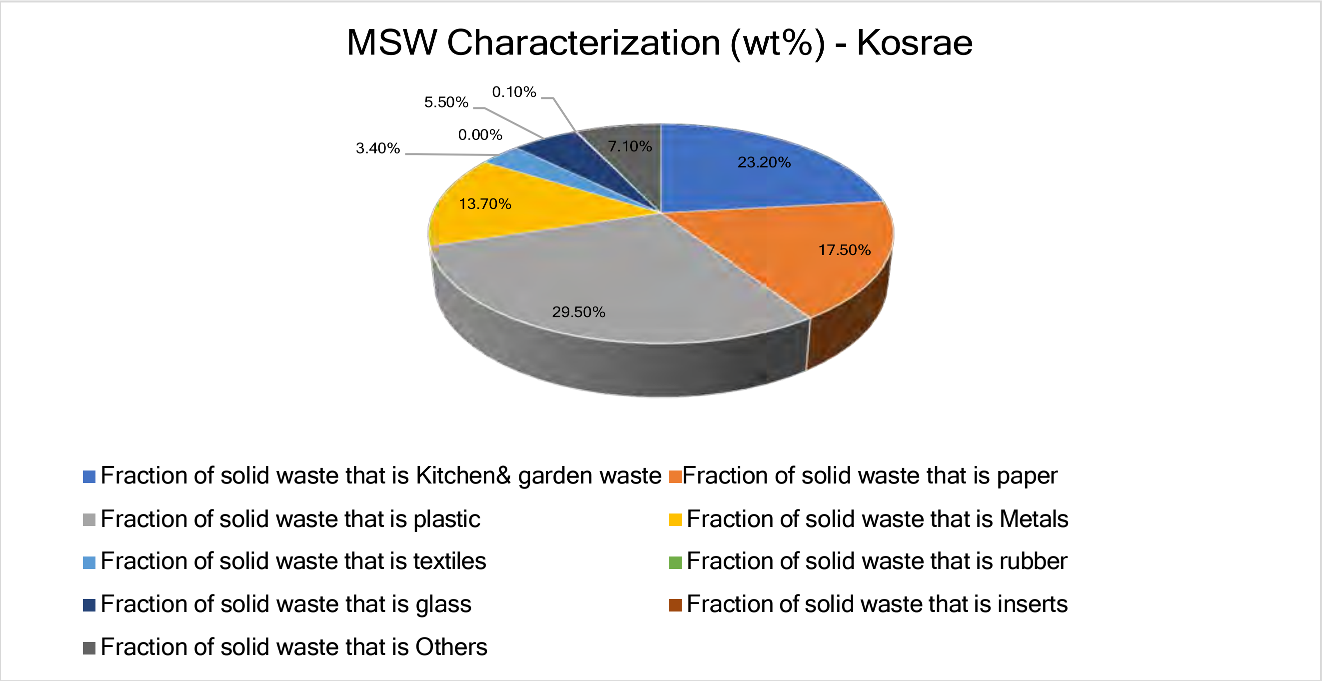
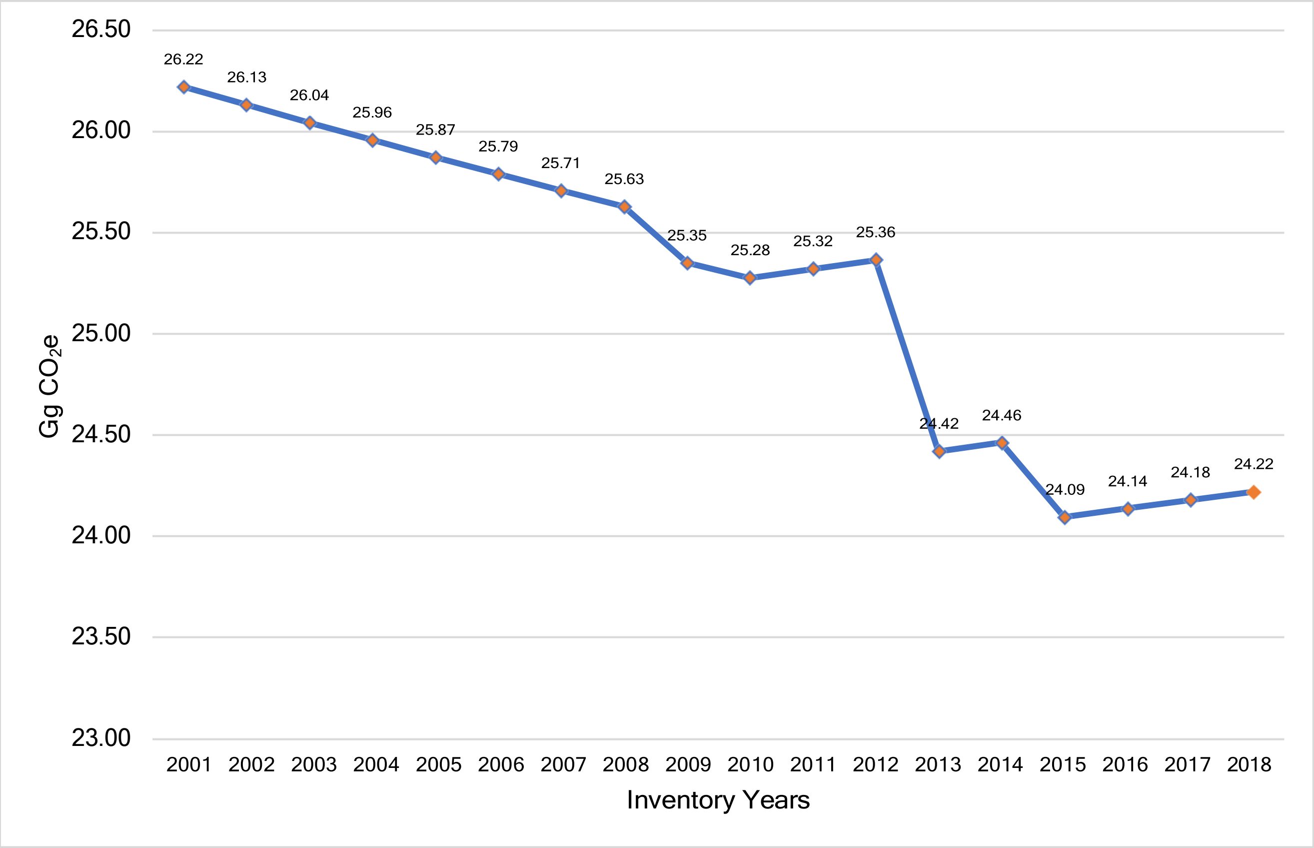


Figure 33. GHG emissions from Solid Waste Disposal- MSW: 2001-2018



The GHG emissions from this sub-sector has decreased over the inventory period, reduced to 24.22 Gg CO_2e in 2018 from 26.22 Gg CO_2e in 2001. This decrease is mainly attributed to decreasing population, rehabilitation and upgrading of the several landfills from unmanaged to semi-aerobic site.

Wastewater Treatment and Discharge

Wastewater treatment and Sanitation system is a major concern in the FSM. A large proportion of households in the country still have limited access to public sanitation services and use pit latrines, septic tanks or other unhygienic excreta disposal systems. Access to the public sanitation services provided and managed by the different departments of state governments are confined only to urban areas and to very small population. This allows the discharge of waste water in nearby waterbodies and sea.

The GHG emissions contribution from the wastewater treatment and discharge subsector is about 2.6% of the total GHG emissions of the country and about 11% of total GHG emissions from waste sector. The GHG emissions from this sector includes Methane and Nitrous oxide emissions. The quantity of wastewater generated and IPCC default parameter for Oceania region have been used for estimating GHG emissions due to lack of monitored data. The Tier1 method has been applied to estimate GHG emissions form the sub-sector, that uses the default values for the emission factor and activity parameters and is considered good practice for countries with limited data. The following table presents the parameters used for estimation of GHG emissions from this sub-sector.

The Wastewater emissions, i.e., CH_4 and N_2O estimated using the IPCC methodology and default value for Oceania region are presented in the following table:

Table 19. Parameter used for estimating GHG emissions from Wastewater treatment and discharge

Parameter	Units	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Population	#	106559	106117	105683	105257	104838	104425	104019	103621	103231	102843	103023	103202	103383	103562	103744	103924	104105	104287
Wastewater's source		Domestic																	
Organic content in the wastewater - in inventory year	TOWi	kg BOD/yr	2917053	2904953	2893072	2881410	2869940	2858634	2847520	2836625	2825949	2815327	2820255	2825155	2830110	2835010	2839992	2844920	2849874
Specific per capita BOD in inventory year, BOD	g/person/day	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60	60
Annual per capita protein consumption	kg/person/yr	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075	22.075
Factor to adjust for non-consumed protein, FNON-CON		1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Fraction of nitrogen in protein, FNPR	kg N/kg protein	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16

Table 20. GHG emissions from Wastewater treatment and discharge, 2001–2018

Waste Water Treatment and Discharge Emissions	Units	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Total CH_4 emissions	Gg	0.061	0.061	0.061	0.061	0.6	0.06	0.06	0.06	0.059	0.059	0.059	0.059	0.059	0.060	0.060	0.060	0.060	0.060
Total N_2O emissions	Gg	0.0052	0.0052	0.0051	0.0051	0.0051	0.0051	0.0051	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.0050	0.0051	0.0051
CO_2	Gg	3.087	3.074	3.061	3.049	3.037	3.025	3.013	3.002	2.99	2.979	2.984	2.989	2.995	3.000	3.005	3.010	3.016	3.021

The total GHG emissions from this sub-sector reached to 3.021 Gg CO_2e decreasing from 3.087 Gg CO_2e in 2011, representing a decrease of about 2% during the inventory period 2001-2018. This decrease is mainly attributed due to decline in the population of the country. Further, the data uncertainty and default values used for the waste sector emission shall be overcome by the proper data monitoring and reporting.

3.5 Key Category Analysis–2018

As per the Decisions 17/CP.8 and 2/CP.17 the Non-Annex I Parties are encouraged, to the extent possible, to undertake any key category analysis (level/trend or both) to assist in developing inventories that better reflect their national circumstances. Key category Analysis (KCA) is prominent for the national GHG inventory development and it provides a framework for identifying the most important categories in the GHG inventory. Key categories identified are emission or removal categories that contribute most to the total or trend in emissions level of the country. KCA aids the country to prioritize efforts in improving the GHG inventory over time.

The FSM's National GHG Inventory key categories have been identified in terms of their contribution to the absolute level of national GHG emissions and removals. Basic Approach 1 has been adopted for quantitative analysis in objective manner, accounting uncertainties and suggested aggregation level of analysis, as presented in the table below:

Table 21. KCA: Aggression Level of Analysis for Approach-1

IPCC Category code	IPCC Category	Greenhouse gas	Remarks
Energy			
1.A	Fuel Combustion Activities	CO_2, CH_4, N_2O	All fuel
Agriculture, Forestry and Other Land Use			
3.A.1	Enteric Fermentation	CH_4	All category of Livestock
3.A.2	Manure Management	CH_4, N_2O	All category of Livestock
3.C.4	Direct N_2O Emissions from managed soils		All category of Livestock
3.C.5	Indirect N_2O Emissions from managed soils		All category of Livestock
3.C.6	Indirect N_2O Emissions from manure management	N_2O	All category of Livestock
Waste			
4.A	Solid Waste Disposal	CH_4	MSW Waste- Entire Country
4.D	Wastewater Treatment and Discharge	CH_4, N_2O	Domestic Waste Water- Entire Country

In Approach 1, key categories are identified using a pre-determined cumulative emissions threshold. The approach 1 identify key categories assesses the influence of various categories of sources and sinks on the level, and possibly the trend, of the national greenhouse gas inventory. Key categories are those that, when summed together in descending order of magnitude, add up to 95% of the total level; however as per GPG key categories identified between threshold of 95% and 97%. The result of approach 1 level KCA analysis for the FSM National GHG Inventory for the recent year, i.e., 2018 presented in the tables below:

Table 22. Summary of key category analysis Inventory year 2018

IPCC Category code	IPCC Category	Greenhouse gas	Criteria
1.A	Fuel Combustion Activities	CARBON DIOXIDE (CO_2)	L1, T1
4.A	Solid Waste Disposal	METHANE (CH_4)	L1, T1
3.A.2	Manure Management	METHANE (CH_4)	L1, T1
3.C.4	Direct N_2O Emissions from managed soils	NITROUS OXIDE (N_2O)	L1, T1
4.D	Wastewater Treatment and Discharge	METHANE (CH_4)	T1

The notation keys: L = key category according to level assessment; T = key category according to trend assessment; and Q = key category according to qualitative criteria.

Uncertainty Analysis

Uncertainty estimates are an essential element of a complete emissions inventory. Uncertainty analysis has been carried out in accordance with the IPCC general guidance on uncertainty assessment.[92] In accordance with the 2006 IPCC Guidelines, Approach 1 of uncertainty assessment is used. Approach 1 is based upon error propagation and is used to estimate uncertainty in individual categories, in the inventory as a whole, and in trends between a year of interest and a base year. The Uncertainties from disaggregated levels are combined by multiplying the default uncertainty values. The overall uncertainty in national emissions, i.e., percentage uncertainty in total inventory, was estimated as 7%; and the trend in national emissions between the base year and the current year has been estimated as 8%. The major uncertainty contributed from the AFOLU and Waste sector followed by the Energy sector.

The key uncertainties are mainly attributed with data availability, missing information, data archiving, and lack of country-specific emission factors. It is recognized that the detailed activity data and country-specific emission factors will reduce uncertainty in future inventory. The Inventory Team has also prepared the inventory improvement plan (IIP) to abate the uncertainties as far as it is practically possible for the future GHG inventories.

Table 23. Uncertainty range for key Sector emissions

IPCC Categories	Gas	Activity data uncertainty	Emission factor / estimation parameter uncertainty	Combined uncertainty
		Input data	Input data	
		%	%	%
1 - Energy	CO_2	0.95	0.00	0.95
3 - Agriculture, Forestry, and Other Land Use				
3.A - Livestock	CH_4, N_2O	0.30	0.00	0.25
3.C - Aggregate sources and non-CO_2 emissions sources on land	N_2O	0.30	0.00	0.40
4 - Waste	CH_4, N_2O	0.50	0.00	0.40

[92] The IPCC 2006 Guidelines, http://www.ipccnggip.iges.or.jp/public/2006gl/pdf/1_Volume1/V1_3_Ch3_Uncertainties.pdf.

3.6 Conclusion

This inventory serves as a key source of evidence on the FSM's National greenhouse gas emissions trends and aids in monitoring progress made towards reduction of GHG emission. It also acts as an important tool for the FSM's policy recommendations on climate change and enables to measure success of such policies. The current GHG inventory provides comprehensive information on GHG emissions for the years 2001 to 2018 and also reflects the trend in emission levels since 1994. The GHG emissions results for the inventory period 2001-2018 reveals a varying trend over the reporting period with the annual variation dominated by fuel consumption in energy sector.

The compilation of the GHG inventory continues to remain a major challenge, especially in terms of the availability of activity data for estimation of GHG emissions. The key findings and recommendations of this inventory development exercise have been identified during and highlighted in previous sections of the report. However, data collection, monitoring and verification for GHG emission sector are key takeaways of this exercise. For the future GHG inventory, the FSM shall minimize the data gaps and uncertainty specifically in Energy, Livestock and Waste sector.

National GHG Inventory Improvement Plan (NIIP)

- Precursor gases: The estimation and reporting of the precursors for national inventories emissions, i.e., carbon monoxide (CO), oxides of nitrogen (NOx), non-methane volatile organic compounds (NMVOCs), and sulphur dioxide (SO_2) may be considered to the extent possible and based on national circumstances and possibilities.
- Key Category Analysis: The activity data collection and review process will be improved and higher tier (tier-2) analysis of GHG from the key categories and sub-categories identified for Vanuatu proposed for the next inventory. The activity data collection, review process and QA/QC procedure will be developed and implemented for all the key categories and sub-categories.
- Trend Analysis: The GHG emissions from the previous year will be recalculated for trend analysis, if there is change in the methodologies used during the reporting period.
- Procedural arrangements: (a) Data Collection: The activity data collection from the industry, public and private sector as well as institutions and department shall be formalized via suitable instrument e.g., legal contracts, MoUs, MoAs, or other legal documents. (b) The Department of Environment, Climate Change and Emergency Management (DECEM) will initiate the regulation to formalize the database management, archives and institutional setup for the above. (c) Department of Environment, Climate Change and Emergency Management (DECEM) will establish arrangements for implementing improved QA/QC procedures, manage and operate the inventory database, and document and archive inventory information and the operation of the inventory.
- Implementation Integrated Monitoring, Reporting and Verification (MRV Tool) for National GHG Inventory: Department of Environment, Climate Change and Emergency Management (DECEM) will

implement and operationalize the web based integrated monitoring, reporting and verification system for national GHG inventory.

- Energy sector data: Limited data was available on quantity of fuels imported to the country (data for the inventory years 2001-2009 not available). Hence, GHG emissions was computed using only reference approach. More data on fuel distribution and their consumption in different fuel combustion activities like electricity generation, transportation, etc. will be obtained from FSMPC and national statistics department for computing emissions using sectoral approach in the future inventory.
- Livestock Data: More detailed and granular data on livestock species and their population will be obtained from animal husbandry department for the future inventory.
- Forestry and Other Land Use: Limited data and information available from this sub-sector hence emissions/removals are not estimated in this report. Data will be collected for the future inventory.
- Waste Sector Data: The waste (Solid waste and waste water) sector activity data monitoring and reporting needs to be initiated in urban centers.
- Capacity building and training activities will be conducted for the stakeholders involved mainly for monitoring and data collection. Further the stakeholders will be sensitizing on accuracy, traceability and transparency of data, QA/QC and reporting aspects of national GHG inventory.
- GHG Inventory Software: Latest version of IPCC GHG inventory software will be used.

Chapter 4
Mitigation

Photo credit: Micah Seidel, Rutgers University

Empowered lives.
Resilient nations.

4.1 Introduction

The Federated States of Micronesia (FSM) is a Non-Annex I Party to the United Nations Framework Convention on Climate Change (UNFCCC). As such, the FSM prepares and submits National Communications every four years and Biennial Update Reports every two years to the Conference of Parties (COP) containing information on climate change mitigation measures and their effects. Two national communications have already been submitted (4 December 1997[93] and 12 November 2015[94]), containing measures to reduce GHG emissions.

According to the Second National Communication (SNC) and the FSM's Intended Nationally Determined Contribution (INDC, submitted on 15 September 2016[95]), the FSM committed to formulating strategies, national policies and best practices for addressing GHG emissions and making a practical contribution to global mitigation efforts, while improving the renewable energy ratio in the energy matrix. The development objectives are planned to be achieved by integrating GHG abatement efforts with other social, environmental and economic priorities (FSM INDC, 2016). The FSM's Updated NDC,[96] submitted on 19 October 2022, committed to ambitious contributions in line with the country's development circumstances. This document recognizes that "it is imperative to achieve net zero greenhouse gas emissions at the global level by 2050 in order to preserve a reasonable chance at achieving the long-term temperature goal under Article 2 of the Paris Agreement to ensure the persistence of the country, its population, cultural unicity and exceptional biodiversity. With the provision of the necessary means of implementation from international sources, the FSM has the potential and the political will to take even greater action in the high emitting sectors, with a view to achieving net zero emissions as soon as possible." The FSM also recognizes the substantial sustainable development co-benefits that would accompany such an ambitious undertaking.

The INDC was approved and became FSM's First Nationally Determined Contributions (NDC). The First NDC communicated the FSM's intention to implement a variety of National and Sector Mitigation policies related to emission reduction, targeting the Energy Sector, specifically electricity generation and transport sub-sectors. On 17 October 2022, the FSM submitted its Updated Nationally Determined Contribution (Table 1). Under this Updated NDC, the FSM's mitigation and adaptation cross-cutting commitments represent a refocusing of the country's efforts through 2030, compared to the first NDC target year 2025. The preparation of the second NDC document was led by the Department of Environment, Climate change and Emergency Management (DECEM) with the involvement of national and state stakeholders. The Updated NDC 2022 describes the contributions of the FSM, including the adaptation and mitigation co-benefits, across several relevant economic and policy areas, including (i) energy security, (ii) food security, (iii) water security, (iv) fisheries and marine conservation, (v) resilient transport systems, (vi) public health, and (vii) emergency management and response.

The current institutional framework for delivering the FSM's mitigation action is coordinated by the Department of Environment, Climate change and Emergency Management (DECEM) that is responsible for: (i) the monitoring, reporting and verification of climate action; (ii) coordinating the compilation of the GHG inventory; and (iii) the development of projects for information gathering and to track progress on climate actions. The FSM recognizes that a Domestic Measurement Reporting and Verification (dMRV) is important to ensure transparency by reporting the nation's progress towards achieving its climate change commitments, by tracking internal achievements and reporting on the support received towards meeting its NDC.

---

[93] https://unfccc.int/sites/default/files/resource/Micronesia%20INC.pdf%20First%20NC%20addendum,%201999:%20https://unfccc.int/-sites/default/files/resource/-Micronesia_INC_Addendum%20to%20NC1.pdf
[94] https://unfccc.int/sites/default/files/resource/fsmnc2.pdf
[95] https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Micronesia%20(Federated%20State%20of)%20First/Micronesia-%20(Federated%%2020State%20of)%-20First%20NDC.pdf
[96] https://unfccc.int/sites/default/files/NDC/2022-10/Updated%20NDC%20of%20the%20MICRONESIA.pdf

Table 1. FSM Updated Nationally Determined Contributions for 2030. The table presents a summary of the FSM's contributions to the mitigation sectors (Source: FSM NDC, 2022).

Areas of interest	Contributions by 2030	Mitigation benefits
Energy	By 2030, increase access to electricity to 100% nationwide By 2030, increase electricity generation from renewable energy to more than 70% of total generation By 2030, reduce carbon dioxide emissions from electricity generation by more than 65% below 2000 levels	- Reduced emissions of carbon dioxide - Reduced demand for, and use and transport of, diesel fuel - Reductions of non-CO_2 diesel emissions, e.g., black carbon, methane
Short-lived climate pollutants	Meet Kigali Amendment HFC phase down commitments (in advance of schedule if possible) Reduce black carbon and methane emissions related to diesel electric generation more than 65% below 2000 levels by 2030 Undertake a national methane inventory and assessment of methane abatement opportunities	- Reduced emissions of HFCs - Reduced emissions of black carbon - Reduced emissions of methane
Resilient Transport systems	By 2030, climate-proof all major island ring roads, airport access roads, and arterial roads By 2030 complete climate-proofing major ports (larger and more resilient docks meeting ISPS standards)	- Reduction of emissions from idling vessels waiting to dock - Reduction of emissions from large transportation idling vessels waiting to dock by incorporating renewable energy technology for powering their auxiliary equipment
Food security	By 2030, increase annual production of coconuts and coconut-based projects to improve resilience to climate change impacts on the food system	- Potential for increased production of coconut-derived biofuels to replace certain uses of fossil fuels
Ecosystems Management	By 2030, effectively manage 50% of marine resources and 30% of terrestrial resources, including restricting commercial fishing in up to 30% of the FSM marine environment.	- Less disturbance of land and ocean- based carbon sinks - Reduced emissions from fishing fuel
Emergency Management & Response	By 2030, update vessels and/or secure additional vessels for inter-state transportation and emergency response operations, incorporating renewable energy technology	- Reduction of carbon dioxide emissions from emergency response vessels

The Second National Communication (SNC) included an inventory of the FSM's total GHG emissions for key sectors, based on data from 2000. These sectors were: energy, industrial processes, waste, agriculture, and land use-change and forestry. In the SNC, GHG calculations were conducted using the *Revised 1996 IPCC Guidelines* *for National Greenhouse Gas Inventory*,[97] which differentiated between agriculture and Land Use Change and Forestry (LUCF). In this context, it is important to note that since the 1996 Guidelines, the IPCC has published: (i) the *Good Practice Guidance (GPG) for Land Use, Land-Use Change and Forestry* in 2003, which expanded the LUCF to include the Land Use, Land-Use Change and Forestry (LULUCF[98]) and (ii) the *2006 IPCC Guidelines for National Greenhouse Gas Inventories*,[99] that merged Agriculture, Land Use, Land Use-Change and Forestry under the AFOLU (Agriculture, Forestry and Other Land Use) category. AFOLU is now used to present information on the sum of the GHG inventory for the Agriculture and LULUCF sectors. Also, in 2019 the IPCC adopted the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*,[100] which supplement the 2006 IPCC Guidelines providing updates and/or elaborates on identified gaps or out-of-date science.

According to the FSM's SNC, the Energy sector was by far the largest contributor to emissions (78%). Waste was estimated to emit a small amount of methane and nitrous oxide. Industrial processes were determined to have a negligible impact on emissions. Agriculture was determined to have minor emissions contributions as a result of livestock and burning of cropland. Finally, land use change and forestry (LUCF, as for the Revised 1996 IPCC Guidelines) were estimated to have removed more CO_2 from the atmosphere than was emitted from the sector, acting as a carbon sink. However, there was a notable lack of data and difficulty in quantifying emissions for sectors other than energy.

The Third National Communication (TNC) presents a comprehensive description of anthropogenic Greenhouse Gas (GHGs) emissions and removals from FSM for the year 2018 (also include for the period 2001 to 2017) in accordance with the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, 2006 IPCC Guidelines for Greenhouse Gas Inventories and IPCC Good Practice Guidance (GPG). In 2018, the FSM's total GHG emissions (excluding removals) was 174.19 Gg CO_2e, in comparison to 184.63 Gg CO_2e estimated for year 1994 under the first national communication and 173.52 Gg CO_2e estimated for year 2000 under the Second National Communication (SCS Ltd, 2022[101]). The FSM's total GHG (CO_2e) emissions for the year 2018 was around 0.0000031% of the total Global GHG emissions. The FSM's per capita GHG emissions (in terms of tonnes of CO_2e per person), for the year 2018, was around 1.67 tonnes of CO_2e per person per year, whereas for the same period, the global per capita GHG emissions were about 7.274 tonnes of CO_2e per person per year.

Following the SNC, there has been more knowledge available regarding the role of mangrove ecosystems in the FSM. Mangroves serve an important role in reducing GHG emissions and are an effective carbon sink. Emissions from AFOLU may be much higher than previously calculated when taking into account the effect of mangrove deforestation. As more analysis with updated data has been conducted, it is revealed that the effect of clearing mangroves impact emissions in two ways: by reducing the number of mangroves available to sequester CO_2 from being released into the atmosphere and by releasing stored CO_2 therefore increasing emissions. In addition to the importance of mangroves for GHG emissions mitigation, mangroves provide many other important ecosystem services, such as providing essential nursery habitat for many fish and crab species, as well as shoreline protection from storms.

The impacts of climate change are being felt in the FSM in many ways. Climate change has impacted different

---

[97] IPCC 1996, Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by – JT Houghton, LG Meira Filho, B Lim, K Treanton, I Mamaty, Y Bonduki, DJ Griggs and BA Callender (Eds). IPCC/OECD/IEA. UK Meteorological Office, Bracknell: https://www.ipcc- nggip.iges.or.jp/public/gl/invs1.html

[98] Good Practice Guidance for Land Use, Land-Use Change and Forestry (GPG LULUCF; 2003): https://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_files/GPG_LULUCF_FULL.pdf

[99] IPCC 2006, 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme, Eggleston H.S., Buendia L., Miwa K., Ngara T. and Tanabe K. (eds). Published: IGES, Japan: https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html

[100] https://www.ipcc-nggip.iges.or.jp/public/2019rf/index.html

[101] Subbarao Consulting Services Ltd. (2022). Federated States of Micronesia National Greenhouse Gases (GHG) Inventory Report (NIR): 2018.

sectors within society including public health, education, the economy, and culture. Every area of life within the FSM has the potential to be impacted. Changes that are made with the intention of mitigating climate change also have the potential to impact society and the ways in which people are able to live. Some mitigation actions could impact people's livelihoods, access to energy and transportation, and traditional cultural norms. Optimal strategies for climate change mitigation are those that provide co-benefits that benefit multiple sectors of society. Mitigation strategies should not cause unintended harm to vulnerable groups at the minimum, but ideally would strengthen support for vulnerable groups to ensure their success in the future.

GHG Emission Sectors and Mitigation Measures in the FSM

In 2018, the main sectors contributing to GHG emissions in the FSM are the energy sector (fuel combustion from electricity generation, transport and other), followed by the AFOLU and the waste sectors (Fig.1; SCS Ltd., 2022[102]).

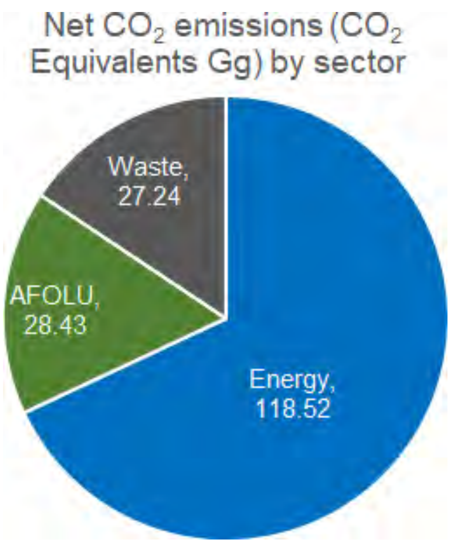


Figure 1. FSM's Total GHG Emission (Gg CO_2e) in 2018 (Source: SCS Ltd., 2022)

The National GHG Inventory Report (NIR) estimates GHG emissions for relevant sectors in the FSM, including energy, Agriculture, Forestry and Other Land Use (AFOLU) and waste sectors. Emission from the Industrial Processes and Product Use (IPPU) is not reported in the NIR since in the country, industrial activities are negligible and GHG emissions occurring from IPPU are considered as zero (SCS Ltd., 2022). The dominant GHG emission in FSM is carbon dioxide (CO_2), which emits mainly from fossil fuel combustion activities for power generation, transportation. The next main GHG is Methane (CH_4) and it mainly occurs from Livestock, Aggregate sources and non-CO_2 emissions sources on land and Solid Waste and Waste water disposal and treatment activities. This is followed by N_2O emissions mainly from livestock, Aggregate sources and non-CO_2 emissions sources on land and waste water sub-sector (SCS Ltd., 2022).

This section presents the FSM's progress since the submission of the SNC in 2015, including plans and strategies to mitigate the country's GHG emissions.

Energy Sector

The energy sector is the main source of CO_2 emissions, which accounts for entire CO_2 emissions in the FSM.

[102] Subbarao Consulting Services Ltd. (2022). Federated States of Micronesia National Greenhouse Gases (GHG) Inventory Report (NIR): 2018.

The net CO_2 emissions shows an increasing trend and has increased from 39.73 Gg CO_2e in 2009 to 119.79 Gg CO_2e in 2018 (SCS Ltd., 2022). The FSM's mitigation actions, since the SNC, focused principally on abating GHG emissions from the electricity production, with an ongoing transition from diesel-fueled generation to various renewable options. The FSM Energy Master Plan (EMP, Castalia, 2018) suggests a target for 84% renewable generation between 2020 and 2037. The FSM INDC (2015) made GHG emissions reductions from the energy sector conditional on requisite funding being made available from the international community for assistance with the transition. This assistance has been provided in the past and is now coming in the form of nationwide grants and loans for projects that are under implementation or planned. FSM has set strong goals for improving equitable access to energy for the population and for reducing reliance on fossil fuels for energy generation (FSM NDC, 2022[103]). The country envisions achieving 100% access to energy by the end of the decade and an 80% reduction of fossil fuel diesel for electricity generation use over the next two decades. Full implementation of the EMP by 2037 would increase electricity access from 67% to 100% and renewable energy generation from 19% to 84%. This would also reduce both diesel fuel generation and the resulting carbon dioxide emissions by almost 65% (FSM NDC, 2022). Relevant projects for the accomplishment of the FSM's ambitious energy goals are presented in Table 2.

Table 2. The Energy sector: some major projects implemented, and under implementation, in the FSM since the SNC (2015).

Project	Funding Agency	Energy option
North-REP: North Pacific ACP Renewable Energy and Energy Efficiency Project	EDF 10 – *completed 2015*	Hydropower Solar power systems
Adapting to Climate Change and Sustainable Energy (ACSE) Programme	EDF 10 – *completed 2018*	Solar power grid connected systems
Yap Renewable Energy Development Project	Asian Development Bank – *completed 2018*	Wind energy system Solar power systems
Energy Sector Development Project (ESDP)	World Bank – *completed 2019*	Energy efficiency
Renewable Energy Development Project (REDP)	Asian Development Bank – *under implementation*	Solar power grid connected systems
Micronesia Public Sector Buildings Energy Efficiency (MPSBEE) Project	UNDP GEF6 – *under implementation*	Energy efficiency
Sustainable Energy and Accompanying Measures (SEAM): Renewable Energy and Energy Efficiency (REEE)- FSM Sustainable Energy (FSM.SE)	EDF 11 – *under implementation*	Solar power grid connected systems
Sustainable energy development and access project	World Bank – *under implementation*	Solar power grid connected systems Energy efficiency

Over the past ten years, the FSM has made considerable investment and achievement towards the goal of providing electricity to all residents. Delivering electricity to outlying islands and remote populations in particular is a persistent challenge and one that has required innovative technology to overcome. The volatility of fuel price adds to the development challenges faced by the country, which spends about US$40 million annually on imported fuel, the majority of which is utilized for running power plant generators that provide electricity to the four states. In the coming years, rural and remote communities' migration towards higher islands may see a steady increase, owing to climate change persistent impacts (i.e., rising sea level), and access to

[103] Federated States of Micronesia Updated Nationally Determined Contribution (2022). Retrieved from: https://unfccc.int/sites/default/files/NDC/2022-10/Updated%20NDC%20of%20the%20MICRONESIA.pdf

education and health services. Considerations to maintain an energy grid that serves a larger population on higher islands are essential for the implementation of the EMP. The SNC (2015) highlighted specific mitigation measures targeting the energy sector, some of which were: energy efficiency, solar energy, hydropower, wind energy, biofuel, biomass, and ocean energy. The SNC also discussed barriers to realizing these mitigation actions including the need for new technology, lack of public awareness, gaps in capacity and training, data gaps, and limited staff to meet climate threats to the FSM, among others (SNC, 2015). Many of the mitigation actions that were suggested in the SNC have been addressed by the FSM's EMP (Castalia Advisory Group, 2018), which address the energy transition in far more detail at the state level, including actionable items. Key strategies that were proposed in the EMP for the FSM are increased access to electricity, with a target of 100% access in 2027, a greater percentage of renewable energy use (84% in 2037 versus 44% in 2020), reduced reliance on diesel fuel (a reduction of 1.4 million gallons/year from 2020 to 2037), and reduced GHG emissions from the energy sector. Under the actions laid out in the EMP, the FSM is encouraged to set targets for emissions reductions, which have been outlined in the 2022 country NDC. The ambitious conditional targets set by the FSM Updated NDC (2022) for reducing GHG emissions produced by the energy sector require the continued cooperation of multiple stakeholders for full implementation.

Transport Sector

Greenhouse gas emissions from the transport sector are combined under the energy sector GHG emissions, which also includes the sub-sectoral levels for energy generation, residential and commercial, and others. Nevertheless, the FSM has worked to reduce the impact of this sector on the country's GHG emissions. This includes improvements in roads and the use of alternative energy saving maritime transport systems.

At the National level, the Department of Transportation, Communications & Infrastructure (TC&I) has the mandate to manage all interstate and international sea and air transportation. Under the transportation sector TC&I has two divisions: Marine Division and Division of Civil Aviation. The Marine Division is responsible for planning, coordinating and regulating the nationwide sea transportation system. The Division of Civil Aviation is responsible for the Administration of Aviation programs and activities in the country, including the management of the nation's airspace, airports, and airfields. Land transport in each state is managed by the states' Departments of Telecommunication and Infrastructure (T&I) in Pohnpei and Kosrae, Department of Public Works and Transportation in Yap, and Department of Transportation and Public Works in Chuuk.

Compared to other countries, land transportation in the FSM is limited due to the small land mass and dispersed geography of the country combined with an underdeveloped road system in some states. Mitigation on this sector is currently limited to the states' regulations for air quality control, with the exception of Chuuk, which has banned importation of noncommercial vehicles with over 100k miles, thereby reducing emissions from fuel inefficient vehicles (Chuuk State Clean Environment Act 2018). Plans and strategies to reduce emissions from land transport, owing to importation of fuel-inefficient high-emissions vehicles into the FSM, are not in place, and standards to ensure that only fuel-efficient vehicles, which contribute to lower emissions, are allowed into the county are likely to also address the disposal of old vehicles that are closer to the end of their usable life. The FSM is highly dependent on maritime transport, which plays a central role in national development and social cohesion and service delivery.

Waste Sector

The NIR estimated that in the FSM solid waste and wastewater disposal and treatment activities contributed to about 54% of methane emissions in the FSM for the period 2001-2018 (SCS Ltd., 2022). Since 2000, GHG emissions inventory, solid waste management plans and strategies have been implemented by the four states, assisting in the reduction of methane emissions from this sector. The upgrading of States' waste disposal sites, from unmanaged to semi-aerobic processes, have contributed to a year-to-year decline of methane emissions from 0.936 Gg in 2001 to 0.865 Gg in 2018. However, wastewater handling remains a challenge in most of the states, contributing, over the period 2001-2018, to 3% of the country's methane emissions, and 20% of Nitrous Oxide emissions (SCS Ltd., 2022).

AFOLU Sector

Agriculture is a key sector in the FSM and is extremely important for household food security and livelihoods. Subsistence-level agriculture is very common, with some of the most commonly grown food crops being taro, breadfruit, yam, and bananas. In some of the FSM's States, common cash crops include sakau (kava) and betel nut. The traditional importance of agriculture in the FSM is in competition with the rise and reliance of the FSM on imported foods (annual import of food in 2018 accounted for about US$ 56 million, excluding beverages[104]). Imported food into the FSM emits more GHG emissions within its supply chain as compared to locally grown food. Under this lens, actions undertaken with the goal of reducing reliance on imported foods and promoting the production, harvest, and consumption of locally produced food is a method of climate change mitigation. Under this sector the FSM NDC (2022) identifies unconditional contributions for food security for a total amount of US$9,393,350, which are being disbursed through the country's GCF program. Among these are (i) strengthening of farmers' activities through cooperatives, (ii) climate-smart agriculture training to farmers, (iii) improved markets access for local farmers, and (iv) increased annual production of coconuts and coconut-based projects (FSM NDC 2022).

FSM's Agriculture sector emissions (excluding removals) reached to 28.43 Gg in 2018 from 35.12 Gg CO_2e in 2001, representing a decrease in emissions of about 19% approximately. The emissions from "Livestock" and "Aggregate sources and non-CO_2 emissions sources on land" sub-sector in FSM shows a decreasing trend until the year 2014 and thereafter increases slightly during the end years. Livestock sector emissions reached to 22.35 Gg CO_2e in 2018 from 0.75 Gg CO_2e in 2000. Livestock production (pigs and poultry) is important throughout FSM, particularly for subsistence and cultural use. However, there is a lack of modern scientific manure management systems and most of the livestock are free ranging due to which the emissions from both "livestock" and "Aggregate sources and non-CO_2 emissions sources on land" sub-sector has the significant share in the total GHG emissions from FSM. The emissions from field burning of agricultural residues, use of urea and other synthetic fertilizers have not been estimated for the inventory period 2001-2018 due to lack of data.

At the time of the FSM's SNC, there was an absence of data for the Forestry and Other Land Use sector. As a result, it was estimated that GHG emissions from this sector were offset by the existing vegetation. Similarly, the NIR for the Third National Communication includes emissions by source, but excludes removals by sink due to limited data and information for this subsector. However, since the publication of the SNC, research into the impact of mangrove clearing indicated that mangrove clearing has a larger impact than initially accounted for. The impact of mangrove clearing has been estimated to be responsible for an additional 20,000mt CO_2/year for Pohnpei State only (Crooks et al 2016[105]). The NIR recommends the collection of data to estimate removal by sinks as part of the FSM National GHG Inventory Improvement Plan.

FSM is taking strong actions to improve the management and protection of its watersheds and mangroves systems through a combination of strengthened regulations, and improved education and public awareness. Expanding protected areas aims to conserve and sustainably manage these key ecosystems, which are also carbon sinks.

4.2 Technology and Options to Reduce GHG Emissions in the FSM

Energy Sector

[104] EconMAP (2019). Federated States of Micronesia Fiscal Year 2018 Statistical Appendices. Retrieved from: https://pubs.pitiviti.org/fsm-fy18-economic-statistics (Accessed January 2022).
[105] Crooks, S., Emmer I., von Unger M. 2016. Blue Carbon Project: Pre-Feasibility Assessment. Prepared by Silvestrum for Micronesia Conservation Trust.

Diversification of energy sources, through the increase of renewable sources, is the strategy enacted by FSM to meet its targets of reducing reliance on imported fuel and costs of energy production, while greatly reducing emissions and improving economic efficiency in this sector (FSM NDC, 2022). As reported in the FSM Updated NDC (2022), large-scale nationwide deployment of renewable energy is the backbone of the FSM's "National Vision" for energy security. However, some barriers still need to be addressed in consideration of this long-term vision (Table 3).

Table 3. Energy sources utilized by the FSM for reducing the country's GHG emissions and achieving full electrification by 2030.

Energy Source		Barriers
Increased Energy Efficiency to reduce GHG emissions	Tackle energy efficiency at the supply (energy production and distribution) and demand (energy use) side of the electric grid. Energy efficiency investments for upgrades designed for long-term application.	✓ Lack of nationwide energy efficiency standards for appliances. ✓ Requires for subsides to assist low-income households to access more efficient appliances. ✓ Disposal costs for existing appliances when replaced with more efficient options.
New main grid solar energy-transition to solar power to reduce GHG emissions	✓ FSM is already transitioning to RE, including solar power ✓ Solar energy to reduce reliance on imported diesel fuel (EMP, 2018) ✓ Long-term success of solar systems built through availability of technical expertise support	✓ Lack of technical capacity and training for operation and maintenance of battery storage systems. ✓ Some states lack legislative infrastructure to make solar credits and 'individually' produced solar power feeding into the main grid. Disposal costs for battery storage systems. ✓ Disposal costs for photovoltaic systems and panels, and increased environmental hazards from toxic material. ✓ Likely higher costs (replacement costs) if limited use of current generators shorten their usable life span. In the energy mix generators will still be in use, particularly as 'back up' or potentially following disasters.
Micro-grid solar energy – electrification trough RE	✓ This technology can help meet the FSM's goal of electrifying rural communities and outlying islands. ✓ Provision of RE for electrification can help FSM to meet its NDC (2022) targets while reducing GHG emissions.	✓ Potentially highly subsidized: costs for operation, maintenance and disposal of these systems cannot be fully recovered from rural low-income households. ✓ Lack of plans or strategies to divert solar panels from landfill.
	✓ This technology is a feasible alternative to small diesel generators	Disposal costs for appropriate disposal to reduce hazards to the environment and human health.
Upgrade Diesel Generators to reduce GHG emissions and improve energy efficiency	Diesel generators are an important part of energy production in the FSM. Reliance on generators for electricity production is forecasted to continue to decline sharply (EMP, 2018). In future diesel generators are likely to fill a back up role rather than serve as primary source for energy production.	Raised costs for Utilities if generators currently in use are upgraded before they reach the end of their usable life. Elevated capital costs[106]

[106] Upgraded generators will require more capital costs up front but according to the research conducted in the Energy Master Plan, the increased efficiency will balance this out and not negatively affect utility companies' budgets (EMP; Castalia, 2018)

Biogas	✓ Presently biogas in FSM is generated through the breakdown of animal waste. ✓ This technology was deployed in some areas of Pohnpei (52 homes using biodigesters) ✓ The advantage over solar RE is that it does not require battery storage systems. ✓ Biogas has potentials to supplement the FSM energy needs as part of the energy mix.	Constant supply of organic material may be problematic in some small islands. Potentials to supplement energy needs at small scale, but not fully support FSM energy needs. Transition to biogas may be problematic to some households because it requires changes in daily routines. Maintenance costs.
Energy Source		Barriers
Biodiesel: local biodiesel production from coconuts	✓ Coconuts have a high potential for biodiesel conversion. ✓ Vital Energy is responsible for coconut biodiesel production in the FSM. ✓ Potentials to increase biodiesel production in the country through the expansion of domestic coconut production under the successful Coconuts for Life (C4L) initiative. ✓ The increased production of coconut-derived biofuels can help the country to replace certain uses of fossil fuels.	Availability of suitable land for agriculture may be reduced by sea level rise. Increased production of coconut competing with agricultural production of food crops.
Hydropower	✓ This technology requires specific conditions to be feasible. ✓ Presently a hydropower system has been deployed in Pohnpei.	Conditions to expand hydropower are limited due to the geography of the nation. Drought conditions can adversely affect the functioning of hydropower systems.
Wind Energy	✓ This technology requires a specific set of criteria and is generally more expensive than other RE alternatives. ✓ Wind capacity for the country is estimated to be site specific. ✓ Presently a wind power plant is supplying the Yap state electric grid.	Elevated capital and maintenance costs. Requires high technical skill for maintenance. Site specificity limits expansion of this technology. Land tenure systems can limit access to land for installing wind turbines. Disposal costs when the system reaches the end of its usable life.

Transport Sector

The FSM currently lacks any mitigation system for the transportation sector, with the exception of the deployment of renewable energy vessels (*Vaka Moutu*) into operations in the maritime sector. Import of fuel-efficient vehicles is not encouraged either through an excise tax on fuel or on less fuel-efficient vehicles, which are largely imported into the country. The importation of second-hand vehicles, which are considerably affordable, has enabled low-income households to commute to urban centers and broaden their employment opportunities (IMF, 2019). Any increase in fuel taxation can have a repercussion on the economy and the most-vulnerable sectors of society. This will also have an adverse impact on access to markets, essential services, as well as impacting coastal fishery which is one of the primary sources of proteins at subsistence level. On the other hand, differentiated excise tax with increases in line with the age and engine size of the vehicle may encourage consumers to purchase smaller and more fuel-efficient cars (IMF, 2019). The analysis from the IMF suggests, as an alternative to excise tax, the use of feebates[107] to reward consumers who decide to choose fuel-efficient and lower-emitting vehicles. The lower costs of fuel-efficient vehicles can encourage consumers to direct their choice towards these items, without considerably impacting low-income households. The FSM's strategies to reduce GHG emissions from the transportation sector should take into account the fragile sectors of society, while the strengthening of an almost nonexistent public transportation system can be a further measure

[107] Feebates is a system of charges and rebates whereby energy-efficient or environmentally friendly practices are rewarded while failure to adhere to such practices is penalized.

to implement. In line with this approach, the FSM National Environment Management Strategy 2019-2023 (NEMS, 2019) indicates the promotion of public transportation, also through alternative modes (electric cars) and the development of an incentive program, as strategy to reduce reliance from fossil fuel and decrease GHG emissions.

Waste Sector

Effective solid waste management is a common problem among small islands, given the limited land available for waste disposal. While the FSM overall emissions from the waste sector are relatively low (solid and water waste sum up to 0.961 Gg methane emissions and 0.0051 Gg Nitrous Oxide emissions), this sector is the third contributing to GHG emissions in the country and projects that provide significant co-benefits for mitigation have been implemented in the years. The management of solid waste is a cross-cutting issue in small islands that if left unchecked, reduces ecosystem resilience, impacts biodiversity and holds great potential to increase GHG emissions, by degrading natural carbon sinks. Plans and strategies that the FSM is implementing to improve solid waste management and development are frequently intertwined to emissions reductions. Burning of waste and/or illegal dumping has been an issue the state governments have been working on for many years. Burning waste emits greater GHG emissions than managed landfills, making the burning of waste a climate change emissions concern. Increasing access to waste collection and disposal may provide multiple benefits, including improved public health and the environmental quality as well as reduced GHG emissions. Improved waste collection and access to appropriate solid waste disposal sites can encourage households to appropriately dispose of their solid waste, instead of burning or dumping it, thereby reducing GHG emissions from this sector, and the release of Persistent Organic Pollutants (POPs) in the environment. The FSM states developed, with assistance from JICA, Solid Waste Management Strategies. The SWMS, currently under implementation, is a first step to establish financially sustainable solid waste management systems. The country is addressing existing and upcoming risks from the disposal of hazardous waste (i.e., e-waste, healthcare waste) through the PACWaste Plus programme. A large portion of household solid waste in the FSM is biodegradable, with weight ratio ranging from 23.2% to 64% in Kosrae[108] and Yap,[109] respectively. Given that this waste is biodegradable, composting[110] represents a viable waste management option for the country. Enhancing composting is likely to reduce GHG emissions than burning or allowing for biodegradable to add to landfill waste, but also address the challenge of the island's limited physical space, while providing compost to farmers and households. Given that land is at a premium in the FSM and soil fertility is a rising issue, enhancing composting production represents a viable multi-benefits option to address both adaptation and mitigation to climate change. In recent years, composting has been encouraged at the household level as part of food security projects for adaptation to climate change. In Yap, the FSM-College of Micronesia has implemented food security projects that included local composting as an alternative option to imported compost and fertilizers. In Chuuk, a local NGO, the Chuuk Women Council has assisted women in enhancing their household food gardens through the production of local compost. The USDA NRCS, whose main office is located in Pohnpei, has implemented several programs and training on composting for household food gardens. Composting, in tandem with agricultural interventions that improve food independence and local food security, represent a cost-effective strategy with multiple benefits that extend beyond adaptation and vulnerability reduction.

AFOLU Sector

The FSM is highly reliant on imported foods. Many imported foods are less healthy than traditionally locally grown foods, and have a higher carbon footprint. Food that is shipped to the FSM emit more GHG emissions within its supply chain from cooling and transportation. Therefore, actions that improve food independence in the

[108] Kosrae State Solid Waste Management Strategy 2018 – 2027 (Action Plan: 2018-2022). Kosrae State, FM.
[109] Yap State Solid Waste Management Strategy 2018 – 2027 (Action Plan: 2018-2022). Yap State, FM.
[110] Strategies to increase compost production at country level should consider that in many households kitchen waste is generally recycled as a feed of livestock.

FSM are also actions that reduce GHG emissions from imported foods. In the Micronesia region, food security has worsened in the past half century and climate change is likely to further hamper local food production, especially in low-lying atolls.[111] There have been ongoing efforts to improve local food use and production (e.g., the Pohnpei "Go Local" campaign from Island Food Community[112]). For example, since 2017, Yap CRE has partnered with Catholic Relief Services to support island communities and smallholders to enhance their agriculture strategies with outreach, technical assistance and extension training in climate adaptive techniques to make local food production more resilient to extreme weather events.

Figure 2. Summary of mitigation opportunities for the waste sector and associated barriers to implementation.

WASTE SECTOR

Increase access to waste collection

Presently collection of waste is limited and inconsistent

- ✓ Waste collection and disposal remains a persistent problem, particularly for waste produced in the remote rural areas.
- ✓ Burning of waste still occur, and unmanaged landfill are also present, contributing to the nation's GHG emissions.
- ✓ Increasing access to waste collection and disposal may provide multiple benefits in terms of public health, environmental quality and reduced GHG emissions.

Increase composting

Enhance compositing production at household level

- ✓ "A large portion of household solid waste in the FSM is biodegradable: ~36% is yard waste and ~ 12% is kitchen waste.
- ✓ When biodegradable waste breaks down as compost emits fewer GHGs than when is burned or added to a landfill.
- ✓ Compost can be used in household gardens or agricultural areas, bringing additional benefits in terms of adaptation and mitigation (i.e., enhanced agroforestry and food production).

Waste to Energy

Potential conversion of waste to energy in the FSM

- ✓ Waste disposed in unmanaged landfills generates more methane than carbon dioxide, which has greater warming potential.
- ✓ Waste to energy plants burn waste and capture the energy generated to power the electrical grid.
- ✓ In terms of GHG emissions, waste to energy plants perform better than unmanaged landfills.

BARRIERS

Increase access to waste collection

- ✓ Cost of not subsides waste disposal systems.
- ✓ Overcoming the limited impact of waste management education and awareness.
- ✓ Imported food comes with non biodegradable food packaging.
- ✓ Limited coverage of waste collection services.
- ✓ Funding, technical support, and education on the benefits of recycling and appropriate waste disposal.
- ✓ Lack of easy-to-enforce system to handle cases of illegal dumping at state level.

Increase composting

- ✓ Lack of extensive awareness on methods for and benefits from household composting.
- ✓ Lack of waste separation (green waste vs. other solid waste) at landfill
- ✓ Funding, technical support needed to expand on existing waste to compost systems (e.g.. Animal waste to compost through dry litter piggery system)

Waste to Energy

- ✓ Elevated costs.
- ✓ Solid waste production for this type of system may be insufficient.
- ✓ Geography and costs reduce feasibility of this technology.

---

[111] Connell J. (2016). Food security in the island Pacific: Is Micronesia as far away as ever? Regional Environmental Change 15(7).
[112] Englberger et al (2013). Let's Go Local! Pohnpei promotes local food production and nutrition for health. Chapter 12, In: Indigenous Peoples' Food Systems and Well-Being Interventions and policies for healthy communities, Eds: Food and Agriculture Organization, 2013, Rome.

Figure 3. Summary of mitigation opportunities for the agriculture sector and associated barriers to implementation.

AGRICULTURE

Promote Local Food Production

Enhance FSM production of local food production

- ✓ The FSM is highly reliant on imported foods.
- ✓ Imported foods have a higher carbon footprint: food that is shipped to the FSM has more GHG emissions bundled within its supply chain from cooling and transportation.
- ✓ In the FSM there have been ongoing efforts to improve local food production.

Increase Agroforestry Practices

Increase in agroforestry practices

- ✓ Agroforestry is the integration and retention of trees in agricultural lands.
- ✓ Agroforestry has demonstrate to sequester carbon in agricultural land versus traditional methods that do not include trees.
- ✓ Agroforestry is largely used in traditional agriculture in the FSM.

Increase Taro Farming

Increase in swamp taro production

- ✓ Taro is a widespread cultivated staple crop in in the FSM.
- ✓ Taro farming is traditionally implemented by local communities and has cultural significance.
- ✓ Swamp taro may help sequester carbon due to the wetland growing conditions.
- ✓ Value-added products such as taro flour could make taro farming more profitable.

BARRIERS

Promote Local Food Production:

- ✓ Overcoming the preference for imported foods.
- ✓ Need for improved awareness, in all states, on the importance of local food production for climate change mitigation.
- ✓ Adverse impact of invasive alien plant species on the ongoing agricultural productivity and yield.
- ✓ Outmigration of the labor force reduce labor availability to enhance local food production and food security.

Increase Agroforestry Practices:

- ✓ Funding, technical support, and education on the benefits and methods of agroforestry for mitigation.
- ✓ Loss of labor due to outmigration is impacting workforce availability, causing many of these systems to be neglected.
- ✓ Loss of a traditional practice, leading to a reduced capacity for climate change mitigation.

Increase Taro Farming:

- ✓ Preference for imported staples, such as rice, could make an increase in taro production unprofitable if the local demand is inadequate.
- ✓ Access to markets, local and export.
- ✓ Loss of traditional knowledge regarding planting techniques.
- ✓ Sea level rise could negatively impact taro patches through saltwater intrusion, particularly in outlying islands.
- ✓ Limited opportunities to commercialize taro.

Forest and mangroves provide a multitude of services to the FSM's communities. Forests are important for water security, raw materials and food. Mangroves are important for most types of fishing and marine resource extraction, especially for women who are traditionally more involved with nearshore activities such as gleaning, netting, and inshore fishing.[113] Forest and mangrove clearing in the FSM occurs for a number of reasons such as land reclaimed for monocropping, roads development, dredging boat channels, accessing coral resources, sand mining, and the use of forest and mangrove wood for firewood, building material, and handicrafts. In addition, climate change represents a further threat to mangroves, with accelerating sea level rise potentially reducing their ability to retreat in land to prevent submergence. A recent study conducted in Pohnpei by Buffington et al. (2021[114]) indicates that Pohnpei's mangroves would be resilient to low and moderate sea level rise, but high and/or extreme sea level rise scenarios can result in extensive loss of mangrove habitat around the island, with adverse consequences for carbon sequestration. Opportunity still exists to protect the nation's mangroves, particularly those that are located near freshwater sources that may be more resilient to climate change.

A feasibility study was conducted on the potential for blue carbon projects in Pohnpei (Crooks et al 2016). According to the study, the FSM presents moderate potential for blue carbon, such a blue carbon project would

---

[113] Pacific Community (SPC) 2019. Gender analysis of the fisheries sector in Federated States of Micronesia. 42 p. ISBN: 978-982-00-1200-4.

[114] Buffington, K.J., MacKenzie, R.A., Carr, J.A., Apwong, M., Krauss, K.W., and Thorne, K.M., 2021, Mangrove species' response to sea-level rise across Pohnpei, Federated States of Micronesia: U.S. Geological Survey Open-File Report 2021–1002, 44 p., https://doi.org/10.3133/ofr20211002.

likely not cover all of the opportunity costs of a loss of dredging, but would provide long-term incentive to protect mangroves as a longer-term financial strategy (Crooks et al 2016). However, a regional Blue Carbon project, which aggregate PICs mangroves and seagrass meadows in the region is likely to bring the largest benefits in terms of incentives for coastal ecosystem protection.

Forest and mangrove protection is challenging, due to the land tenure systems in the four FSM's states. Protecting existing forests and mangroves requires cooperation between many different stakeholders, including traditional leadership. In recent years, the FSM Ridge-to-Reef projects shared with local leadership and communities the advantages of maintaining corridors of healthy ecosystems that extend from the ridgeline down to the nearshore environment. Ridge-to-Reef planning includes upland forest areas all the way to the nearshore coral reef, mangroves, or seagrass beds, thereby including important carbon sinks for the country. This approach is more beneficial than piecemeal conservation projects as there are multiple benefits beyond land use, land cover change. These benefits include carbon sequestration through intact upland forests, mangroves, and seagrass beds; biodiversity through the protection of adjacent pieces of land; and socio-cultural benefits. Although the Ridge-to-Reef project has primarily been conducted under the expectation of improved ecosystem health and biodiversity conservation, it is undeniable its key contribution to climate change mitigation.

Figure 4. Summary of mitigation opportunities for the FOLU sector and associated barriers to implementation.

FORESTRY AND OTHER LAND USE

Mangrove protection policies

Protection of mangroves to reduce removal and mitigation of GHG emissions

- ✓ Mangrove clearing in the FSM occurs for a number of reasons (e.g., dredging boat channels, sand mining, firewood and building material).
- ✓ Mangrove clearing has the potential to increase FSM contribution to GHG global emissions.
- ✓ Increasing threat from climate change: accelerating sea level rise reduce mangrove ability to retreat in land.

Ridge-to-Reef Planning

Ridge-to-Reef planning to enhance mitigation of GHG emissions

- ✓ "Ridge to reef" approach to maintain corridors of healthy ecosystems that extend from the ridgeline down to the nearshore environment.
- ✓ "Ridge to reef" includes ecosystems that are crucial for carbon sequestration (i.e., forest, mangroves, seagrass meadows).
- ✓ "Ridge to reef" planning is a key strategy to climate change mitigation for Pacific island nations.

Blue Carbon project

Potential applications of Blue Carbon to mitigate FSM emissions

- ✓ "Blue carbon" involves the intentional conservation of coastal wetlands, specifically for their carbon sequestration capacity.
- ✓ Feasibility studies to assess the potential for blue carbon projects have been conducted in the FSM (i.e., Pohnpei).
- ✓ Blue carbon projects are often externally funded and their carbon credits may be traded through international markets.

BARRIERS

- ✓ Land tenure system, with mangroves areas privately owned by families or clans.
- ✓ Lack of awareness and/or knowledge transfer on the sustainable use of mangrove resources (e.g., sustainable harvesting).
- ✓ Effective enforcement and compliance with future regulations on mangroves due to understaffed agencies and limited funds.
- ✓ Stringent application of Environmental Impact Assessment process, and mitigating strategies, for major development projects.

- ✓ Land Tenure system may limit the inclusion of areas of ecological and biological significance.
- ✓ Shift to a cash economy: loss of habitat through deforestation and sand mining and extensive extraction of resources.
- ✓ Lack of extensive awareness on benefits from restoration and rehabilitation.
- ✓ Limited data/information on land survey.
- ✓ Control and/or eradication of invasive species due to forest removal.

- ✓ Limited knowledge and understanding on Blue Carbon.
- ✓ Limited Blue Carbon potentials (e.g., mangrove and seagrass bed areas not sufficient to support Blue Carbon).
- ✓ Limited data/information on Blue carbon potentials for the nation to determine Blue Carbon feasibility.
- ✓ Establishment of regional cooperation on blue carbon projects.

4.3 Mitigation Actions

Energy Sector

The FSM's mitigation actions for the energy sector are focused on energy supply projects with energy supply elements, most of which were successfully completed or are planned or under implementation. Consistent Energy supply remains a challenge throughout the FSM. There is a prominent goal to increase electrification of households and in some cases government facilities, particularly in the low-lying islands and in Chuuk State, where more than 70% of households still have no access to electricity. In-country support for the implementation of energy efficiency projects occurs through the Federated States of Micronesia Development Bank (FSMDB) Home Energy Loan Program (HELP), lending for energy efficient home construction and renovation and purchase of energy efficient household appliances. Energy efficiency and renewable energy requirements, toward reduced emissions, were captured in the FSM's Energy Master Plan. The plan estimated that US$296 million capital expenditure, over a period of approximately 20 years, is required for increasing production of energy from renewable sources but this estimate may vary due to changes in transportation costs. Additionally, this estimate does not account for costs for capacity building, including technical knowledge transfer and awareness requirements. This increased reliance on RE corresponds to annual average carbon dioxide emissions of 21,980 tCO_2e by 2027 and 15,769 tCO_2e by 2037. The FSM's investment on renewable energies is in line with the country's 2022 Updated NDC conditional target of reducing, by 2030, carbon dioxide emissions from electricity generation by more than 65% below 2000 levels. In 2000, GHG emissions were 150,000 tCO_2e and electricity generation accounted for 42 percent of this (64,000 tCO_2e). The implementation of the Energy Master Plans will result in about 65% below the electricity sector's total emissions in 2000.

Table 4 provides a summary list of actions, identified in the FSM's Energy Master Plan, necessary to improve energy access, efficiency and reduce GHG emissions in the FSM.

Table 4. Types of energy mitigation measures as reported by the FSM's Energy Master Plan (2018) and implemented energy projects. PV: Photovoltaic

Category	Description
Main grid solar (PV) installation and storage	Solar PV installations to feed renewable electric power generation into the main grid and decrease reliance on diesel generators
Mini-grids solar PV for rural areas	The mini-grids solar PV are the most efficient cost-effective options for electrification of low-lying islands and rural areas.
Solar/diesel hybrid mini-grids	A hybrid system for power generation for some of the low-lying islands
Stand-alone solar PV Installations	Solar PV installations in residences and government buildings for power generation in the low-lying islands
Energy efficiency in power plants	Implemented measures such as upgrades and increase capacity generators power plant to increase fuel efficiency and reduce emissions
Replace and upgrade connection to the main grid (underground cables)	Upgrade and/or replace energy assets to improve distribution and energy efficiency
Improve electric power network and distribution	Increase the number of residents connected to the main-grid distribution system

Energy efficient street lighting	Replace street lights, at states and National Government facilities, with more efficient (LED) or solar street lights to reduce consumption of petroleum fuel and improve energy savings
Other renewables	Use of other renewable technologies including wind, hydropower, and others to reduce use of diesel fuel for power generation

A significant number of initiatives have been undertaken in the energy sector. Since the submission of its INDC in 2015, the FSM has conducted assessment of the States' Public Utilities electricity provision and technological needs and employed renewable energy for power generation in some of the low-lying islands and main islands. The FSM's progress in emission reductions is largely attributed to the expansion of solar PV systems, use of wind and hydropower and energy efficiency measures for electricity generation. In this context, the FSM's efforts to reduce the use of fossil fuel for electricity generation were supported from different international donors:

- The *Energy Sector in Five ACP Pacific Island Countries Programme* (REP5; completed in 2009): funded by EU (EDF9[115]) this project installed stand-alone PV systems for schools and dispensaries in five Pohnpei's outer islands, a PV-powered mini-grid on Ulithi islets (Yap), stand-alone PV systems for schools and dispensaries of four Chuuk's low-lying islands and five grid-connected PV systems to Kosrae's airport, legislature, governor's office, hospital, and power plant.
- The project for the *Introduction of clean energy by solar electricity generation system* (completed in 2013): funded by JICA, this project installed photovoltaic (PV) power systems at Capital buildings and College of Micronesia campus (20 kW and 160 kW, respectively) in Pohnpei.
- The *FSM Pacific Environment Community (PEC) Fund Project* (completed in 2014): funded through the PEC (a fund established by the Japanese Government) this project was expected to contribute 1.7% electricity generation to the national renewable energy target of 30% energy from renewable energy sources by 2020 and a reduction on carbon emissions (~500 tCO_2eq per annum). The project installed photovoltaic power systems (max capacity 200 kW) in each state at the following facilities: Kosrae Utilities Authority, Netti elementary school in Pohnpei, Chuuk high school and Yap State Public Service Corporation.
- The *North Pacific ACP (African, Caribbean and Pacific) Renewable Energy and Energy Efficiency Project* (North REP; completed in 2015): funded by the European Union (EDF10[116]) and implemented by the Secretariat of the Pacific Community (SPC) this project addressed education and health with 24- hour access to electricity in these institutions in remote areas. Renewable energy strategies were: rehabilitation of the Pohnpei state's hydropower plant; PV systems installed in four schools and two health centers at Yap's low-lying islands; solar pico lighting system with charging stations provided to 50 households (~ 200 people) in Chuuk; solar PV system installed in Walung's school in Kosrae. The project also assisted in finalizing the FSM's Energy Policy (Volume 1) that was drafted under REP5.
- The *Pacific Islands Greenhouse Gas Abatement through Renewable Energy "PLUS" Project* (PIGGAREP+), under SIDS DOCK Program (completed): the SIDS DOCK Support Program was a joint initiative of the United Nations Development Programme (UNDP) and the World Bank (WB)

[115] EDF9: 9th European Development Fund
[116] EDF10: 10th European Development Fund

and implemented by SPREP[117] to promote low carbon development for Pacific SIDs through the deployment of renewable energy resources and enhanced energy efficiency. In the FSM the project was implemented under the *Sustaining Renewable Energy and Energy Efficiency Measures in Micronesia* (SREEM) that contributed to the improvement of power generation for energy efficiency in the four FSM's States Utilities and assisted in expanding the FSM's Home Energy Loan Program (HELP).

- The EU-GIZ project *Adapting to Climate Change and Sustainable Energy* (ACSE) *Programme* (completed in 2018): funded by the European Union (EDF10), administered by the GIZ[118] and implemented by SPC. The project had two components: 1) Protecting Islands through Learning and Leading in Adaptation and Renewable Energy Education programme (PILLAR Ed), and 2) enhancing investments in small-scale renewable energy technologies in the FSM. Under component 2 of the ACSE, energy security in the FSM was enhanced through increased penetration of renewable energy and investment on small scale renewable energy installations for grid connection to diversify the renewable energy mix.

Energy savings and emission reductions for initiatives under implementation or planned, have been aggregated and compiled in table 5. Most of these energy projects were accompanied by gender assessments and gender action plans, to ensure equal and effective participation of women in this sector. Full details of the actions can be found in Annex 2.

Table 5. Summary of approved projects in FSM, taking into consideration donor and government funding from 2013 to 2021.

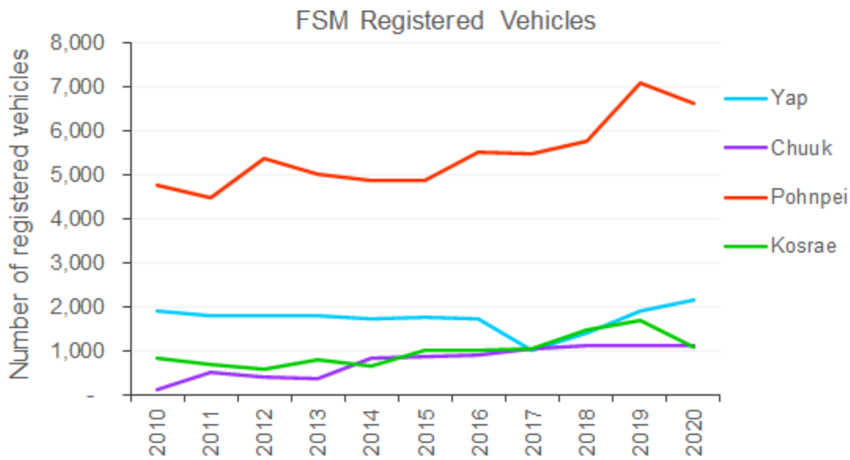
Project	Agency	Activity	Estimated emission reduction	Status
M1: Yap Renewable Energy Development Project	Asian Development Bank -Loan	Installation of 825 kilowatts (kW) of wind generation and 300 kW of rooftop solar photovoltaic generation	3,470 tCO_2e per year	Completed (2018)
M2: Energy Sector Development Project (ESDP)	World Bank - Grant	Improve fuel efficiency, increase penetration of renewable energy sources, loss reduction, performance improvement activities and maintenance plans for the States utilities, including key investments in the equipment needed to increase revenues and reduce energy losses	Unknown	Completed (2019)
M3: Renewable Energy Development Project (REDP)	Asian Development Bank - Grant	Increase renewable energy generation in Kosrae and Yap, reduce reliance on fossil fuel consumption for power generation and achieve about 30% renewable energy contribution in the first year of the project's operation in the states of Yap and Kosrae.	2,533 tCO_2e per year	Under implementation

117 SPREP: Secretariat of the Pacific Regional Environment Programme
118 GIZ: Deutsche Gesellschaft für Internationale Zusammenarbeit

Project	Agency	Activity	Estimated emission reduction	Status
M4: Micronesia Public Sector Buildings Energy Efficiency (MPSBEE) Project	UNDP GEF-6	Improve application of energy conserving and energy efficient (EC&EE) techniques and practices in the design, retrofit, and ongoing operation and maintenance of public sector buildings in the FSM.	Estimated project lifetime direct GHG emission reductions: 23,842 tCO_2e The Range of lifetime consequential GHG emission reduction is estimated between 99,800 – 286,109 tCO_2eq	Under implementation (Launched in 2021)
M5: Sustainable Energy and Accompanying Measures (SEAM): Renewable Energy and Energy Efficiency (REEE)-FSM Sustainable Energy (FSM.SE)	European Union EDF[119]-11	Support, in the four FSM's states, the transition to renewable power options into the future, by improving access to renewable energy, especially in un-electrified low-lying islands communities of Chuuk, and supporting private sector investment in energy efficiency and renewable energy supply.	End of the project target: 28% reduction in emissions from the year 2000 by 2025	Under implementation
M6: Sustainable energy development and access project	World Bank - Grant	Improve reliability of electricity supply in Pohnpei State, expand access to electricity and scaling up renewable energy generation by installing a utility-scale solar power plant to reduce fuel cost of diesel-based power generation in Chuuk State; scaling up renewable energy generation and increase storage capacity in Yap and Kosrae	137,000 tCO2e	Planned

[119] EDF: European Development Fund

Figure 5. Number of registered vehicles in the FSM by State.



Transport

A large part of transport activities in the FSM is carried out over the sea and/or land. There have been some limited efforts undertaken by the private sector to increase the efficiency of vessels through the introduction of renewable energy vessels into operations. Since 2018, the *Okeanos Sustainable Sea Transport Ltd.* have operated three *Vaka Motu*[120] (boat for the island) vessels in the FSM for inter-island travel. These traditional sailing canoes are powered through renewable energy (wind and solar) and biofuel (coconut oil). The operation of renewable energy vessels represents a transformational change in the concept of sea transportation, which has helped FSM to reduce and avoid carbon dioxide emissions while reinforcing the Pacific's traditional way of transportation. Though efforts have been put in place to improve low emission sea transportation in the FSM, there are still large transportation gaps and limited access to the remote outer island communities, which are still largely in need of consistent services such as health and education. Unfortunately, tracking emission reduction from these measures remains a challenge.

Diesel and gasoline fuels used in road transportation are also a source of emissions. Land transport is largely dominated by second-hand imported vehicles that are characterized by high fuel consumption and high-level emissions. There has been an increase in imported vehicles since 2010, with much of the imported vehicles being concentrated in Pohnpei State (Fig. 5). At the state level, the state of Chuuk has implemented measures to reduce importation of high-emission vehicles. Through the Chuuk State Clean Environment Act of 2018, Chuuk has banned importation of noncommercial vehicles with over 100k miles. A concern regarding older vehicles is not only that they have higher emissions potential, adding to the states total GHG inventory, but also that they are closer to the end of their usable life and may soon become a disposal issue for the FSM. The state of Yap, through its 2015 Air Quality Regulations requires that all vehicles and machinery pass the visible emission check before registration or during registration renewal. Similarly, Pohnpei has Air Pollution Control Standards and Regulations.

Solid waste and wastewater

Waste management is a growing challenge in the FSM due to the limited land space available for waste disposal and the fragile ecosystem of the country. Although the FSM state governments have been working to reduce unmanaged open burning and illegal dumping, these issues still persist. The Waste sector emissions in FSM

[120] https://okeanos-foundation.org/vaka-motu/

reached 27.24 Gg CO_2e from 14.50 Gg CO_2e in 1994 (SCS Ltd., 2022). The waste sector emissions show a decreasing trend during the inventory years 2001 to 2018. This is mainly due to decrease in the reported population of the country between years 2000 to 2010 and some of the waste disposal sites were rehabilitated and upgraded to semi-aerobic type from anaerobic (SCS Ltd., 2022). Over the period 2001-2018, GHG emissions from solid waste disposal have decreased from 26.22 Gg CO_2e in 2001 to 24.22 Gg CO_2e in 2018. This decrease is mainly attributed to decreasing population, rehabilitation and upgrading of the several landfills from unmanaged to semi-aerobic site (SCS Ltd., 2022). According to the FSM's NIR (SCS Ltd., 2022), solid waste and wastewater disposal and treatment activities contributed to about 54% of methane emissions in the FSM for the period 2001-2018 (SCS Ltd., 2022). The largest contribution to methane emissions is from solid waste with an average of 0.901 Gg CH_4 over the period 2001-2018, whereas average emissions from wastewater treatment and disposal are estimated at 0.06 Gg of CH_4 and 0.0051 Gg N_2O over the same period.

Solid waste and wastewater are managed at state level through state agencies and utilities, respectively. In recent years, the four FSM's States have developed,[121] solid waste management plans that have been recently updated into States' Solid Waste Management Strategy[122] (SWMS) for the years 2019-2028 utilizing funds from the Japan International Cooperation Agency (JICA) and assistance from J-PRISM II. The goal of the SWMS is to establish a technically sound and financially sustainable solid waste management (SWM) system in each of the four states. This includes proper management of landfill sites and recycling of beverage containers. Disposal of solid waste in unmanaged systems contributes to GHG emission due to waste generated methane gas released as it breaks down, thus contributing to global warming. The FSM ratified the Stockholm Convention (SC) on Persistent Organic Pollutants (POPs) in 2005, under which, the FSM committed to take measures to eliminate or reduce the release of 12 different POPs into the environment. Under Article 5 of the SC, FSM is required to implement measures to reduce and eliminate the release of dioxins and furans from unintentional sources (uPOPs), which are generally from the open burning of organic waste (kitchen and yard waste) and other materials containing chlorine (e.g., PVC plastic). The use of efficient waste disposal systems and the reduction of the overall amount of waste generated can reduce these emissions and mitigate their impact on the environment. The 2018 revision of the National Biodiversity Strategic Action Plan (NBSAP), and its subsequent implementation, provides the basis for interlinkages between climate change adaptation and biodiversity conservation. The management of solid waste is a cross-cutting issue in small islands that if left unchecked, reduces ecosystem resilience, impacts biodiversity and holds great potential to increase GHG emissions. Addressing SWM issues will help the country tackle emission reductions while improving ecosystems resilience to climate change.

Mitigation actions for the Waste Sector

As part of the JPRISM I, the states phased out open dumping and transitioned to controlled facilities under semi-aerobic conditions, known as the Fukuoka Method.[123] The Fukuoka method was used to rehabilitate the states' existing dumpsites and convert them to a low-cost sanitary landfill system (Table 6). Comparative studies[124] between open unmanaged waste systems and a semi-aerobic landfill suggested that the Fukuoka method has the potential to reduce 37%-40% of GHG emissions produced by open, unmanaged waste systems. Currently there are no specific estimates on GHG emissions reduction from the implementation of the Fukuoka method in the FSM. Under the FSM Updated NDC (2022), the country conditionally committed to undertake a national

[121] Japanese Technical Cooperation Project II for Promotion of Regional Initiative on Solid Waste Management Strategy in the Pacific Island Countries.
[122] Solid Waste Management Strategies for the four states are as follow: Chuuk State Solid Waste Management Strategy 2019–2028; Pohnpei State Solid Waste Management Strategy 2019 – 2028; Kosrae Solid Waste Management Strategy 2019–2028
[123] The Fukuoka method promotes the use of semi-aerobic sanitary landfills that accelerate waste stabilization in the landfill, control CH4 gas emissions and reduce leachate generation. In landfills that employ the Fukuoka Method, leachate (wastewater) is quickly removed from waste materials, allowing the inflow of air, which, through internal fermentation heat, accelerates the decomposition of waste materials, thus improving leachate water quality and inhibiting the emission of methane gas. https://www.japanfs.org/en/news/archives/news_id031355.html
[124] dos Muchangos L.C., Tokai A. (2020). Greenhouse gas emission analysis of upgrading from an open dump to a semi-aerobic landfill in Mozambique –the case of Hulene dumpsite. Scientific African 10, e00638.

methane inventory and assessment of methane abatement opportunities, which can help address this gap (Table 6).

Table 6. Final waste disposal in FSM's States[125] main islands (Source: FSM State of the Environment, 2018).

States	Yap	Chuuk	Pohnpei	Kosrae
Final waste disposal in FSM main islands	In Yap proper, the majority of solid waste (>80%) is properly disposed of in the public landfill, while 14% is dumped at community sites. Yap public landfill implements the semi-aerobic sanitary landfilling Fukuoka Method.	In Weno, the majority of solid waste (> 70%) is discharged to the Marina interim dump site. The remaining 23.2 %, is disposed of in unmanaged open dump sites. Fifty-two percent of the incoming waste to the Marina interim dump site is brought directly by households and business entities	The Dekehtik landfill site on Pohnpei island, in operation since 1997 was improved by adopting the Fukuoka Method. This site reached its maximum capacity in 2018 and therefore a second sites, employing the Fukuoka Method, was developed	Kosrae's landfill site entered in operation in 2009. Kosrae's landfill implements the semi aerobic sanitary landfilling method called "Fukuoka Method."

Additionally, each state has approved legislations for the recycling of aluminum can beverage; banned the use of plastic bags; implemented Reduction, Reuse, and Recycling (3R) awareness and education campaigns; and executed activities which addresses the challenges of islands with small land masses to further reduce the amount of waste disposed in the landfills, including biodegradable waste. The states' governments, in collaboration with NGOs, are promoting composting of biodegradable waste for agriculture use. Although some GHGs (methane and nitrous oxide) are emitted from the process of composting and from farmlands applying the compost, the alternative for FSM's farmers is the use of imported compost or fertilizers, which have a larger carbon footprint.

A summary of the actions implemented by the FSM states and National governments to reduce GHG emissions from solid waste are shown in Table 7.

Table 7. Actions to reduce disposal of solid waste in landfills and control GHG emissions

Action	Description
Establishment of Solid Waste Management Strategies	All states have adopted Solid Waste Management Strategies to reduce solid waste that enter states' landfills.
Recycling program: Container Deposit Legislation (CDL)	The FMS's States have adopted Container Deposit Legislation (CDL): Pohnpei Chapter 3 of Title 27 of the Pohnpei Code pertaining to the recycling of beverage containers was amended in 2016 to require importers to pay deposits at the time of import; Yap is implementing CDL under the Yap State Recycling Act and associated regulations; Kosrae is implementing CDL under its Recycling Program Regulations and adopted in 2013 the Scrap Metal Regulations to implement the Kosrae Scrap Metal Recycling Program.

[125] Source: SPREP (2019). FSM State of the Environment 2018. Apia.

Action	Description
States laws to ban use of plastic bags	Yap 2014 Regulations for the prohibition of plastic bags, banning the distribution of disposable plastic bags. Kosrae 2014 Act to end the provision of non-recyclable and non-biodegradable single-use plastic bags and single-use polystyrene foodservice ware products.
National law to ban import of Styrofoam, plastic food service items and plastic bags	On June 2020, the FSM has enacted a law (Public Law 21-76) to ban imports of one-time-use disposable Styrofoam, plastic food service items (i.e., plastic cups, straws and other eating utensil) and plastic bags, which will further reduce the amount of non-biodegradable and compostable material entering the states landfill.

In the four states, wastewater systems are limited in space and capacity, with a large number of households discharge their wastewaters into septic tanks or directly into the environment. Sewage plants are managed by the states' public utilities: in Chuuk, CPUC is responsible for the wastewater services to the island of Weno, the remaining islands in the Chuuk lagoon utilize septic tanks or release sewage directly in the environment; in Pohnpei, PUC has the mandate to operate the sewage plant that collect and treat effluents from the town of Kolonia, in the rest of the island, septic tanks are the only method for wastewater disposal; in Kosrae, the Department of Transportation and Infrastructure has mandate for wastewater services, but since the service is currently not available, households wastewater on the island is discharged in septic tanks or directly in the environment; in Yap, the Yap State Public Service Corporation is responsible for a sewer collection system has been deployed in Colonia area, but on the rest of the island, the population discharges the sewage into private septic tanks or directly in the environment.

AFOLU

The Agriculture, Forestry and Other Land Use sector includes anthropogenic GHG emissions and removals by sinks that occur on managed lands. Most climate change related projects and programs in the AFOLU sector are adaptation oriented, with the aim to decrease climate change impacts and improve resilience and adaptive capacity of communities and ecosystems. The actions presented in this section were implemented for biodiversity conservation and climate change adaptation, although the FSM Updated NDC (2022) has targets to effectively manage 30% of terrestrial resources due to mitigation co-benefits.

Agriculture

The FSM's total GHG emissions from the Agriculture sector totaled 28.43 Gg CO_2e in 2018. The emissions from "Livestock" and "Aggregate sources and non-CO_2 emissions sources on land" sub-sector in the FSM shows a decreasing trend until the year 2014 and thereafter increases slightly during the end years i.e., during 2015 to 2018 (SCS Ltd., 2022). Important mitigation actions, with potential for emissions reduction, have now been included in the FSM Updated NDC (2022).

The FSM Updated NDC's target of increasing the production of coconuts and coconut-based projects by 2030, has the potential to enhance the use of locally sourced biofuels from coconut by-products, which can assist the FSM to further reduce dependency from imported fuel and carbon dioxide emissions. The FSM has a limited land mass and most of it is covered by forest (66%) or utilized for agroforestry (18%).[126] Agroforestry, which is largely promoted as traditional practice for adaptation, is known to contribute to carbon sequestration. In 2021, the Green Climate Fund approved the disbursement of funds for the adaptation project *Climate resilient food*

[126] SPREP (2019). Federated States of Micronesia State of Environment Report. Apia, Samoa.

security for farming households across the Federated States of Micronesia (FSM), implemented by the Micronesia Conservation Trust (MCT). This project has a strong focus on climate change adaptation, but the actions for promoting and establishing a traditional and climate resilient agroforestry system will also contribute to carbon sequestration and address the country's food security mitigation targets. An important co-benefit of enhancing food security in the FSM is the decreased reliance on imported food, which overall have a positive impact on the associated GHG emissions from imports.

Livestock in the FSM is maintained at subsistence level and it is a major source of methane emissions, after the waste sector in FSM. Livestock sector emissions reached 22.35 Gg CO_2e in 2018 from 0.75 Gg CO_2e in 2000 (SCS Ltd., 2022). Major share of GHG emissions in FSM's agriculture sector comes from Livestock farming, mainly manure management (77%) and Enteric fermentation (3%). The rest comes from Direct N_2O emissions from managed soil (14%) and Indirect N_2O emissions from managed soils, 2.8%, and manure management 3.2% (SCS Ltd., 2022).

Forestry and Other Land Use

Forests in the FSM varies across the four states and include montane rainforest, lowland tropical rainforest, agroforest and mangrove swamps,[127] all of which are carbon sinks that can significantly contribute to emission reduction. The NIR does not estimate the emissions from Forestry and Other Land Use due to limited data available for calculations. Nevertheless, since FSM's forests are important carbon sinks that can considerably contribute to removal, the NIR Improvement Plan, recommends the collection of data for this sub-sector (SCS Ltd., 2022).

Most climate change related projects and programs in the forestry sector are adaptation oriented. Conservation and protection of forests and wetlands for adaptation purposes has mitigation co-benefits, including the persistence of functional carbon sinks. The strong interlinkage between the conservation of these ecosystems for biodiversity and climate change adaptation and mitigation is emphasized in the UNFCCC COP Decision 1/CP.26 (2021) which "recognizes the critical role of protecting, conserving and restoring nature and ecosystems in delivering benefits for climate adaptation and mitigation, while ensuring social and environmental safeguards." In 2018, through the Micronesia Challenge (MC), the FSM expanded its ambitions to effectively manage 30% of terrestrial resources. In 2015, the FSM's National government established the Protected Areas Network (PAN) National Guiding Policy Framework.[128] The PAN Policy Framework assists the country in expanding the number of terrestrial and marine protected areas across the four FSM's states, further advancing the protection of FSM's carbon reservoirs from losses associated with deforestation, forest and land degradation, urbanization, and other land mismanagement practices. Both the MC and PAN are protection tools that the FSM has established to enhance biodiversity and ecosystem services, such as carbon sequestration, as well as expanding carbon stores in forests, including through reforestation, afforestation, and forest management efforts. In addition, fire management plans have been developed and are implemented in the four FSM's states, which assist in reducing emissions of other greenhouse gases from land use interventions from fire management.

Since 2016, afforestation and reforestation activities of degraded upland forest, wetlands and mangrove areas were sustained and increased through the implementation of the National Ridge to Reef (R2R) Project, funded through UNDP GEF-5. The R2R project targets to rehabilitate upland forests, wetlands and mangroves, and to protect terrestrial ecosystems that are crucial for biodiversity.

[127] The Percentage of forest area by forest community across Micronesia in 2016 was: 5.1% montane rainforest, 60.7% lowland tropical rainforest, 18.2% agroforest and 15.7% mangrove swamps (FSM State of Environment Report, 2018)
[128] https://www.cfsm.gov.fm/ifile/20%20congress/PASSED%20RESOLUTIONS/CR_NO_20-87.pdf

Industrial Processes and Product Use (IPPU)

One mitigation strategy that FSM identified in this sector is the phase down of the use of HFCs.[129] In May 2017, the FSM ratified the Kigali Amendment of the Montreal Protocol to phase down the global use of Hydrofluorocarbons (HFCs) that are known to be potent greenhouse gases. Through this ratification, the FSM committed to phasing down HFC consumption starting in 2024. In 2015, the FSM developed an HCFC Phase-out Management Plan (HPMP) in which enabling activities will focus on analyzing and forecasting consumption for HFCs and non-ODS alternatives. Data collection for HFC was programmed for 2020 – 2022, but it was delayed due to the Sars-Cov-2 pandemic. The data will be used to calculate the country's baseline that will be established in 2024. The average HFC consumption values for 2020 – 2022 will serve as starting point for the global HFC phase-down for A5 Group 1 countries in 2024.[130]

Synergies between Mitigation Efforts and SDGs

As a small island developing state (SIDS) experiencing systemic vulnerabilities and structural challenges caused by its limited size and high exposure to natural disasters, the FSM is exposed to several shocks outside its control. The FSM is therefore promoting synergies between initiatives to mitigate climate change and promote other co-benefits. In addition to helping fulfil sustainable development goal 13 (Climate Action), 13 other SDGs are targeted by the various outlined climate actions listed in this chapter or implemented (Table 8). Affordable and Clean Energy (SDG 7), Life on Land (SDG 15), Clean Water and Sanitation (SDG 6), Sustainable Production and Consumption Patterns (SDG 12) and Life Below Water (SDG 14) were recognized as the most likely to be fulfilled following the successful implementation of the various mitigation policies currently implemented in FSM. In addition to SDGs, the mitigation climate actions had wider impacts including fulfilling SAMOA[131] Pathway Climate Change [44, 45], Sustainable Energy [47, 48, 50], Oceans & Seas [53], Sustainable Transportation [67], Water & Sanitation [65-b], Management of chemicals and waste [71-d], Biodiversity-*Forests* [94-b]

[129] HFC: Hydrofluorocarbons
[130] FSM and the Montreal Protocol: https://decem.gov.fm/ozone-layer/
[131] SIDS Accelerated Modalities of Action (SAMOA) Pathway: https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/69/15&Lang=E

Table 8. Synergies between mitigation actions and SDGs by sector

	Mitigation areas					
	Energy	Transportation	Waste	Agriculture	Forestry	IPPU
1 NO POVERTY				✓	✓	
2 ZERO HUNGER				✓	✓	
3 GOOD HEALTH AND WELL-BEING	✓					
4 QUALITY EDUCATION	✓					
5 GENDER EQUALITY	✓					
6 CLEAN WATER AND SANITATION			✓	✓	✓	
7 AFFORDABLE AND CLEAN ENERGY	✓					
8 DECENT WORK AND ECONOMIC GROWTH				✓		
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	✓		✓			
10 REDUCED INEQUALITIES	✓		✓			
11 SUSTAINABLE CITIES AND COMMUNITIES	✓					
12 RESPONSIBLE CONSUMPTION AND PRODUCTION	✓		✓	✓		✓
13 CLIMATE ACTION	✓	✓	✓	✓	✓	✓
14 LIFE BELOW WATER	✓	✓	✓	✓	✓	
15 LIFE ON LAND			✓	✓	✓	
16 PEACE, JUSTICE AND STRONG INSTITUTIONS						
17 PARTNERSHIPS FOR THE GOALS	✓					✓

Domestic Measurement, Reporting, & Verification (MRV)

Introduction

A comprehensive Measurement, Reporting, and Verification (MRV) system is integral to a developing country's capacity to effectively monitor and evaluate the progress made in the implementation of its mitigation and adaptation actions as it pertains to greenhouse gas (GHG) emissions, climate change adaptation, financing, and the benefits accrued as the country implements actions to meet their sustainable development goals. Nationally Determined Contributions (NDC) are key features within the MRV as it defines the country's mitigation and adaptation goals, policies, and legal structures. The elements of a domestic MRV supports a country in assessing its progress towards reducing its emissions and ensuring its adaptative capacity. Furthermore, the MRV system is a critical component of the UNFCCC framework, to increase the transparency of mitigation efforts by all member countries and is intended to foster trust and confidence between parties.

Existing MRV Systems

In the FSM, data collection and storage is segregated and conducted on an ad hoc basis. Though the FSM Climate Change Act[155] states that all FSM government departments must mainstream climate change into all departmental programs, the Act does not define the process by which climate mainstreaming should occur, nor does it provide the basis for data collection or information sharing. As such, data collection is project specific, gathered during the project's timeframe, and is not conducted on a continuous basis. However, the FSM is making a concerted effort to monitor projects and centralize information through the Office of Overseas Development Assistance (ODA), whose purpose "*…is to establish approaches to managing our development assistance such that benefits are maximized for all stakeholders. For the FSM this involves positive, sustainable outcomes for individuals, communities, organizations and governments. For our development partners it means effective use of resources and strengthened relationships with the FSM.*"[156] The FSM, through the Office of ODA, is determined to strengthen "core government functions" to guarantee that resources obtained – domestically and abroad – are effectively utilized, efficiently dispersed, and financially accounted for.

Assessment of the FSM capacity to address MRV: Gap Analysis

In the FSM, capacity to develop and implement a comprehensive national MRV system is limited. Though the FSM's adaptation targets are comprehensive, and institutions and stakeholders at the National and Subnational levels are clearly identified, it is not the same for mitigation. Moreover, adaptation targets that have overlapping mitigation outcomes are not fully designed or developed to inform mitigation outcomes, and the FSM does not currently have a system in place to accurately capture the information.

Institutional arrangements, data collection, and identified stakeholders at the National and State governments and civil society have been identified for adaptation and biodiversity conservation, through the Micronesia Challenge (MC), the National and State Biodiversity Action Plans, and through project technical committees that include civil society organizations (CSO) and government. The information and data collected by various stakeholders could be utilized as mitigation data, however, the legal framework, policies, and communication arrangements are not designed to capture mitigation outcomes. Furthermore, institutions and stakeholders, who intuitively would be responsible for capturing mitigation data at the State and National levels, are not mandated to obtain or monitor mitigation data; are not technically equipped to gather and store data; and do not have the capacity to effectively capture or monitor appropriate mitigation information.

Multiple stakeholder engagement workshops were conducted across the nation to ascertain the FSM's current capacity and institutional and data collection infrastructure. The workshops and the evaluation of the current status of FSM's institutional arrangements and policies indicates the need for a domestic MRV structure for the nation.

	Legislative Conditions
Legal Mandate(s)	The Department of Environment, Climate change and Emergency Management (DECEM) is the focal point for the implementation of climate change obligation, including mitigation and disaster emergency response and management. The Department of Resources and Development (DRD) is the focal entity for energy and responsible for managing the implementation of the nation's energy master plan. It is also the principal department that houses the Office of Statistics and the responsible for Protected Areas Network (PAN) and the Micronesia Challenge.
MRV Legal Framework	FSM does not have an institutionalized legal framework in place for MRV
	Institutional Structures
Institutional Arrangements	DECEM is the legally mandated focal point for climate change initiatives in the country, and stakeholders and departments in each of the states have been identified to support the implementation of climate change and mitigation activities on the ground. However, none of the stakeholders and government departs have been officially designated and the establishment of a mechanism for a functioning domestic MRV system with consistent participation does not exist. Implying that coordinated work by DECEM is not based on an existing formal structure.
Roles & Responsibilities	Each of the stakeholders (government departments and CSOs at the national and state levels) have clearly defined roles and responsibilities in the sectors where they operate. However, their roles as it pertains to implementing the MRV is not defined at all levels of government (national and state).
Capacity	Limited capacity and expertise exist to fully execute a robust domestic MRV system.
Multi-sectoral Support	Multi-sectoral arrangements across departments at National and Subnational levels, with the inclusion of the private sector and civil society has yet to be established. Collaboration is usually designed as needs and determined by project.
	Procedural Structure
Database Management & Information Systems	Data base management systems and information repositories have not been developed for capturing data necessary to track mitigation information. Adaptation and biodiversity conservation information is collected by various institutions and the information is shared for the purpose of reporting and updating the FSM government and various stakeholders on the progress of the Micronesia Challenge[157158].
Guidelines & Tools	Limited tools and the absence of data collection protocols and guidelines for gathering data.
Technical Working Groups	FSM established working groups during the Second National Communication reporting. However, these working groups were not formalized and the lack of a formalized process is a challenge for continuous data collection, sharing and storing.
Baseline Information	Currently lack baseline information for a MRV system and the capacity to establish criterion in order to determine future projections.
Verification Systems	Currently do not have verification procedures in place.
Communication Systems	Stakeholder engagement is standard for the FSM, as all aspects of environmental management and climate change adaptation implementation are carried out by the States. However, standardized procedures for data collection, communication, and engaging the wider and diverse set of stakeholders is limited. Furthermore, data publication is limited to a small subset of stakeholders.
Information Management:	GHG Data Collection & MRV Systems
Guidelines for Data Collection & Reporting	Identification of key datasets and existing templates or guidelines for data collection and reporting at sectoral levels do not exist.

Challenges	Lack appropriate funds to collect needed data. Submission of data at sectoral levels is not mandatory.
Existing Data Collection	Data collection is performed on a per project basis and is not compulsory beyond the life of a project.
Data Management	Strategies for data management, regular updates of information, data backup, and secure data repository, with archival routines, are not currently in place.
Handling of Data	Policies and procedures for handling data, including confidentiality and privacy, do not exist.
GHG Registry	A national GHG registry is not yet in place. GHG data gathering occurs for reporting purposes to the UNFCCC, National Communications and for the First Biennial Update Report. However, consistent data collection does not occur and an appropriate facility to store, maintain, and update the registry is currently nonexistent.
Public Communication	Reporting to the public about GHG data does not occur.
Quality Control – National	Quality assurance (QA) and quality control (QC) at the National level with a strategic action plan and detailed suite of responsibilities does not currently exist.
Quality Control – Sectoral	QC and QA at the sectoral level is not existent.
	Indicators: Mitigation & Adaptation Actions
Mitigation Indicators	Mitigation indicators, templates for the purpose of compiling data to create indicators are nonexistent, and timelines for data analysis on identified indicators, does not exist.
Indicators for Data	Data on indicators do not happen on a regular basis, as indicators have yet to be set.
Mitigation Actions: Quality Control & Quality Assurance	Does not occur.

Actions Needed

This gap analysis identifies areas that the FSM should consider improving and/or establishing in order to build a system to support the tracking and management of GHG emissions to support policies for data collection and for the implementation of mitigation and adaptation actions.

Legislative Conditions:

- Although the FSM has a Climate Change Policy, there are no procedural arrangements for data collection, management, and sharing. The policy does not identify a coordinating body to actively support the collection of data and the dissemination of information to stakeholders. Though the Climate Change Act states that all Departments, at the National Level, are to provide DECEM with their climate change policies, strategies, and plans, tracking the implementation or effectiveness of Departmental climate change policies or how Departmental actions contributes towards the FSM's adaptation or mitigation goals and targets remains a challenge.
- Legislation and policies for adaptation and biodiversity conservation focus primarily on state of the environment (SOE) and state of conservation (SOC) impact, but do not include mitigation targets. These policies could be expanded to include mitigation outcomes as nature-based solutions (NbS) and could be recognized as playing a role in GHG emissions mitigation.
- Development planning legislation includes climate adaptation and requires extenuation plans to offset environmental impacts; however, it does not require future development projects to include climate mitigation.

Institutional Structures:

- Formalized procedural arrangements need to be established to ensure that government departments at the National and Subnational are included in the MRV system.
- MRV data sharing between government departments at the National and Subnational levels need to be established.
- The FSM Energy Masterplan's primary purpose is to ensure that 100% of the FSM has access to electricity by 2027. Secondarily, that the energy provided is clean and renewable. However, departments at the national level (e.g., Resource & Development (R&D) and Transportation, Communication & Infrastructure (TC&I)) and state level (Environmental Protection Agency (EPA) and Public Utilities Companies) are not required to capture GHG emissions or mitigation outcomes.

Procedural Structures:

- FSM has established an institutional arrangement to monitor, report, verify, and respond to the review of GHG estimates, to further the process for data compilation and continuous improvement in an NIR is an important aspect of institutional arrangement.
- The Department of Environment, Climate Change, and Emergency Management (DECEM) is the national entity responsible for NIR and NC reporting in FSM.
- The MRV system should not only capture GHG emissions, but should integrate:
    - Sustainable development goals;
    - Capture transformative changes that are occurring;
    - the impacts of progress and how resources are spent while implementing the MRV; and,
    - It is important that clear strategic plans with appropriate indicators and targets are developed, backed with clear procedural processes and robust communications plans.
- The 2006 IPCC Guidelines (Tier 1 approach) was used to inform the national GHG inventory for the

year 2018 (also include for the period 2001 to 2017). Further, the IPCC Good Practice Guidance have also been used to ensure precision and reliability of the national inventory and to fulfil the UNFCCC data quality principles of transparent, consistent, comparable, complete, and accurate (TCCCA).

GHG Data Collection & MRV System:

- Non-GHG emissions data, indicators, and impacts identified in the FSM NDC, which recognizes biodiversity, environmental, socioeconomic, and multi-sectoral benefits, should be a part of the MRV system, as NbS have mitigation relevance.
- In the development of a national MRV system, the sectors identified in the mitigation plan are related to achieving the goals listed within the FSM's NDC.
- Improvements need to be made for procedures for data collection and compilation for the next inventory cycle and BUR:
  - Type of Data Collection: activity data from the different industries, public and private sectors as well as institutions and departments should be formalized via a suitable instrument, such as, but not limited to legal contracts, Memorandum of Understanding (MoU), Memorandum of Agreement (MoA), or other legal documents.
  - Formalized database management, archives, and institutional setup for tracking the implementation and outcomes of legal contracts, MoU, MoA, and other legally binding agreements.
  - Established arrangements for implementing improved QA and QC procedures, management and operating the inventory database, and document and archive inventory information and the operation of the inventory.
- As the FSM develops its MRV system, specific goals, objectives, and needs should be clearly defined. Preferably, this would be done at the national level and for each of the key mitigation sectors. Scenarios should be established, and the potential outcomes and impacts should be listed within the MRV, which would include categories such as GHG (reducing emissions), non-GHG impacts (contributions to the FSM development goals, climate adaptation, and gender inclusion), as well as progress towards achieving the goals of the NDC.
- Conversely, Key Performance Indicators (KPIs) should be developed per sector and measurement indicators to determine impacts per identified category. These indictors should be in line with the NDCs.

Establishing an MRV System for Mitigation and Adaptation Actions in the FSM

The gaps identified in Section 1 (through a comprehensive Mitigation and MRV workshops at national and state levels) has prompted the FSM to begin discussions to design and establish a domestic MRV system to monitor and evaluate its progress towards meeting its mitigation and adaptation goals listed in the Nationally Determined Contributions (NDC 2022[132]). It is understood that the establishment of a national infrastructure to manage the MRV system will necessitate protocols supported by legislation, with clear procedural arrangements, to collect, authenticate, archive, and distribute information. It is understood that clear mandates must be established to provide authority, with clearly identified roles and responsibilities, be instituted to ensure proper governance and management of a domestic MRV structure. With the establishment of a MRV system, the FSM will need to consider actions that are necessary to prepare the government, and appropriate institutions and stakeholders, for GHG emissions data collection and management. These actions include identifying the appropriate institution(s) to manage data collection and storage, build the capacity of government agencies to support the collection of data, and establish legal structures to not only support the implementation of the MRV system, but also for verification, and dissemination of information.

[132] Department of Environment, Climate Change and Emergency Management (DECEM) 2022. Updated Nationally Determined Contribution of the Federated States of Micronesia for the period through 2030.

Recommendations

Corresponding with the identified gaps, in line with the National Circumstances, and based off the recommendations provided through multiple stakeholder engagements at the national and sub-national levels, the FSM identified the following actions that need to be taken to establish a domestic MRV system:

Identify an institution or create an agency that can support the coordination of data collection and communication of a MRV system.

- Ensure legal and procedural arrangements are in place to support effective implementation and management of a domestic MRV.
- Ensure the establishment of a data management system for archiving and analyzing MRV data.

The FSM is fully aware that proper authority and delegation of duties are integral for the governance of a domestic MRV (dMRV) system. As such, the FSM is investigating opportunities to support the creation of a structure with the necessary legal and institutional support at the national and subnational levels to ensure success. As part of this process, it is imperative that institutional capacity and stakeholder development are prioritized to ensure that data collection and management for GHG emissions, in concert with the preparations of scenarios, forecasts, and goals, to ensure FSM attains and remains at a net neutral GHG country.

	Recommendations
MRV Situational Analysis	a) Mitigation analysis at the national and sectoral levels conducted to define priorities within the MRV. b) State of readiness of existing structures, processes, institutional capacity and proficiencies, and the availability of existing baseline data and their quality should be determined. c) Ascertain if current MRV efforts, such as an existing GHG Inventory, have sufficient foundations to build and improve on.
Common MRV Framework	a) Ensure that existing institutional arrangements for the implementation of MRV systems and for coordination of MRV activities are established. b) Institute clear roles and responsibilities, with supporting operational procedures, templates, and a proper data management system.
Methodologies	a) Define sector specific parameters, in line with the common MRV Framework, that includes well defined MRV methodologies. b) Sector specific parameters should include KPIs, disaggregated data needs, and the different factors at various levels of mitigation actions. c) Identify key stakeholders (ensuring their roles and responsibilities are clearly specified) who are involved in key mitigation sectors at each level of government (national and state), as well as across sectors, and those who are involved in implementation of mitigation actions.
Framework	Establish appropriate and reasonable legal infrastructure to support the implementation of a domestic MRV to properly fulfill reporting requirements domestically and internationally.
Establishing Protocols	Create mandates that establishes protocols and procedures to ensure effective consultations with stakeholders.
Capacity Building	Establish regular and ongoing capacity building of institutions involved in the MRV system, to ensure proper implementation and operations. Capacity building should include agencies and offices within departments, state government agencies, municipal agencies, private sector/companies, and civil society organizations.

Next Steps

Based on the gaps that the FSM identified during the stakeholder engagement process, and by developing mitigation scenarios in certain key sectors, the FSM identified key actions that need to be undertaken in order to develop a functioning MRV system.

Actions for Consideration	
Define NAMA	Define the scope and logical framework to determine mitigation action by creating a master plan to determine how goals will be met, ensuring that there is a clear delineation between objectives and actions, and outputs verses outcomes.
MRV Strategic Plan	Create a MRV strategic action plan to ensure proper management, governance, and functions of all entities involved in the implementation of the domestic MRV.
Strengthen Capacity	Establish capacity at the National and subnational levels to increase their knowledge in existing institutional arrangements and further expand existing arrangements to: d) Broaden stakeholder engagement process to ensure cross-sectoral input to ensure buy-in from a wider range of stakeholders. e) Increase capacity to review and amend existing regulatory framework, to restructure existing legislation and regulations to support the establishment of a national MRV system. f) Build capacity to collect, manage, and monitor data, and to effectively report on information gathered to stakeholders at the national and subnational levels.

Resourcing & Staffing	Secure funding to support training of key technical staff from relevant government departments and agencies, to develop technical and management skills in order to collect, monitor, and report on the FSM's mitigation progress.
Coordination	Furthermore, establishing a formalized working group with clearly established goals and standard operating procedures to guide coordination between the working group and key stakeholders.
Human Resource Development	Establish and resource a government institution that is designated with managing the National MRV system. Ensure that the expertise required and enabling legal conditions are conducive to ensure that the institution is well equipped to fulfill their duties: a) Include capacity development into the MRV process b) Reduce turnover by establishing work incentives c) Incorporate development needs of key relevant stakeholders g) Consolidate learning needs and activities into strategic action plans and institutional development goals.
Establishing Protocols	Create mandates that establishes protocols and procedures to ensure effective consultations with stakeholders.
Identify Gaps in Legislative and Regulations Framework	Creating effective communications protocols and proper flow of communication to support the identification of gaps in the regulatory infrastructure.
Developing State level Capacity	Develop a monitoring and reporting system with proper guidelines and standard operating procedures for all aspects related to the MRV system and establish strategic development plan that focuses on building capacity at the subnational levels to properly collect information.
Financial Reporting	Ensure transparency by establishing proper monitoring and reporting on the use of donor funds.

Establishing initiatives to develop a MRV system In Compliance with the Paris Agreement

The FSM submitted an inventory of its total GHG emissions for key sectors to the UNFCCC, in 2015, through its Second National Communication (SNC). The SNC focused on five (5) sectors: energy, industrial processes, waste, agriculture, and land use-change and forestry. During national and state stakeholder consultations in preparation for the Third National Communication (TNC) and the First Biennial Update Report (BUR), all stakeholders felt that the sectors identified in the SNC remained as priorities. These areas not only supported the FSM's intended mitigation actions, but they also had tremendous benefits that support livelihood, access to energy and transportation, and secures the nation's traditional cultural norms. The actions that the FSM intends to include in their mitigation and adaptation action are underpinned by a strong sense of responsibility to ensure that development and adaptation should include and incorporate traditional knowledge, ensure that vulnerable members of the population are included, and that all genders are equitably represented.

The SNC only included mitigation scenarios for the energy sector. However, in the TNC, the FSM has included agriculture, forestry and other land use, and waste, further emphasizing the nation's commitment to climate change mitigation. These added mitigation scenarios are efforts that not only contribute to global emissions reductions, but they also address immediate and very pressing community-level needs. Further ensuring that the FSM's mitigation approach has co-benefits that support adaptation, community resilience, and socioeconomic security. The FSM fully recognizes that in order to implement a national MRV fully and effectively it must build institutional and human resource capacity. It is imperative that the technical capacity is improved for public institutions and non-state actors; to develop guidelines for tracking climate change financing; and to establish enabling infrastructure in order to implement all necessary activities needed for the dMRV.

The FSM will investigate opportunities to establish appropriate data collection, data management procedures, and broaden legal instruments needed to establish and execute an appropriate MRV system. To do so, the FSM will need to address several key issues:

- Methodologies for data collection and data management.
- Guidelines that support continuous data handling, reporting, and sharing.
- Capturing socioeconomic and gender related progress impacts.
- Understanding how to detangle and report information that has co-reporting benefits (e.g., mangroves: carbon sequestering – mitigation – and shoreline protection – adaptation).

Nationally Appropriate Mitigation Action & the NDC

Through stakeholder engagements, the FSM discussed various types of MRV systems that could be relevant and most appropriate for the Nation's needs: a National Appropriate Mitigation Actions (NAMA), MRV of Emissions, and MRV of Support. The NAMA would be guided by the recently submitted NDC 2022, and the MRV of Support would be informed by the FSM Office of Overseas Development Assistance (ODA) through reporting requirements as detailed in their mandate. However, the FSM will have to develop clear outcomes to appropriately track the NDC, through the NAMA, and the impacts of the mitigation and adaptation actions taken. Though the NDC does make every effort to show linkages between mitigation action and co-benefits for adaptation and biodiversity and vice versa, a system such as the NAMA will require the FSM to:

- Fully understand their emissions outline by utilizing a well-established MRV of Emissions that tracks sectors with the largest emissions output.
- Establish priorities and the potential of the NAMA based on:
  - Top and most pressing priorities within the NDC
  - Cost of implementing mitigation actions
  - Adaptation benefits
  - How priorities affect and support the countries development goals
  - Country's current mitigation capacity and future potential

Components	Activities for Consideration
GHG Inventory & Adaptation	• Institutional arrangements enhanced and/or expanded facilitate implementation of roles and responsibilities and operationalize a MRV system that fully captures data and information at the sectoral and national levels. • Establish operational agreements (e.g., MOUs or MOAs) that are supported by legislations and regulations.
Tracking tools	• Develop indicators for tracking mitigation and adaptation actions, and the effects and co-benefits of policies and legislation in coordination with DECEM and other agencies who are responsible for collecting data that will contribute to the MRV. • Establish a data repository/hub and determine which Department within the National government is most suited to manage the collection and storage of data (e.g., Division of Statistics under the Department of Resources & Development).
Database Storage & Management	• Create coordination, ensure capacity building opportunities exist, and facilitate transparency. • Work with partner agencies and donor countries to support capacity building
Operationalize the MRV	Work with partners, experts, and donor agencies and/or countries to support capacity building of technical staff to full operationalize the MRV.

GHG Inventory Compilation – MRV of Emissions

- Activity data from the Energy sector (Fuel Combustion Activities), Agriculture sector (Livestock) Production and Waste sector (MSW and Domestic Wastewater) was collected to inform the inventory of years 2001-2018. Following data gaps and challenges were encountered in collecting data from stakeholders of the relevant sectors:
    - **Energy sector data**: Limited data was available on quantity of fuels imported to the country (data for the inventory years 2001-2009 not available). Hence, GHG emissions was computed using only reference approach. More data on fuel distribution and their consumption in different fuel combustion activities such as electricity generation, transportation, etc. should be obtained from FSM Petro Corp (FSMPC) and national statistics department for computing emissions using sectoral approach in the future inventory.
    - **Industrial Process & Product Use (IPPU) data**: Lime production takes place in FSM, however, due to the lack of data the emissions levels from this source category are not estimated. Similarly, Food Industries such as breadmaking and other food production process (e.g., meat, fish, and non-alcoholic beverages) exists in FSM which are source of non-methane volatile organic compounds (NMVOC) emissions, but lack of data on quantity of production of these food item and beverages were not possible to estimate the level of NMVOC emissions from this source category for the inventory period. Furthermore, FSM imports small quantities of products such as solvents, fire extinguishers, refrigerants, and ozone depleting substances (ODS) but due lack of data on quantity of products imported into the country, the GHG emissions from this source were also not estimated for this inventory period.
    - **Livestock Data**: Limited data available on total livestock population and livestock farming practices in FSM. The data used for the inventory period 2001- 2018 have been estimated based on the Integrated Agriculture census 2016 and Household Income and Expenditure Survey Report 2013-2014. The data for the missing years have been estimated using Extrapolation and Interpolation Techniques in accordance with the IPCC Good Practice Guidance (GPG). More detailed and granular data on livestock species and their population should be obtained from animal husbandry department for the future inventory.
    - **Forestry and Other Land Use**: Limited data and information available from this sub-sector hence emissions/removals were not estimated for the inventory years. Data on Land Use and Land Use change should be collected for future inventory.
    - **Waste Sector Data**: The waste (solid waste and wastewater) sector activity data monitoring and reporting needs to be initiated in urban centers.

MRV of Support

The FSM government through the ODA has been preparing a report with the assistance of the Department of Finance to develop a summary report of overall assistance that entered the Nation. The report will make an account of all ODA funded projects through expenditure reports. The information in the report will list the total assistance received by donor countries, development partners, and sectoral support. The report will also analyze the priorities that were set in 2016 and determine the status of priorities established in 2020.

During stakeholder engagements the FSM government felt that the Division of Statistic, within R&D, would be the best place to house and manage data, in collaboration with DECEM. DECEM would coordinate the collection of certain key data in partnership with ODA and key stakeholders at the state level.

Components	What is being Analyzed
Status of Projects Under 2016 Priorities	● Determine progress made on projects related to food and water security across the nation. ● Status of renewable energy projects as defined by the FSM Energy Master Plan ● Analyze progress made on road maintenance and development in Chuuk and Kosrae ● Status of air and seaports projects in Kosrae and Pohnpei
Amount of Assistance Received	● Determine the amount of assistance that has been received per priority and how the funds were directed and utilized. ● Work and coordinate with other agencies to determine how the funds were distributed, progress being made to made on national priorities, and how actions contribute towards the FSM development goals.
Donor Agencies	● Create coordination, ensure capacity building opportunities exist, and facilitate transparency. ● Work with partner agencies and donor countries to support capacity building
Operationalize the MRV	Work with partners, experts, and donor agencies and/or countries to support capacity building of technical staff to full operationalize the MRV.

Chapter 5
Vulnerability

Photo credit: FSM Department of Environment, Climate Change and Emergency Management

Empowered lives.
Resilient nations.

5.1 The Federated States of Micronesia's Vulnerability to Climate Change

The FSM is particularly vulnerable to climate change and likely to suffer serious adverse environmental, social and economic consequences. According to the Notre Dame Global Adaptation Initiative (ND-GAIN),[133] in 2020 the FSM was the 12th most vulnerable country to climate change and the 123rd in terms of climate change readiness in the world (FSM scored 0.58 on the vulnerability scale and 0.35 on the readiness scale). The geographic remoteness of the islands, limited infrastructure, dependence on foreign aid, and small landmass, which constrains any scalable development for export, exacerbates the nation's vulnerability. The FSM's population is already suffering from negative impacts associated with climate change, which will increasingly compromise land, fresh water and food availability and the maintenance of settlements and infrastructure, as well as economic activities. The FSM is particularly vulnerable to the combined effects of sea level rise, changes in rainfall and large-scale ocean-atmosphere oscillations (El Niño–Southern Oscillation [ENSO]), increasing tropical cyclone intensity, and ocean warming and acidification. Most of the nation's population, infrastructure and cultural sites are located within 500 m and 1 km of the coastline and therefore particularly vulnerable to climate-induced impacts.[134] Almost all of the FSM's outer island atolls lie within the 2-meter zone of potential sea level rise, and all lie within a 5-meter zone of storm surge. This poses a significant disaster risk to most public and private buildings, homes and infrastructures. The FSM's extensive coastline is prone to climate-induced coastal erosion, spring tides, and species loss / coral bleaching. The high dependence of the population on fisheries and agriculture for subsistence is another factor shaping the vulnerability of the FSM, since both sectors are particularly susceptible to climate change and the FSM population is highly dependent on marine biodiversity as a protein source. Natural hazards have affected the population and natural resources over the years, also contributing to human displacement, both internal (to urban centers) and external (to other countries), affecting the overall social capacity of the FSM. The reliance on economic assistance under the Compact of Free Association (COFA) and the impact of the Sars-Cov-2 pandemic on the national economy further exacerbates the FSM's vulnerability.

Small island developing states like the FSM are internationally recognized as very much at risk due to climate change and are often described as being at the frontline of climate change (Corneloup and Moi, 2014; Schleussner C-F and Kumar M, 2018, Walsh and Stancioff 2018). The recognized threat of climate change and the strong passionate advocacy of the small island developing states, through the Alliance of Small Island States, has been critical to influencing the United Nations Framework Convention for Climate Change attempting to hold the line on the projected temperature increase to 1.5° C (Betzold 2010, Ourbank and Magnan 2018, Thomas et al. 2020). While these efforts continue, current trends in global temperature will exceed the 1.5° C benchmark within the next seven to eight years with worst cases on the highest emissions scenarios suggesting a possible 3.0° C by the end of the century. Therefore, while impassioned advocacy is required by all to still try to avoid this benchmark, a strong focus must also focus on strategies to increase FSM resilience in the face of expected change.

Long-term temperature data over the last 70 years have documented a general warming trend across the FSM (0.10-0.15° C per decade) with variations across the island states and some indications of an accelerating trend since 1980s. Coincident with the rising temperatures, long term trends suggest a decline in annual rainfall (FSM 2015), however the trends are not yet statistically significant (Australian Bureau of Meteorology and CSIRO, 2014) resolving the climate induced signals from natural variability is difficult but long-term trends suggest that

[133] See https://gain.nd.edu/our-work/country-index/.

[134] See Kumar L, Gopalakrishnan T, Jayasinghe S (2020). Population distribution in the Pacific islands, proximity to coastal areas, and risks. In Kumar L, ed. (2020). Climate change and impacts in the Pacific. Springer Climate. https://doi.org/10.1007/978-3-030-32878-8 and Andrew NL, Bright P, de la Rua L, Teoh SJ, Vickers M (2019). Coastal proximity of populations in 22 Pacific Island Countries and Territories. PLoS ONE 14(9): e0223249. https://doi.org/10.1371/journal.pone.0223249.

the FSM should develop long term plans to address the ocean vulnerabilities with expected long-term change. Beyond the large-scale changes in the atmosphere and ocean reflecting human-induced climate change there is additionally regional/local forcing reflecting human activity. Therefore, a holistic strategy is required with a recognition that the environmental changes will be expressed in a myriad of forms and the impacts will be differentially expressed on the outer islands and larger island communities. Specific issues to consider are provided below which we separate global trends driven by climate change to those that could be influenced from global-regional-local influences.

5.2 Current Climate Change Scenario

This section provides a description of the climatic scenario for the FSM including its past and present climate as well as projections for the future and is derived from the Pacific- Australia Climate Change Science Adaptation Planning (PACCSAP) reports (Australian Bureau of Meteorology and CSIRO 2011, 2014) and the Australia Bureau of Meteorology and CSIRO, and the Pacific Climate Change Data Portal (PCCDP[135]). Additionally, most recent changes in average climate were derived from the "Next Generation Climate Projections for the Western Tropical Pacific."[136] Sea level data for the FSM were obtained from different data sets and reports. Data and figures on mean monthly sea level for Pohnpei (2001-2020) is obtained from PCCDP, Lindsey (2020)[137] and the World Bank Climate change knowledge portal.[138]

Observed trends and analysis of air temperature, rainfall, extreme events (including tropical cyclones), sea-surface temperature, ocean acidification, mean and extreme sea levels are presented and projections for air and sea-surface temperature, rainfall, sea level, ocean acidification and extreme events for the next century are provided.

The FSM has a tropical climate that is strongly influenced by northeast trades that prevail from December through April. The country has two seasons, a dry season that occurs from November to April and a wet season from May to October, when the Inter-Tropical Convergence Zone (ITCZ) is strongest and furthers North (Australian Bureau of Meteorology and CSIRO, 2014[139]). In western FSM (Yap and Chuuk), the West Pacific Monsoon (WPM) affects rainfall patterns, bringing additional rain during the wet season (FSM SNC, 2015[140]). Rainfall is generally high on the volcanic islands of Pohnpei, Kosrae and Chuuk (Fig. 1), with mean annual rainfall reaching 466.8cm (183.8 inches) on Pohnpei main island for the latest 30 years (NOAA NCEI, 2021[141]). The FSM western states of Chuuk and Yap are affected by WPM climatic patterns bringing storms and typhoons with excessive rainfall more frequently than the eastern states of Pohnpei and Kosrae. The states of Yap and Chuuk are also affected by drought spells associated with the warm and cold phases of the El Niño–Southern Oscillation (ENSO); more frequent periods of drought can be experienced by the most western state of Yap (Australian

[135] The PCCDP was developed through the Pacific Climate Change Science Program (PCCSP; 2009-2011) and Adaptation Planning Programs 2009-2014, with further improvements/updates undertaken by the Climate and Oceans Support Program in the Pacific 2018-2022 (http://www.bom.gov.au/climate/pccsp/). PCCDP provides site-specific historical climate information and trends for the Pacific Islands.
[136] CSIRO and SPREP (2021). 'NextGen' projections for the Western Tropical Pacific: current and future climate for Federated States of Micronesia. Final report to the Australia -Pacific Climate Partnership for the next generation Climate projections for the Western Tropical Pacific project. Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Secretariat of the Pacific Regional Environment Programme (SPREP). CSIRO Technical Report, Melbourne Australia. This is a technical report developed in 2021 by the Australia-Pacific Climate Partnership (APCP) and delivered by CSIRO Climate Science Centre in partnership with the SPREP Pacific Met Desk Partnership.
[137] Lindsey R. (2020) Climate Change: Global Sea Level. NOAA, Climate Watch Magazine (2017). Available at: https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level.
[138] World Bank Climate change knowledge portal; last accessed July 15, 2021 at: https://climateknowledgeportal.worldbank.org/country/federated-states- micronesia.
[139] 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 Commonwealth Scientific and Industrial Research Organisation, Melbourne, Australia.
[140] Federated States of Micronesia. (2016). Second National Communication under the UN Framework Convention on Climate Change. Retrieved from: https://unfccc.int/resource/docs/natc/fsmnc2.pdf (Accessed: June 2021)
[141] NOAA National Centers for Environmental Information (NCEI): most recent standard climatological period (1991-2020) for precipitation data was derived from the U.S. Climate Normals Quick Access tool, last accessed on 26 December 2021 at https://www.ncei.noaa.gov/access/us-climate- normals/#dataset=normals-annualseasonal&timeframe=30&location=FM

Bureau of Meteorology and CSIRO, 2014). The ITCZ plays a significant role in influencing climate in the FSM and recent studies suggest a range of possible future changes in annual and seasonal rainfall largely determined by the intensification or weakening of the ITCZ (CSIRO and SPREP, 2021).

Air Temperature

The FSM experiences little seasonal variation in mean air temperatures across the year (less than 1.5° C / 2.7° F between the average hottest and coolest months), which is driven mainly by sea surface temperatures around the islands (Fig. 2). In general, across the island groups, the mean annual temperature averages 27.1° C (80.8°F) over the period 1901–2019, with interannual variability determining cooler years and warmer years (CSIRO and SPREP, 2021). However, annual mean air temperatures have increased (~0.5 - 1˚C) across the FSM since 1951 (Australian Bureau of Meteorology and CSIRO, 2014), showing a warmer trend over the 1850-2020 period with years since 2000 warmer than the pre-industrial climate average (CSIRO and SPREP, 2021).

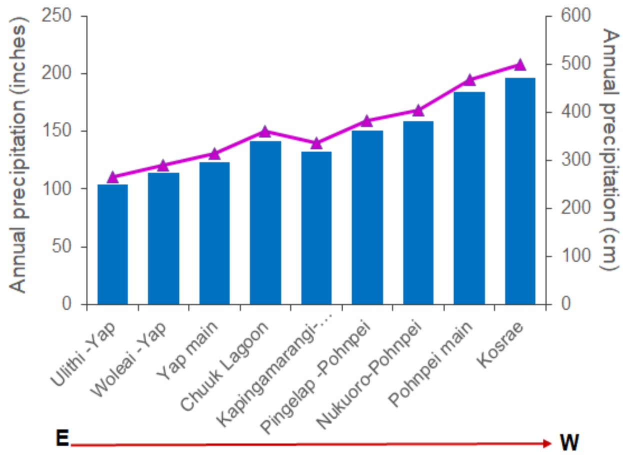
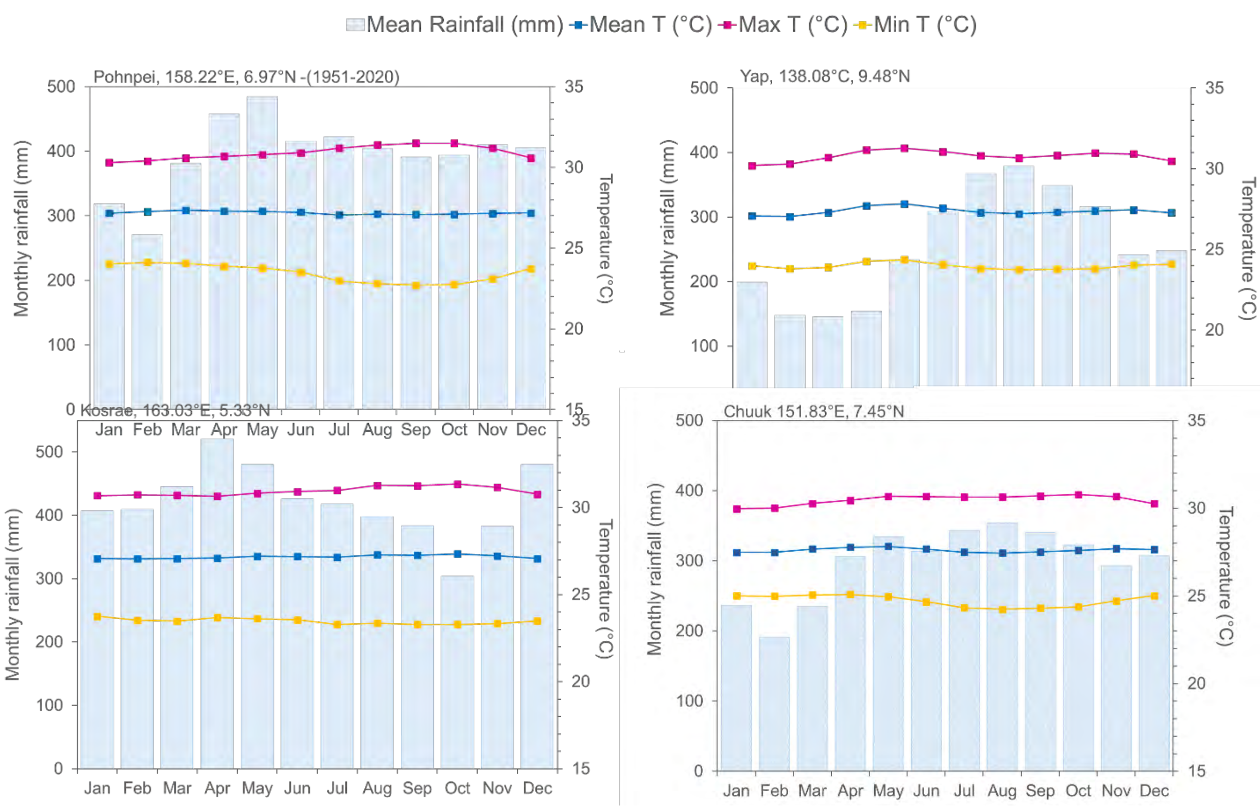


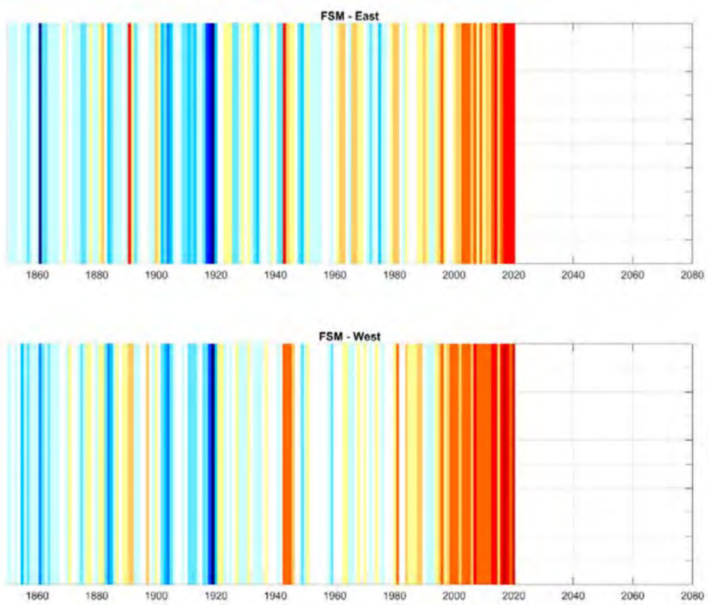
Figure 1. Mean annual rainfall normals in eastern and western FSM. Blue bars: annual rainfall in inches; purple line: annual rainfall in cm. Source: NOAA NCEI

Figure 2. Mean annual rainfall, monthly maximum, minimum and mean air temperatures at Pohnpei, Yap, Kosrae and Chuuk over the period 1951-2020 (source: Pacific Climate Change Data Portal; http://www.bom.gov.au/climate/pccsp/).



The warming trend for the FSM is clear (Fig. 3), but its magnitude is less than that observed for the global average. The average temperature by around 0.8 ˚C (1.4°F) in eastern FSM increased and by about 0.9 ˚C (1.6°F) in western FSM (CSIRO and SPREP, 2021).

Figure 3. Stripe pattern (from Hawkins 2018) indicates a clear change in temperature records since 1850 for east and west FSM. Cooler than average temperatures (blue stripes) are replaced by warmer than average temperatures (red stripes), especially since 2000 (Graphs sourced from CSIRO and SPREP, 2021).



Extreme temperatures in Pohnpei are consistent with the increasing global trends. Annual mean temperatures at Pohnpei show an increase, while at Yap, little variation was observed up to 2010. However, mean annual temperatures increased sharply at Yap during the 2015 ENSO event, which continued to impact global temperatures at the beginning of 2016. Indeed, 2016, tied to strong El Niño conditions, was the warmest year on record since 1850, overcoming the previous record (set in 2015) by 0.2°C (0.36°F; NOAA, 2016).

Annual maximum temperatures have increased in the FSM over the period 1951-2020. Maximum temperatures have increased at a rate of +0.26 ºC (0.47°F) per decade at Chuuk and at a rate of +0.12°C (0.22°F) per decade at Pohnpei and Yap (Fig. 4), with Yap maximum temperatures increasing at a rate of +0.18˚C (0.32°F) per decade during the dry season (November–April). Maximum annual air temperature trends in Pohnpei and Yap are significantly increasing (Australian Bureau of Meteorology and CSIRO, 2014).

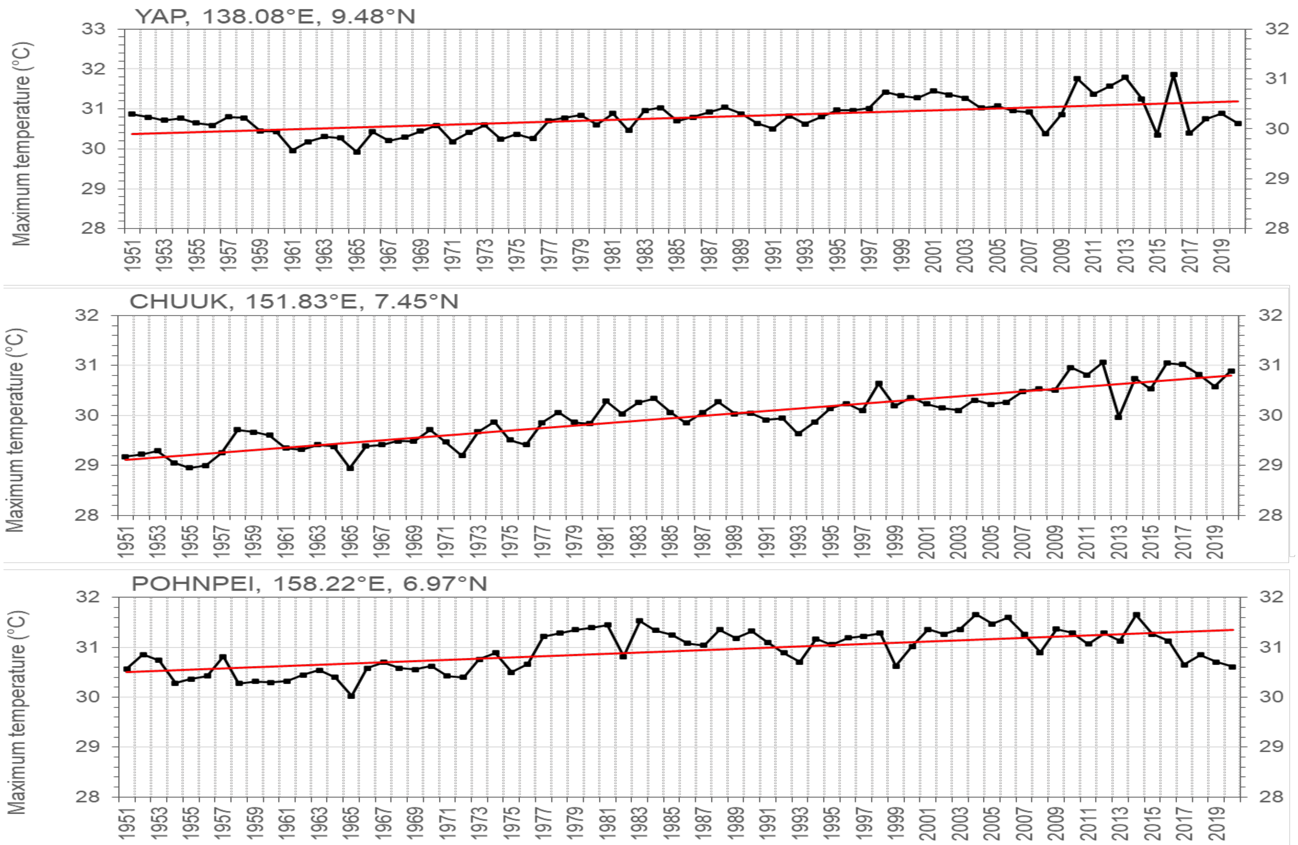


Figure 4. Trends in annual maximum air temperature for Yap, Chuuk and Pohnpei (source PACCSAP and the relevant FSM meteorological service; Pacific Climate Change Data Portal, last accessed July 10, 2021, http://www.bom.gov.au/climate/pccsp/).

For the state of Pohnpei, trends in increasing "warm days" and "warm nights" are statistically significant (Table 1). In Yap, a significant increase of maximum air temperature is observed, albeit extreme minimum temperature shows an opposite trend. The inconsistency observed for mean and extreme global warming trends (Table 1) is "likely due to remaining inhomogeneities in the data record" (Australian Bureau of Meteorology and CSIRO, 2014). The decrease in the occurrence of cool nights may be correlated to the increasing Sea Surface Temperatures (SST) that may add to the local moisture content and help sustain elevated nighttime temperatures (Marra et al., 2017[142]). Overall, in the FSM, the number of hot days has increased since 1950, while in the last decade the number of cool nights has decreased to an average of 59 nights per year (Grecni et al, 2022[143]).

[142] Marra J.J., Kruk M.C. (2017). State of Environmental Conditions in Hawaii and the U.S. Affiliated Pacific Islands under a Changing Climate: 2017. NOAA NCEI. Available at: https://coralreefwatch.noaa.gov/satellite/publications/state_of_the_environment_2017_hawaii-usapi_noaa-nesdis- ncei_oct2017.pdf
[143] Grecni Z., Bryson C., Chugen E. (2022). Climate Change in the Federated States of Micronesia: Indicators and Impacts in Key Sectors. Report for the Pacific Islands Regional Climate Assessment (PIRCA). In publication.

Table 1. Annual air temperature at Pohnpei and Yap over the period 1952-2011. Values for trends significant at the 5% level are shown in boldface; 95% confidence intervals are shown in parenthesis (Australian Bureau of Meteorology and CSIRO, 2014).

TEMPERATURE	Pohnpei	Yap
Warm Days (days/decade)	**7.86** (+3.65, 11.70)	**12.23** (+4.60, +19.80)
Warm Nights (days/decade)	**5.12** (+1.22, +9.05)	**-16.68** (-21.57, -10.24)
Cool Days (days/decade)	**-3.98** (-5.53, -2.52)	**-8.50** (-13.66, -2.67
Cool Nights (days/decade)	-2.73 (-8.21, +3.68)	**+8.70** (+3.71, +14.90)

Warm Days: Number of days with maximum temperature greater than the 90th percentile for the base period 1971–2000
Warm Nights: Number of days with minimum temperature greater than the 90th percentile for the base period 1971–2000
Cool Days: Number of days with maximum temperature less than the 10th percentile for the base period 1971–2000
Cool Nights: Number of days with minimum temperature less than the 10th percentile for the base period 1971–2000

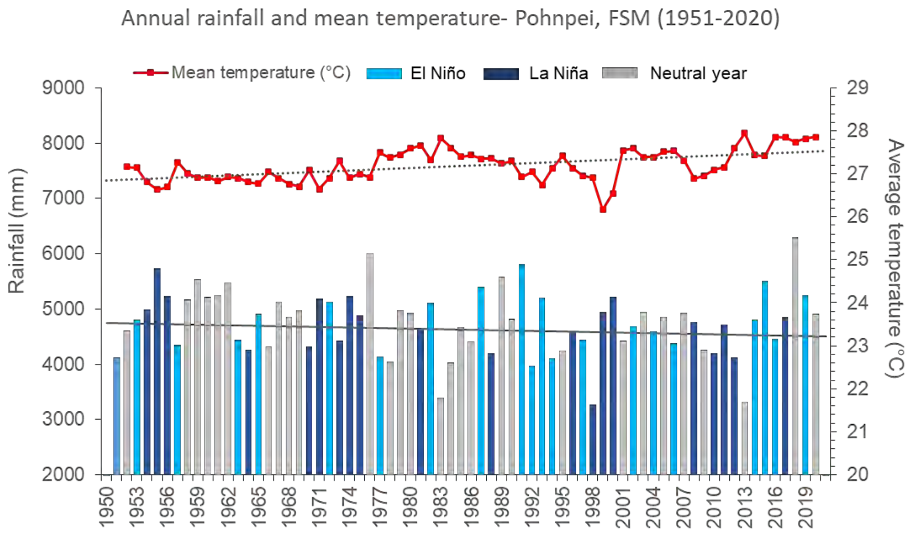
Rainfall

Annual total rainfall in the region shows large interannual variability partly related to the ENSO, and no significant trends for the FSM since 1960 (Australia Bureau of Meteorology and CSIRO, 2014). Similarly, there is no significant change in annual rainfall between the pre-industrial baseline of 1850-1900 to the more recent baselines (CSIRO and SPREP, 2021). At Pohnpei, there has been a statistically significant (at 5%) declining trend in May–October rainfall since 1950 (Fig. 5). This may imply that the mean location of the ITCZ is shifting away from Pohnpei and/or that rainfall associated with the ITCZ is changing in the intensity (Australian Bureau of Meteorology and CSIRO, 2014). There have also been statistically significant negative trends in annual "very wet day" rainfall at Pohnpei and annual "consecutive dry days" at Yap since 1950 and 1952 respectively (Table 2).

The average number of heavy rainfall days per year shows a non-significant increase for Pohnpei and Yap, and no change for Kosrae since 1951 (Marra et al, 2021[144]). Declining trends in annual rainfall of -45.5mm (1.8 in) per decade were observed for Pohnpei, -17.4mm (0.7 in) per decade for Chuuk and -0.87mm (0.03 in) per decade for Yap (Fig. 5), since 1950.

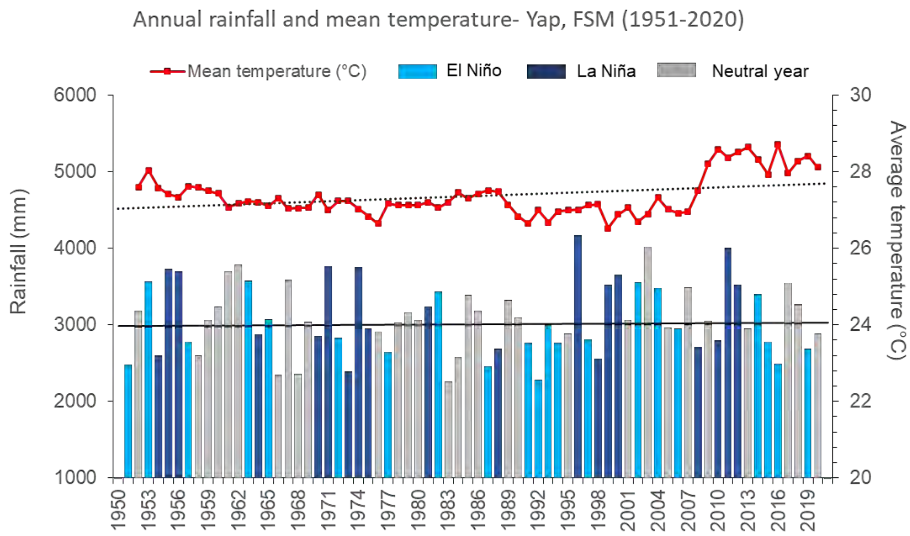
Figure 5. Time series of mean annual air temperature (degree Celsius) and total rainfall (mm) in Pohnpei, Yap, and Chuuk from 1951 to 2020. Light blue, dark blue and gray bars denote El Niño, La Niña and neutral years respectively. (Source: PACCSAP Program and the Yap, Chuuk, and Pohnpei meteorological services; data source: Pacific Climate Change Data Portal, http://www.bom.gov.au/climate/pccsp/.)

[144] Pacific Climate Change Monitor: 2021. Marra, J.J., Gooley, G., Johnson, M-V, Keener, V., Kruk, M.K., McGree, S., Potemra, J.T., and Warrick, O., 2021. Pacific Islands - Regional Climate Centre Network (PI-RCC) Report to the Pacific Islands Climate Service (PICS) Panel and Pacific Meteorological Council (PMC). April 18, 2022.



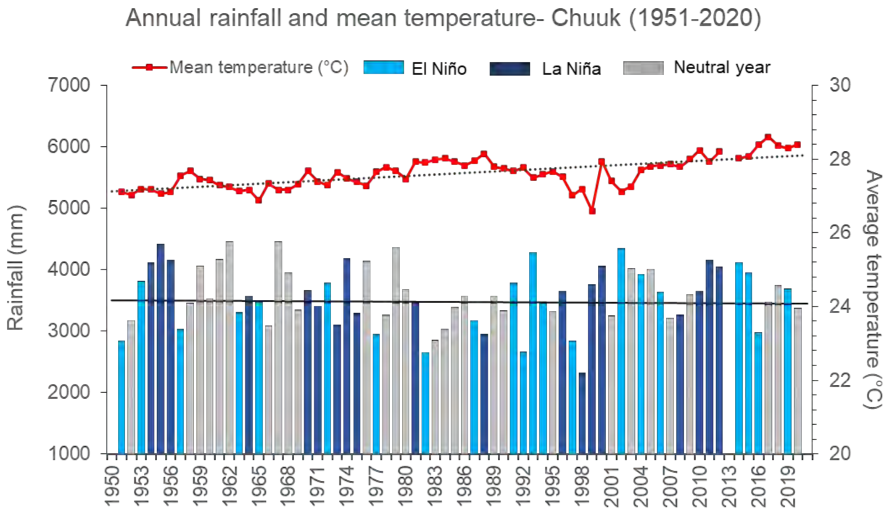
Average annual rainfall and temperature Pohnpei:

Rainfall least squares linear trend of -45.55 mm/decade (solid black trend line);
Average annual rainfall 4727 mm (186in);
Temperature least squares linear trend of +0.13°C/decade (0.23°F/decade).



Average annual rainfall and temperature Yap:

Rainfall least squares linear trend of -0.87 mm/decade (solid black trend line);
Average annual rainfall 3098 mm (122in);
Temperature least squares linear trend of +0.17°C/decade (0.3°F/decade).



Average annual rainfall and temperature Chuuk:

Rainfall least squares linear trend of -17.38 mm/decade (solid black trend line);
Average annual rainfall 3579 mm (140.9in);
Temperature least squares linear trend of +0.19°C /decade (0.34 °F/ decade)

Interannual rainfall variability, associated with ENSO events, was observed for Pohnpei since 1950 and Yap since 1952 (Leong et al., 2014[145]). A decline of 15% in annual rainfall has been observed in the eastern-most islands of FSM, although a slight increase in precipitation, related to ENSO variability, is observed for the western-most islands. In a typical El Niño, dryness and drought are common in the FSM.

Table 2. Annual trends in rainfall extremes in Pohnpei and Yap over the period 1952-2011. Values for trends significant at the 5% level are shown in blue bold face; 95% confidence intervals are shown in parenthesis (Australian Bureau of Meteorology and CSIRO, 2014).

RAINFALL		Pohnpei	Yap
Rain Days ≥ 1 mm	(days/decade)	-0.21 (-2.79, +2.48)	-1.01 (-4.20, +1.82)
Very Wet Day rainfall	(inches/decade)	-2.63 (-5.15, -0.12)	+0.22 (-1.39, +1.97)
	(mm/decade)	-66.88 (-130.81, -3.05)	+5.55 (-35.30, +49.95)
Consecutive Dry Days		0.00 (-0.43, +0.20)	-0.37 (-0.77, 0.00)

Rain Days ≥ 1mm: Annual count of days where rainfall is greater or equal to 1mm (0.039 inches)
Very Wet Day rainfall: Amount of rain in a year where daily rainfall is greater than the 95th percentile for the reference period 1971–2000.
Consecutive Dry Days: Maximum number of consecutive days in a year with rainfall less than 1mm (0.039 inches)

Sea Level

The FSM is immediately and directly impacted by the rising global temperatures which is increasing sea level driven by several processes that include the melting of ice in polar oceans and terrestrial regions, the subsidence of land masses, and the thermal expansion of the ocean associated with warming temperatures. Over the last century, the global mean sea level rise has been 1.05 mm/year however since the 1980s these sea level rise rates appear to be increasing (Meirer et al. 2002). Sea level rise will impact all of the FSM, however the impacts will be magnified on the outer islands and atolls that are closer to sea level than the volcanic main islands. The rising sea level potentially will overwhelm lowest outer lying islands and atolls, but the timing of this is difficult to

145 Leong, J.-A., J. J. Marra, M. L. Finucane, T. Giambelluca, M. Merrifield, S. E. Miller, J. Polovina, E. Shea, M. Burkett, J. Campbell, P. Lefale, F. Lipschultz, L. Loope, D. Spooner, and B. Wang, 2014: Ch. 23: Hawai'i and U.S. Affiliated Pacific Islands. Climate Change Impacts in the United States: The Third National Climate Assessment, J. M. Melillo, Terese (T.C.) Richmond, and G. W. Yohe, Eds., U.S. Global Change Research Program, 537-556. doi:10.7930/J0W66HPM.

predict given current model forecast capabilities to provide the specific guidance of the shelter in place to evacuate. It would be critical that the FSM be able to access embedded higher resolution regional modeling assessments within current Global Climate Models (GCM). Beyond the land loss associated with the sea level rise, there will be other impacts including enhanced storm surge, king tides, and saltwater intrusion into groundwater. These combined impacts will be felt most acutely by the outer island and atoll communities and over the long term will affect the overall habitability to support communities.

In the FSM, sea level varies due to seasonal and longer-term variations in winds, ocean temperature and sea-level pressure. In the western Pacific, sea level rising trends, since the start of satellite records in 1993, are doubled relative to the global rate, albeit interannual and multidecadal variation in sea level can be quite large. Satellite data indicates that in the FSM, sea level has risen by over 10mm (0.39 inches) per year since 1993 (Fig. 6). This is above the global average of 2.8–3.6 mm (0.11–0.14 inches) per year (Australia Bureau of Meteorology and CSIRO 2015[146]). This higher rate of sea level rise may be related to natural variations that take place on an interannual or decadal to multi-decadal time scales, generally attributed to changes in prevailing wind patterns associated with El Niño–Southern Oscillation (ENSO) as well as the Pacific Decadal Oscillation (PDO; Leong et al. 2014).

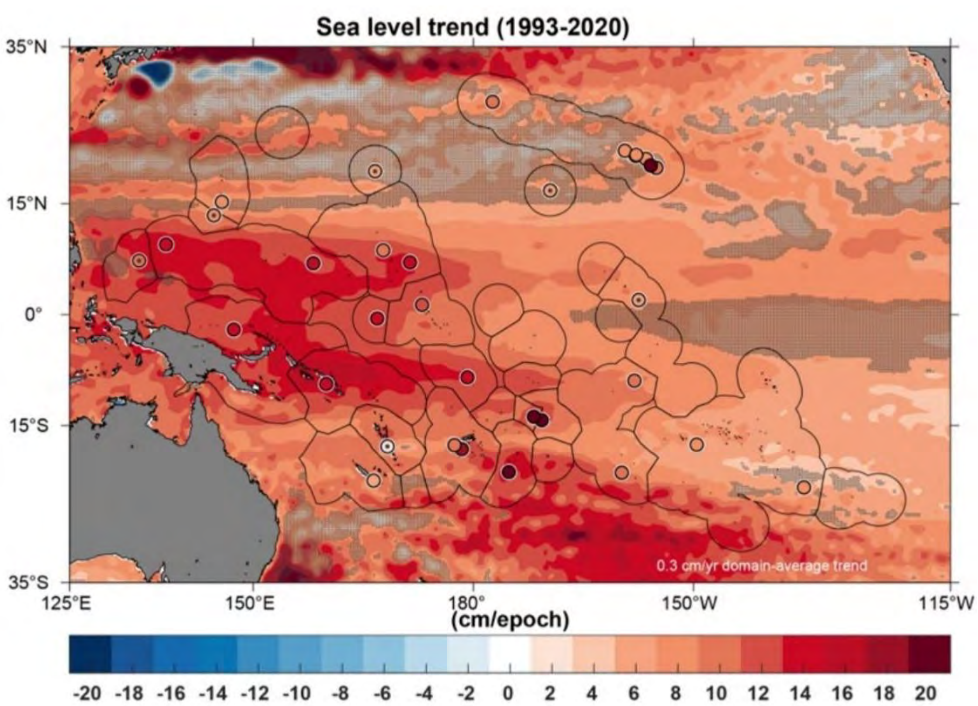


Figure 6. Sea level trends from satellite altimetry (colored contours) and from tide gauges (circles) less than interannual variability as determined by the standard deviation of sea level monthly anomalies since the beginning of the satellite record (1993-2020). Source: Marra et al, 2021

The occurrence of extreme tides is generally associated with changes in water levels due to ENSO, storms and rising sea level. Typically, these events in Pohnpei and Chuuk are observed during la Niña. Rising sea level above its normal value has caused coastal inundation, damaging infrastructures, soil, food and freshwater resources across the FSM. Drinking water sources are becoming more vulnerable, particularly in outlying atoll islands, and food availability is increasingly dependent on imports. After removal of the seasonal cycle, the FSM interannual variability in sea level is about 260mm (10 inches). As reported in the FSM SNC, Pohnpei experiences the highest monthly mean sea levels around March and its lowest around November and December.

Records from the Pacific Sea Level and Geodetic Monitoring Project (PSLGM) indicate that mean sea level over

[146] Pacific-Australia Climate Change Science and Adaptation Planning Program partners (2015). Current and future climate of the Federated States of Micronesia. Retrieved from: https://www.pacificclimatechangescience.org/wp-content/uploads/2013/06/7_PACCSAP-FSM-11pp_WEB.pdf

the period 2001-2021 is 0.77 m (2.53ft), with a minimum of -0.091 m (-0.29 ft) on 11 January 2016, in conjunction with El Niño, and a maximum of 1.79 m (5.87 ft) on 6 November 2017, during La Niña (Fig. 7). In the FSM, extreme low sea levels were recorded at the end of El Niño years (2001, 2010 and 2016), while high sea levels were observed in La Niña years (2002, 2011 and 2017).

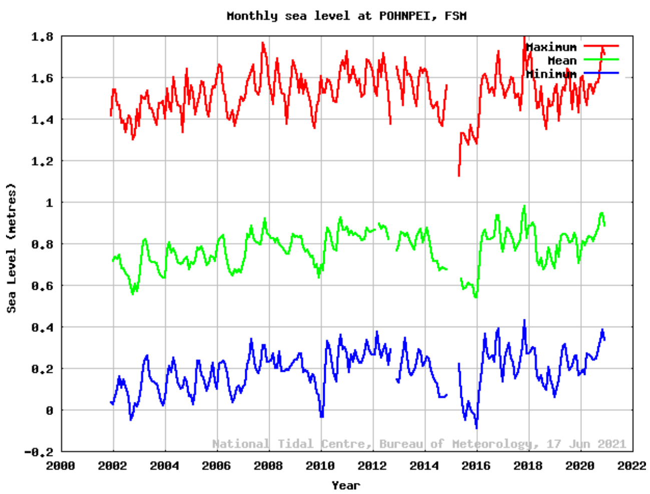


Figure 7. The record of monthly mean, minimum and maximum sea level at Pohnpei over the period 2002-2021 (source: PSLGM available at Pacific Climate Change Data Portal; http://www.bom.gov.au/-oceanograp-hy/projects/spslcmp/data/monthly.sh tml#table).

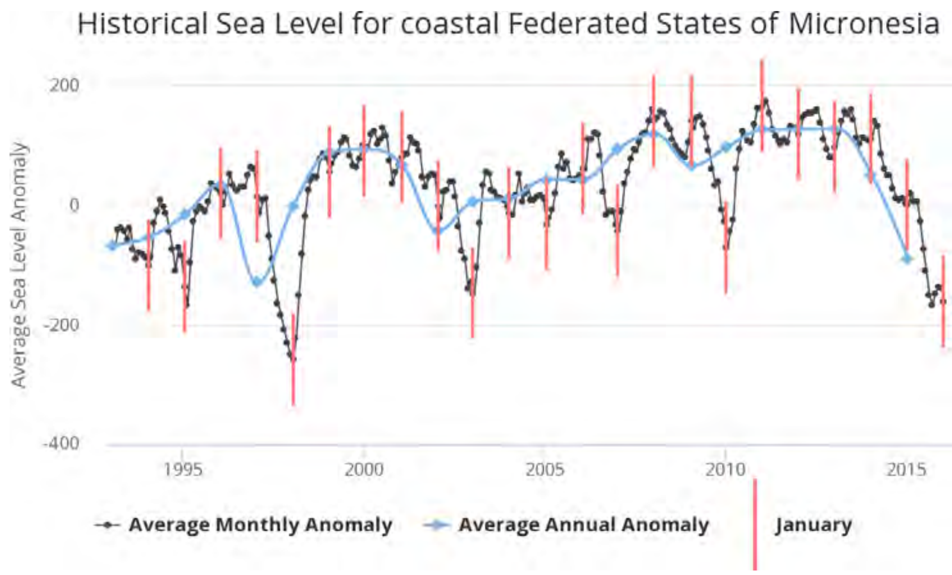


Figure 8. Observed sea level anomalies (mm) relative to mean of 1993-2015 for the FSM (source: Climate Change Knowledge Portal, World Bank; https://climateknowledgeportal.worldbank.org/country/federated-states-micronesia/impacts-sea-level-rise). The drop in SL anomalies in 2015/16 corresponds to El Niño conditions.

Interannual and multi-decadal climate variability

In the Micronesian region, interannual variability is a natural climate phenomenon, affecting rainfall patterns, sea level height and frequency in extreme weather events (i.e., typhoons, tropical storms). This natural climate variability is associated with major climatic drivers such as El Niño–Southern Oscillation (ENSO) and the Pacific Decadal Oscillation (PDO).

The El Niño–Southern Oscillation (ENSO[147]) phenomenon is the dominant mode of year-to-year natural climate variability in the Micronesia region. During El Niño the trade winds weaken and may even change direction, while they strengthen during La Niña. The consequences of El Niño and La Niña phases in the FSM are drastic changes in precipitation, air and sea surface temperature, sea surface height, storminess, and wave size. ENSO extremes affect the interannual position and intensity of the intertropical convergence zone with effects on the seasonal rainfall patterns in the northwest Pacific region countries (Murphy et al 2014[148]). Pohnpei, Yap, and Chuuk are usually drier in El Niño and wetter in La Niña phase than average. Over the past years another type of El Niño, referred to as El Niño Modoki, is observed producing below-normal SSTs in the eastern Pacific (Ashok et al. 2007,[149] Chand, 2020[150]), with some weak but significant correlations on temperatures and a weak impact on Yap dry season rainfall (Australian Bureau of Meteorology and CSIRO, 2011).

The effects of ENSO can be magnified when it is in phase with longer periodic cycles such as the Pacific Decadal

[147] Typically, El Niño years are associated with widespread warming of SST in the near equatorial Pacific east of the dateline between November and April, with greatest warming between December and March. Concurrently there is a weak cooling of SST in the far western Pacific. The opposite pattern (with cooling in the eastern and central equatorial Pacific) occurs during La Niña (Taylor et al, 2016.) The ENSO events are associated with neutral phases, with equatorial SSTs that are near the climatological averages. The effects of ENSO can be magnified when it is in phase with longer periodic cycles such as the Pacific Decadal Oscillation and the Interdecadal Pacific Oscillation.
[148] Murphy B.F., Power S.B., Mc Gree, S. (2014). The varied impacts of El Niño–Southern Oscillation on Pacific Island Climate. American Meteorological Society, 27, 4015–4036.
[149] Ashok, K., S. K. Behera, S. A. Rao, H. Weng, and T. Yamagata, 2007: El Niño Modoki and its possible teleconnection. J. Geophys. Res., 112, C11007, doi:10.1029/2006JC003798
[150] Chand S. S., 2020: Climate Change Scenarios and Projections for the Pacific. In: Lalit Kumar (eds) Climate Change and Impacts in the Pacific, Springer Climate. Springer, Cham. https://doi.org/10.1007/978-3-030-32878-8_3

Oscillation and the Interdecadal Pacific Oscillation (Keener et al. 2018[151]).

The Pacific Decadal Oscillation (PDO) present pattern of variability, in the north Pacific Ocean, on decadal time scales (Chand, 2020), influencing the weather and climate of the region. As for ENSO, which on interannual time scales can influence sea level, differences in regional sea level on multi-decadal time scale across the Pacific Basin are associated with PDO climate variability.

Typhoons and Tropical Storms

The western edge of the Micronesian Region is the most active tropical cyclone basin in the world, with tropical storms and typhoons that can occur annually, causing damage to infrastructure, flooding, and drainage complications. Typhoons affect the FSM mainly between June and November and are more common during El Niño years. The frequency of typhoons affecting the FSM varies from year to year ranging from 0 to 12 in a given year (NOAA 2015[152]), with an average of seventy-one cyclones per decade that developed within or crossed FSM's EEZ between the 1977 and 2011 seasons (Australian Bureau of Meteorology and CSIRO, 2014). Thirty-seven of the 212 tropical cyclones (17%) that passed through the FSM's EEZ between the 1981 and 2011 became severe events, Category 3 or stronger (Fig. 9; Australian Bureau of Meteorology and CSIRO, 2014).

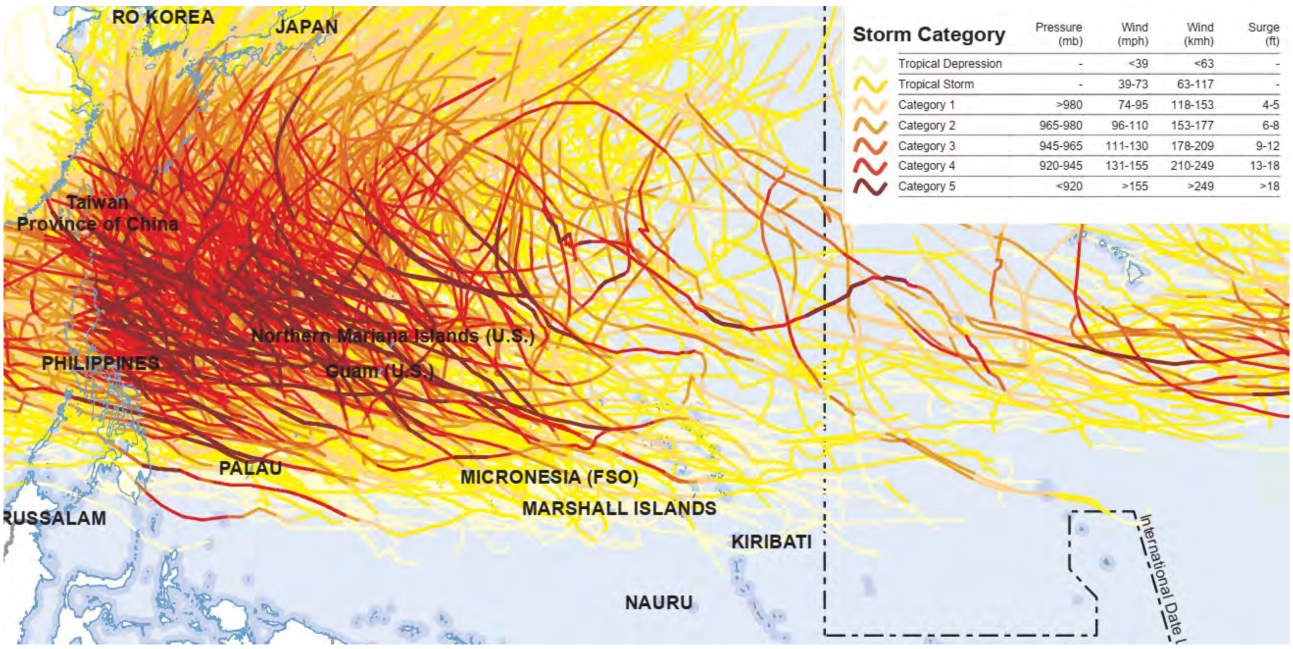


Figure 9. Consolidated history of tropical storm paths over 50 years, 1968-2018, in the North Pacific region. The FSM lie in the path of many of the most destructive storms, which often reach their peak as they move north west from the FSM. (Source: UN Cartographic Section, UNISYS, NOAA; Map Ref: OCHA_ROAP_StormTracks_v8_190314).

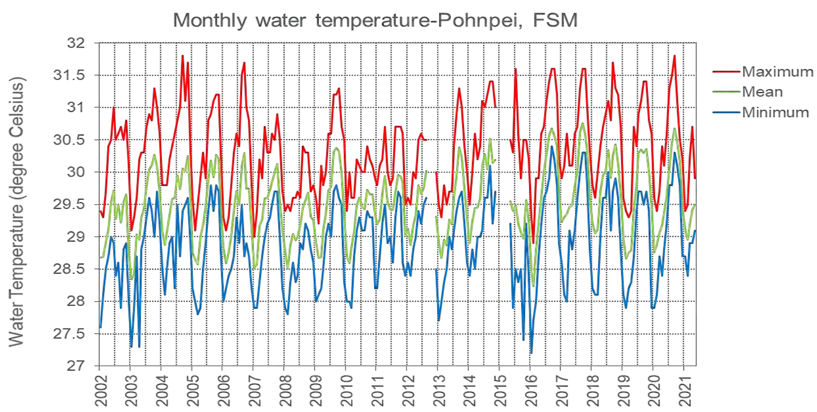
[151] Keener, V., D. Helweg, S. Asam, S. Balwani, M. Burkett, C. Fletcher, T. Giambelluca, Z. Grecni, M. Nobrega-Olivera, J. Polovina, and G. Tribble, 2018: Hawai'i and U.S.-Affiliated Pacific Islands. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, pp. 1242–1308. doi: 10.7930/NCA4.2018.CH2

[152] NOAA (2015). El Niño and its Impacts on Federated States of Micronesia – Pohnpei and Kosrae El Niño in FSM

Sea Surface Temperature (SST)

Historical changes around the Federated States of Micronesia are consistent with the broad-scale sea-surface temperature trends for the wider Pacific region. Warming was relatively weak from the 1950s to the late 1980s. This was followed by a period of more rapid warming (approximately 0.11°C per decade and approximately 0.08°C perdecade for 1970–present, in the eastern and western regions respectively). At these regional scales, natural variability plays a large role in determining the sea-surface temperature, making it difficult to identify long-term trends (Australian Bureau of Meteorology and CSIRO, 2011). Warmer than normal SSTs are determinants for coral reef bleaching and mortality. Large scale coral bleaching was observed during the last El Niño event (2015-2016), impacting coral reefs in most of the FSM islands and in some cases causing local mortality. Coral bleaching is becoming one of the major threats for coral reef persistence, which, driven by increasing SST, is likely to have harmful consequences on the subsistence and livelihoods of FSM communities.

Figure 10. Sea water maximum, mean and minimum temperature over the period 2002-2021 in Pohnpei



Summary of Climate Trends

- Warming trends are evident with an increase by around 0.8˚ C (1.4°F) in eastern FSM and by about 0.9 ˚C (1.6°F) in western FSM since 1951.
- The number of hot days in the FSM has increased since 1950, while in the last decade the number of cool nights has decreased to an average of 59 nights per year.
- Annual total rainfall in the region shows large interannual variability partly related to the ENSO, and no significant trends for the FSM since 1960. At Pohnpei, there has been a significant declining trend in May–October rainfall since 1950. This may imply that the mean location of the ITCZ is shifting away from Pohnpei and/or that rainfall associated with the ITCZ is changing in the intensity
- Sea level has risen by over 10mm (0.39 inches) per year since 1993, which is above the global average of 2.8–3.6 mm (0.11–0.14 inches) per year.
- An average of seventy-one cyclones per decade developed within or crossed FSM's EEZ between the 1977 and 2011 seasons. Thirty-seven of the 212 tropical cyclones (17%) passing through the FSM's EEZ over the period 1981-2011 became severe events (Category 3 or stronger).
- Sea surface warming was relatively weak until late 1980s, showing a more rapid warming of approximately 0.11°C per decade and approximately 0.08°C per decade for 1970–present, in the eastern and western regions respectively

5.3 Climate Projections

Climate projections were derived from the Australian Bureau of Meteorology and CSIRO report[153] (2014) and from the CSIRO and SPREP (2021) "NextGen" technical report. Additional information was obtained from Marra et al. (2021) regional report and the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2021[154]). Sea level projections for the western and eastern FSM were obtained from the Australian Bureau of Meteorology and CSIRO report (2014) as well as Marra et al. (2017, 2021).

Projections for the FSM indicate that:

- **Air temperatures** over the next decade (by 2030) is expected to increase by about 0.7°C from the 1986-2005 baseline under all emission pathways and the increase will continue to the end of the century. By 2050 and 2070 temperature changes will vary depending on the greenhouse gases emission pathway. Under the very low emission scenario (RCP2.6) 0.8°C (1.4 °F) temperature change is expected by 2050 and 2070, and 0.4°C to 1.2°C by 2090, from the 1986-2005 period. Under the very high emission scenario (RCP8.5) temperature will change 1.4°C by 2050, 2.2°C by 2070 and 2.1°C to 4.0°C by 2090, relative to 1986-2005. For the FSM, projections suggest that 2°C global warming relates to 1.3 to 1.9°C (CSIRO and SPREP, 2021).

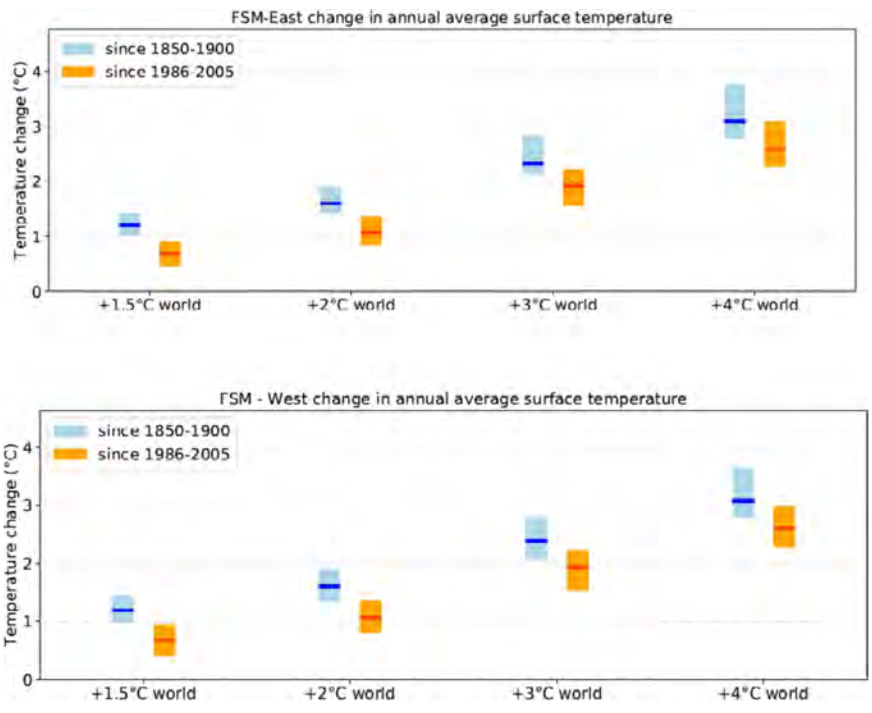


Figure 11. Change in the average annual temperature of FSM east and west at different global warming levels, from the 1850-1900 baseline, and from the more recent baseline of 1986-2005. The bars represent multi-model median and 10th-90th percentile range. (Source of figure and figure legend: CSIRO and SPREP, 2021. "NextGen" projections for the Western Tropical Pacific: current and future climate for Federated States of Micronesia.)

-
- **Extreme temperature** will also increase as warming will continue in the 21st century for all global warming levels

[153] Projections are derived from the Global Climate Model data from the Coupled Model Intercomparison Project, Phase 5 (CMIP5). Projections provided are for the very high emissions scenario, the Representative Concentration Pathway (RCP) 8.5.

[154] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

and future emissions scenarios, extreme temperature events and heat stress (*high confidence*; IPCC, 2021), reducing cold extremes including cool nights (Marra et al 2021). Temperature of extremely hot days and extremely cool days will increase by the end of the century (Table 3).

Table 3. Projected temperature of the 1-in-20-year hot day in western (Yap and Chuuk) and eastern (Pohnpei and Kosrae) FSM (Australian Bureau of Meteorology and CSIRO, 2014).

Emission Scenario	FSM location	2030	2090
Very low emission – RCP2.6	Eastern	+0.6°C (+1.1°F)	+0.8°C (+1.4°F)
	Western	+0.6°C (+1.1°F)	+0.8°C (+1.4°F)
Very high emission – RCP8.5	Eastern	+0.8°C (+1.4°F)	+3°C (+5.4°F)
	Western	+0.8°C (+1.4°F)	+3.2°C (+5.8°F)

- **Long-term average rainfall** in the FSM is projected, by most models, to increase over the century, particularly under higher warming levels compared to lower levels. For the FSM, rainfall increase is expected to be larger for the wet season (May-October) than for the dry season (November-April). Projected annual total rainfall changes will still be greatly dependent on annual variability and largely determined by whether the ITCZ intensifies or weakens (CSIRO and SPREP 2021). A weakened ITCZ will result in a negative percent change in annual rainfall corresponding to -5 to -10% annual rainfall under low emissions (RCP2.6) and -5% annual rainfall under high emissions (RCP8.5). A strengthened ITCZ will result in an increase in annual rainfall under both low emissions (+15 to 20%) and high emissions (+25%). Long-term trends are unclear, and models show from little change to an increase in total annual rainfall (CSIRO and SPREP 2021).

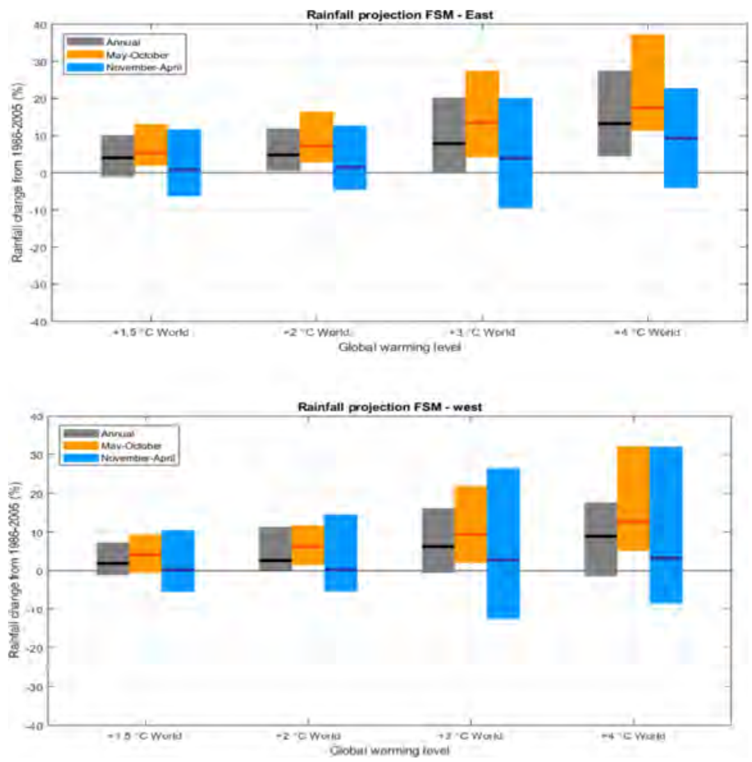


Figure 12. Change in the average annual and 6-month seasonal rainfall in the FSM region at different global warming levels relative to the 1986-2005 baseline. The bars represent multi-model median and 10th-90th percentile range. (Source of figure and figure legend: CSIRO and SPREP, 2021. 'NextGen' projections for the Western Tropical Pacific: current and future climate for Federated States of Micronesia.)

- **Extreme rainfall events (heavy rainfall days)** frequency and intensity are projected to increase by 2030 (*high confidence at 2°C global warming and above*; IPCC, 2021) under the very high carbon dioxide emissions scenario (RCP8.5; Fig. 13). By 2090, the eastern FSM will experience an increase in heavy rainfall events from 1-in-20-year to 1-in-7-year event under very low emissions (RCP2.6) and 1-in-6-year under very high emissions (RCP8.5). In western FSM, a 1-in-20-year event would become a 1-in-8-year event under very low emissions (RCP2.6) and a 1-in-4-year event under very high emissions (RCP8.5; Australian Bureau of Meteorology and CSIRO, 2014).

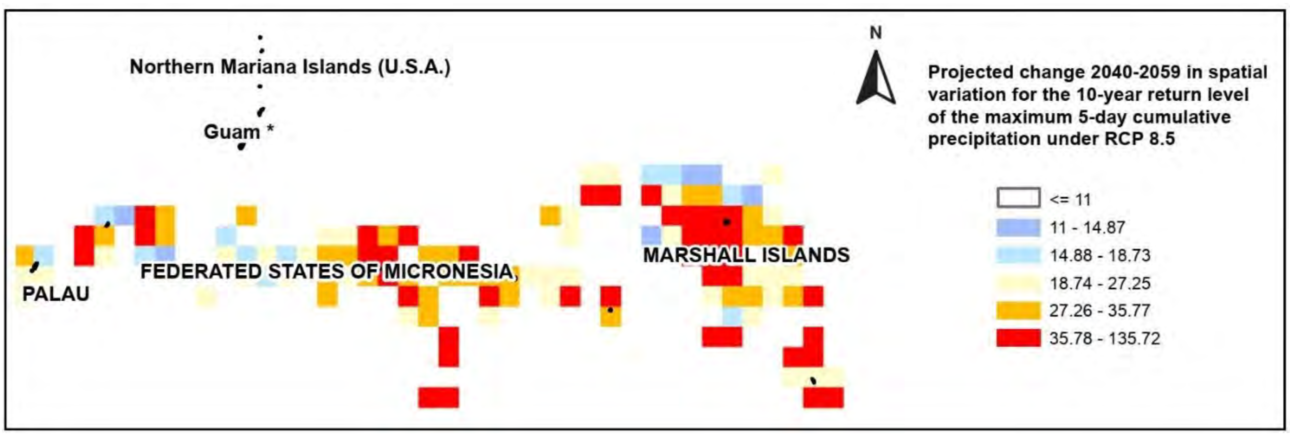


Figure 13. Maximum 5-day cumulative precipitation amount projected to return in a 10-year period in Pacific, RCP 8.5, 2040–2059. (Data source: Sources: Climate Change Knowledge Portal, 2018 and UN Geospatial; Figure source: ESCAP, 2022a[155])

- **Drought (changes in proportion of time in drought)** frequency and duration are expected to decrease under all scenarios for eastern and western FSM (Fig.14).

[155] United Nations, Economic and Social Commission for Asia and the Pacific (2022a). Pathways to Adaptation and Resilience in Pacific SIDS. Subregional report. Asia-Pacific Disaster Report 2022 for ESCAP Subregions

Under RCP8.5 the frequency of drought in all categories is projected to decrease slightly while the duration of events is projected to stay approximately the same. Under RCP2.6 (very low emissions) the frequency of severe drought is projected to decrease slightly while the frequency of drought in all other categories is projected to remain the same. The duration of events in all drought categories is projected to stay approximately the same under RCP2.6.

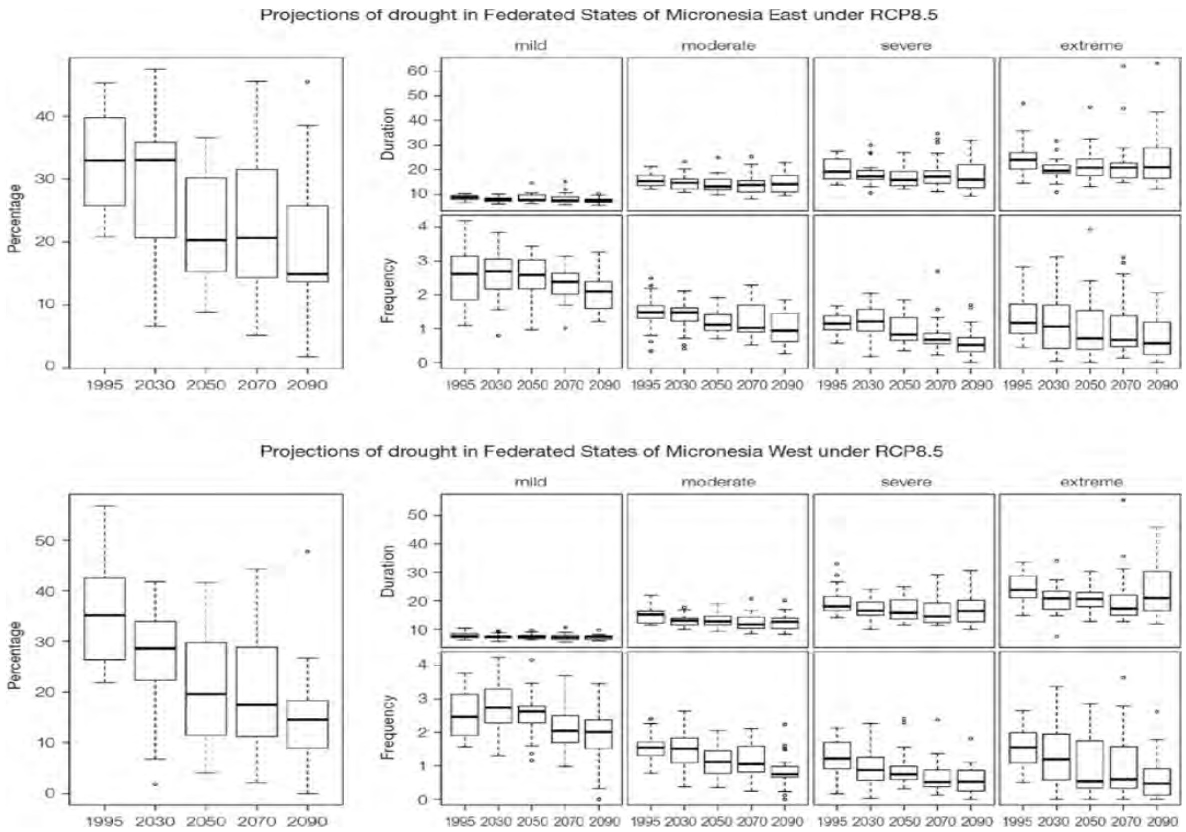


Figure 14. Percent of time in moderate, severe or extreme drought (left hand side), and average drought duration and frequency for the different categories of drought (mild, moderate, severe and extreme) for the eastern (top) and western (bottom) Federated States of Micronesia. These are shown for 20-year periods centered on 1995, 2030, 2050, 2070 and 2090 for the RCP8.5 (very high emissions) scenario. The thick dark lines show the median of all models, the box shows the interquartile (25–75%) range, the dashed lines show 1.5 times the interquartile range and circles show outlier results (Source of figure and figure legend: Australian Bureau of Meteorology and CSIRO, 2014).

- **Tropical cyclones**: Every increment of a degree between 1.5°C and 2°C translates into increased risks of tropical cyclones, particularly in the Pacific. Although TCs are projected to be less frequent their intensity will increase, and annual wind speeds of tropical cyclones will increase as well under the extremely high emissions RCP8.5 (ESCAP, 2022b[156]; Fig. 15).

[156] United Nations, Economic and Social Commission for Asia and the Pacific (2022b). Asia-Pacific Riskscape @ 1.5°C: Subregional Pathways for Adaptation and Resilience. Asia-Pacific Disaster Report 2022 for ESCAP Subregions. Summary for Policy makers.

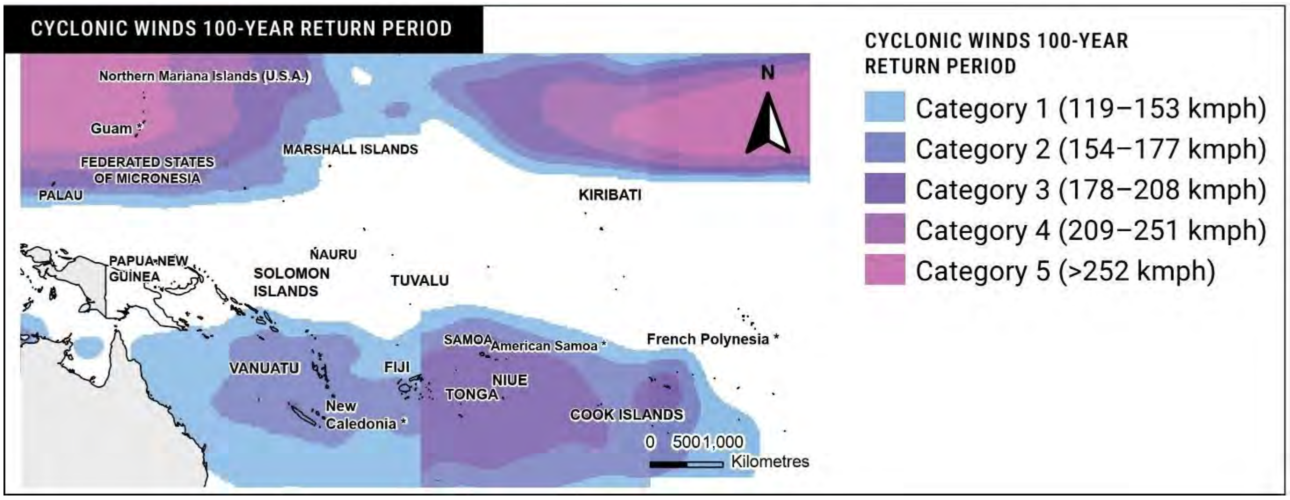


Figure 15. Projected increase in Tropical Cyclones for the Pacific. TC categories are based on the Sar-Simpson scale. (Data sources: ESCAP based on Global Assessment Report on Disaster Risk Reduction (GAR) Risk Atlas, 2015, IPCC WGI Interactive Atlas - Coupled Model Intercomparison Project Phase 6 (CIMP6), 2021, and UN Geospatial; Figure source: ESCAP, 2022b).

- **Rise in sea level** is projected to be in the range of 8 – 18 cm by 2030, under a very high carbon dioxide emissions scenario (RCP8.5; Fig. 16). Sea level rise, will cause shoreline to retreat along sandy coasts (IPCC, 2021), accentuating the impact of storm surges and coastal flooding on aquifers and coastal areas.

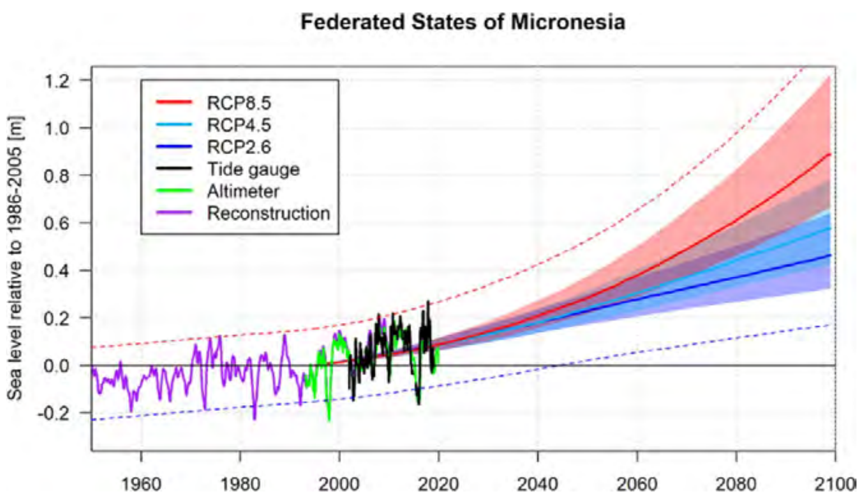


Figure 16. Sea level rise projections for the Federated States of Micronesia. The tide gauge record of relative sea level at Pohnpei is indicated in black, the satellite record in green and reconstructed sea level data is shown in purple, all are monthly means without seasonal cycles and referenced to mean sea level between 1986-2005. Multi-model-mean projections from 1995–2100 are given for the RCP8.5 (red solid line), RCP4.5 (cyan solid line) and RCP2.6 emissions scenarios (blue solid line), with the 5–95% uncertainty range for RCP8.5 and RCP2.6 shown by the red and blue shaded regions respectively. The dashed lines are an estimate of interannual variability in sea level (5–95% uncertainty range) and indicate that individual monthly averages of sea level can be above or below longer-term averages. (Source of figure and figure legend: CSIRO and SPREP, 2021)

- **Sea Surface Temperature** (SST) is projected to increase and will increase further with 1.5°C of global warming (*high confidence*) and with a larger increase at 2°C and higher (IPCC, 2021). This is very likely to cause bleaching and death of corals. Warming temperatures and ocean acidification are expected to have an adverse effect on coral reefs, threatening FSM food security;

- **Ocean acidification** is projected to increase, with consistent decline in aragonite saturation which will reach values below 3.5 by 2030 in the FSM and it is projected to continue declining thereafter (Fig. 17). Based on the IPCC Sixth Assessment Report (2021), ocean acidification will increase further with 1.5°C of global warming and with larger increase at 2°C and higher (*high confidence*);

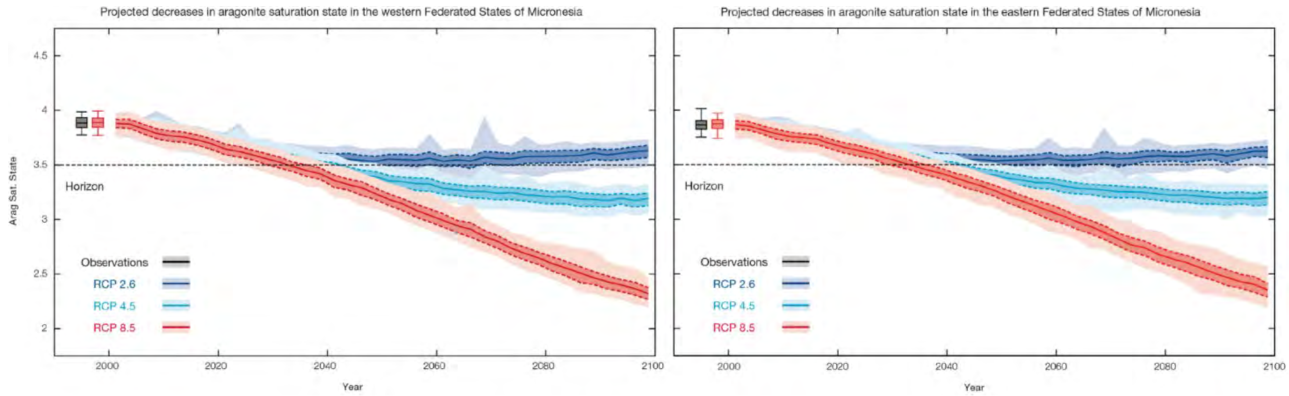


Figure 17. Projected decreases in aragonite saturation state in western (upper) and eastern (lower) Federated States of Micronesia from CMIP5 under RCPs 2.6, 4.5 and 8.5. Shown on these plots are the median values, the interquartile range (the dashed line), and 5% and 95% percentiles. (Source of figure and figure legend: Australian Bureau of Meteorology and CSIRO, 2014).

A summary of projections for RCP2.6 (very low emission scenarios) and RCP 8.5 (very high emission scenario) are presented in Table 4[157] for the Eastern (Pohnpei and Kosrae States) and Western (Chuuk and Yap States) FSM, including impacts on population, key sectors and ecosystems.

Summary of Climate Projections

- El Niño and La Niña events will continue to occur in the future, but there is little consensus on whether these events will change in intensity or frequency.
- Tropical cyclones (TCs) are projected to be less frequent but more intense.
- Annual mean temperatures and extremely high daily temperatures will continue to rise.
- There is a range in model projections in mean rainfall, average rainfall is projected to increase, with more extreme rain events.
- The proportion of time in drought is projected to decrease slightly.
- Sea levels will continue to rise under both very low and very high emissions.
- Ocean acidification and ocean warming are expected to continue, overall increasing the risk of coral bleaching.
- Wave height is projected to decrease across the western FSM in the dry season and storm waves height are projected to decrease in December–March. For the eastern FSM, a small decrease in wave height, with no change in period or direction is expected in the dry season and an increase in the height of storm waves is suggested in June.

[157] Projections suggest that climate in the FSM will continue to change in diverse way; however, lack of high-resolution climate projections, as well as the representation and understanding of interannual and decadal variability and their interplay with trends, suggest that some of the changes may be less predictable.

Table 4. Summary of the projected changes in the Eastern (E) and Western (W) FSM under the low (L) and high (H) emission scenario (RCP2.6 and RCP8.5). Source: Australian Bureau of Meteorology and CSIRO (2014), CSIRO and SPREP (2021) & SOE, 2019.

Climate variable	Expected change		Projected change 2030	Projected change 2050	Projected change 2070	Confidence level	IMPACTS
Surface air (°C/°F)	Annual air temperatures continue to rise.	L	+0.7°C	+0.8°C	+0.8°C		Impacts to human health and health systems related to heat stress if working outside or outdoor recreation. Increased need for cooling systems and energy required for cooling. Air temperature also impacts agriculture and water resources.
		H	+ 0.7°C	+ 1.4°C	+ 2.2°C		
Annual total (% change)	Average rainfall is increase over the FSM.	L	2% (W) 3% (E)	3% (W) 4% (E)	2% (W) 6% (E)		Increases in rainfall intensity will lead to increasing flooding, damage to crops, and increases in run-off/pollutants into coastal waters. It is likely to increase vector-borne diseases (e.g. dengue). Impacts will be felt from periods of drought affecting human health, water supply and agriculture.
		H	2% (W) 3% (E)	5% (W) 6% (E)	7% (W) 8% (E)		
Mean Sea level (in/cm)	Mean sea level is projected to increase.	L	~5.1 in [13 cm]	~9.0 in [22 cm]	~ 12.6 in [32 cm]	High	Sea level rise exacerbates flooding from high tides and storms: likely increase in loss of lives, damage and loss of coastal homes, lands, and infrastructure, contaminated drinking water, and destruction of crops. Increased coastal erosion can result from higher sea levels especially when combined with large waves. Salinity intrusion can damage coastal aquifers and agricultural land.
		H	~5.5 in [14 cm]	~11.0 in [28 cm]	~19.0 in [48 cm]		
Sea Surface temperature (SST)	Sea Surface temperature is projected to increase.	L	~0.6°C	~1–2°C	~2–3°C	High	Coral bleaching is expected to increase. When sea temperatures increase 1–2°C above the normal maximum for > 4–6 week, coral bleaching is likely to occur. Coral bleaching is likely to adversely affect reef-dependent species and reduce services reefs provide (tourism; coastal protection; food and livelihoods; habitat; medicine).
		H	~0.8°C	~1–2°C	~2–4°C		
Ocean acidification (maximum aragonite saturation state, Ωar)	Ocean acidification will continue to increase		NA	NA	NA	High	Ocean acidification (OA) affects many marine organisms that rely on calcium carbonate to build their shells/skeleton (e.g. corals, clams, mussels). OA can result in decreased growth and reproduction and weaker and more brittle skeletons, prone to increased damage from storms. Coral reefs are critical because they provide habitats for fish, support food and livelihoods, income from tourism, medicines, and coastal protection to islands.
		H	~3.5 Ωar	< 3.0 Ωar	< 3.0 Ωar		
Storm Patterns	Typhoons are projected to be fewer but of higher intensity.		↓ 20–50%	↓ 20–50%	↓ 20–50%	Low	More severe cyclones when they do occur and combined with sea level rise will result in increased flooding and potentially coastal change resulting in damage and loss of lives, coastal homes, land, and infrastructure.

5.4 Vulnerability to Disaster Risk Events

The FSM experiences natural disasters regularly. Between 1980-2020, tropical storms top the list of disaster events for the FSM (63%; Fig. 18). Droughts have also significantly affected people over the same period (18.2%; Fig.18). In total, tropical storms have affected about 54,000 persons and led to a cumulative sum of US$ 17.5 million (World Bank, 2021[158]). For example, Typhoon Mitag in 2002 caused 1 fatality, devastated food crops, destroyed buildings and caused important economic losses in the FSM. In 2002, Typhoon Chata'an struck Chuuk State with intense rain, causing floods as well as 265 landslides, with 62 major landslides that killed 43 and injured over 100 on six islands (SPC, 2017[159]). Landslides triggered by rainfall events are recurrent in some of the FSM high islands, posing a significant threat to lives, sources of revenue and road networks. However, there is limited data since their occurrence and impacts are difficult to quantify. Recurring losses from climatic disaster events represent an ongoing erosion of development and subsistence assets, which has also a severe impact on the economic growth of the nation and pose a considerable strain on FSM's communities' livelihood and resilience. The FSM is at risk of losing more than 10% of its GDP annually due to climate- related disasters (ESCAP, 2020[160]). The Global Climate Risk Index (CRI) ranks FSM as the third most at risk country amongst the Pacific Island countries (PICs), considering the long-term CRI (1998–2017).[161]

Since the Second National Communication, disaster events directly affected more than 30,000 people in the FSM. Some of these events prompted a declaration of a state of disaster by the Government (Tables 5 & 6).

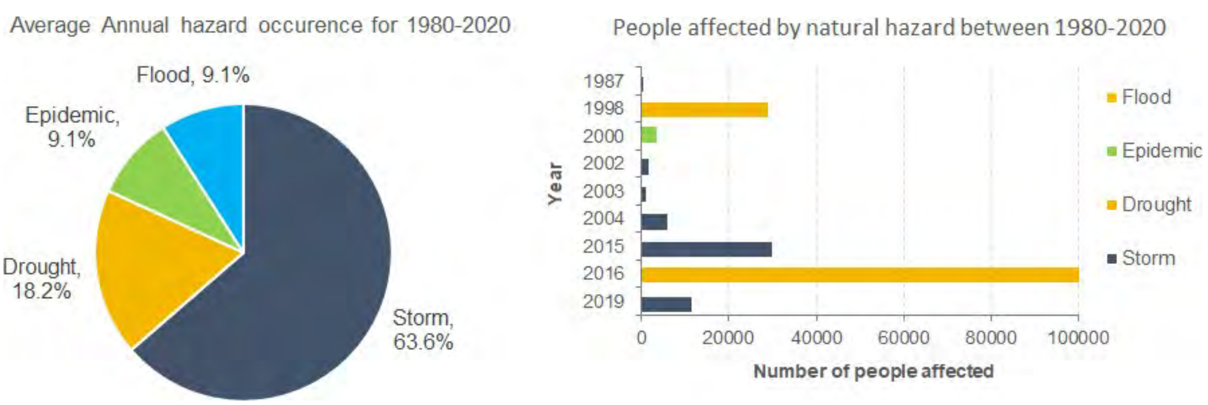


Figure 18. Natural disasters affecting the FSM population between 1980 and 2020. (Source of data: World Bank Climate Change Knowledge Portal.)

Tropical storms and Typhoons

In recent years, the FSM was hit by two damaging typhoons, Maysak and Wutip (Table 5). Typhoon Maysak reached the islands of the FSM in March 2015 causing four fatalities, damaging houses, crops, and public infrastructure, and causing millions of dollars in damage. A Disaster Declaration was issued. Typhoon Maysak was one of the most powerful pre-April tropical typhoons in the North-western Pacific Ocean with nearly one third of FSM's population affected (USAID, 2015[162]). Devastating impacts on island agriculture systems were also recorded, with 90% of the banana, breadfruit, and taro crops destroyed in Chuuk and Yap states. According to the United States Agency for International Development (USAID), more than 29,000 people were directly affected by typhoon Maysak (USAID, 2015), and reconstruction costs to repair and replace homes and public

[158] Climate risk country profile: Micronesia (2021): The World Bank Group. https://climateknowledgeportal.worldbank.org/sites/default/files/country-profiles/15818-WB_Micronesia%20Country%20Profile-WEB.pdf
[159] SPC (2017). Chuuk joint State action plan on disaster risk management and climate change
[160] United Nations, Economic and Social Commission for Asia and the Pacific (ESCAP) (2020). The Disaster Riskscape across the Pacific Small Island Developing States: Key Takeaways for Stakeholders. ST/ESCAP/2880
[161] https://www.germanwatch.org/en/16046
[162] USAID (2015). Micronesia- Typhoon Maysak. Fact Sheet # 2, fiscal year (FY) 2015.

infrastructure damaged or destroyed in the states of Chuuk and Yap, amounted to $42 million USD.

In February 2019, Typhoon Wutip passed over the states of Pohnpei, Chuuk and Yap. Chuuk and Yap's outlying islands were particularly affected. A Disaster Declaration was issued with a request for international assistance to respond to the typhoon related damage. In the immediate aftermath, the most affected islands faced water and food shortage due to the severe damage caused to food crops and water sources from strong winds (75–80 mph and gusts of up to 100 mph) and saltwater intrusion. A joint damage assessment (JDA) carried out by the FSM government with USAID, OFDA and FEMA detected damage to infrastructures, crops and houses, affecting approximately 11,575 persons across 30 islands (IOM, 2019[163]).

The damage from more severe typhoons is increasing FSM's reliance on aids from the global community for immediate response and reconstruction to reduce food and water insecurity, and in the long-term is likely to have an impact on the nation's economy (IMF, 2019[164]). Climate projections indicate that an increase in the intensity of these events is likely to occur and therefore future losses from tropical cyclones compared to the current climate will also increase (Table 7).

Table 5. Recent known damaging TC events affecting the FSM.

Damage Legend Minor: Moderate: Major:

TYPHOONS			
Typhoons	Affected areas	Level of damage	Damage description
Bopha (Nov 2013)	Chuuk: Kutu, Lukunor, Ta		Properties and livelihoods were damaged with loss of crops, but not major damages were reported
	Yap main		Impacts were felt but were minor
Hayan (Nov 2013)	Yap: Ngulu		The island was inundated by 0.50m of salt water and sustained damages to crops and properties
	Yap main		Some fruit bearing trees were destructed
Hagupit (Dec 2014)	Yap: Ngulu, Eauripik, Woleai, Ifalik		Crops, infrastructures, communication and properties were damaged from wind and inundations
Maysak (Mar 2015)	Chuuk lagoon Yap: Ulithi		Damage to crops and infrastructures, contamination of water, 5 fatalities, around 7,000 people homeless in Chuuk and Yap state. About 29,705 people affected.
Dolphin (May 2015)	Pohnpei		Tropical Storm Dolphin passed Northeast of Pohnpei with winds at approximately 80mph causing an Emergency Declaration issued after damage to electrical, roads, uprooting of trees and crops and damaging more than 246 homes, 1 fatality was recorded.
Wutip (2019)	Pohnpei main Sapwafik and Nukuoro		Landslides in Pohnpei main island caused 1 fatality and severe damage to houses in Sokhes, Nett, U and Kitti municipalities, destroying 11 houses on a total of 53 houses being damaged. Damage to crops was also recorded

[163] IOM Micronesia (2019). Newsletter July 2018-April 2019
[164] International Monetary Fund (2019). Federated States of Micronesia Climate Change Policy Assessment. IMF Country Report No. 19/292, Washington D.C.

Typhoons	Affected areas	Level of damage	Damage description
Wutip (2019)	Chuuk: Lukunor, Mortlocks Region and Northwest Region, Houk, Pollowat, Chuuk Lagoon		Severe to moderate impacts to crops while water supplies were somehow affected but showed signs of recovery. Infrastructures and houses in the Mortlocks Region and Northwest Region were severely damaged, with a total of 140 houses destroyed out of 694 houses affected. Public infrastructures were also affected. State of emergency was declared.
	Yap: Satawal, Lamotrek, Elato, Faraulep and Piig		Damage to crops and houses and contamination of water from inundation. State of emergency was declared.

Floods

In the FSM, floods are associated with typhoons, tropical storms, large wind driven swells and extreme tides. The occurrence of these events varies across the country, but coastal flooding from large swell and seasonal high tide events are frequent. Since 2000, FSM has been experiencing periodic rise of sea level in the outlying islands and low-lying coastal areas of high islands (Australian Bureau of Meteorology and CSIRO, 2014). These events are known by the residents as King tides. In 2007, and again in 2008, many FSM communities were flooded by a combination of large swell and seasonal high tides, which produced higher than normal sea levels. The result of these events was widespread damage on numerous islands, particularly low-lying atoll islands, which eroded beaches, damaged roads, intruded aquifers and wetlands, and destroyed nearly half of the nation's cropland (FSM SNC, 2015; Fletcher and Richmond, 2010[165]). These occurrences are frequent, the most recent was recorded in December 2021, with multiple FSM's states experiencing coastal flooding from a combination of King tides, La Niña elevated sea levels, and strong northerly winds. There have been reports of substantial damage to infrastructures, crops, and water resources. A state of Emergency was declared, and preliminary assessments estimated damages to agriculture and infrastructures for US $3.4 million only for the State of Chuuk.

Rising ocean waters are increasing the frequency of flooding events, exacerbating coastal erosion and affecting FSM's coastal communities and critical assets, among which are causeways, roads and jetties. These events adversely affect immediate and long-term food and water security, increasingly posing a threat on residents' health, well-being, and socioeconomic security. Also, in the long-term, damage to much of the infrastructure and property located along all parts of the coastal areas will be increasingly more frequent.

Droughts

Droughts are a recurrent climate feature in the FSM, the intensity and frequency of which is dependent on the intensity and frequency of the ENSO phase. The droughts associated with El Niño years 1982-1983, and 1997-1998 were especially severe, increasing localized threats to biodiversity and water resources. In these years, agriculture systems were damaged, water resources were adversely impacted, and problems associated with wildfires and invasive species were greatly aggravated. Most recently, a strong El Niño that evolved in 2015, continued to impact global weather and temperatures at the beginning of 2016. In 2016, much-below-normal precipitation, causing intense drought, was observed across the FSM, associated with the expected evolution of El Niño (Marra et al., 2017). As a consequence of such intense drought, 2,677 households were affected across the country (IAC, 2019[166]) and the government of FSM promulgated a nationwide Emergency Drought Declaration (Table 6). Insufficient rainfall caused water and food shortages, with direct impacts on population health and everyday life, due to the closure of schools, water rationing in Yap, Chuuk and Pohnpei, and health

[165] Fletcher, C., Richmond, C. (2010). Climate change in the federated states of Micronesia: Food and water security, climate risk management, and adaptive strategies. University of Hawaii Sea Grant Program, School of Ocean and Earth Science and Technology, Honolulu, Hawaii.
[166] Statistics Division (2019). Federated States of Micronesia: Integrated Agriculture Census 2016. Department of Resource and Development (FSM RD), Palikir, FM.

problems associated with the limited access to clean water and malnutrition. Potable water became scarce, particularly in the outlying atoll islands where emergency water supplies had to be delivered by boat (SPC, 2018[167]). Climate projections indicate that the frequency of severe drought will decrease slightly, but the duration of events will remain approximately the same under very high GHG emission. Droughts are slow-onset hazards, spatially extensive that can persist for more than a year with wide-spread consequences for water, food, energy, economic, health and ecosystems. In the FSM, droughts are felt in all sectors, with a general increase in the costs of accessing and delivering water and crop supplies. Drought can also alter rates of carbon, nutrient, and water cycling, further impacting agricultural production and critical ecosystem functions that underpin agricultural systems, and the livelihoods and health of local communities.

Table 6. Recent known most damaging drought events affecting the FSM.

DROUGHTS			
Drought	Affected areas	Extension of damage	Damage description
1997-1998 El Niño	Yap		Water supplies were severely compromised on Yap main and outlying islands. A major drought disaster declaration was promulgated in 1998
	Chuuk		Severe impact on water supply system, crops and food security.
2007 El Niño	FSM nationwide drought emergency		A nationwide Emergency Drought Declaration was signed in 2007.
2016 El Niño	Yap		A nationwide Emergency Drought Declaration was signed in 2016. Damage was estimated to be $11.4million. More than 40 wildfires was reported.
	Chuuk & Pohnpei		

[167] 194 SPC (2018). European Union – North Pacific - Readiness for El Niňo (RENI) Project. Project Design Document: Securing water resources ahead of drought in Yap and Pohnpei States, FSM. https://ccprojects.gsd.spc.int/wp-content/uploads/2018/12/PDD-FSM-FINAL.pdf

Table 7. Summary of vulnerabilities and risks of known damaging climate events affecting the FSM.

Hazard	Vulnerability and risk	Threat	Impacts	Average annual losses
Tropical cyclone	- Damaging winds, rain and storm surge. - Significant damage at the coast, but the whole islands can be severely affected. - Widespread flooding, landslides and damage to infrastructures, buildings, agriculture and livestock and loss of lives.	- Typhoons are projected to be less frequent but more intense.	- Impacts to infrastructures (roads, seaports, airports), buildings, loss of life. - Indirect impacts such as the disruption of essential services across various sectors of the economy and the interruption of supplies.	- By end-of-century average annual losses are projected to increase from 8.0 million USD to 8.4 million USD, an increase of 4.8% - By the end of the century larger increases in losses are projected for more extreme events (> 50-year return period). - Losses from 1-in-50-year tropical cyclones could increase by as much as 59% in the worst-case climate change scenario[195].
Floods, including coastal and fluvial floods	- Much of the population and infrastructures are located on the coastline and highly vulnerable to coastal floods. - Flash flooding is likely to occur during typhoons, tropical storms and extreme rainfall events. - Flooding in high islands has caused landslides and fatalities	- More extreme rainfall events are projected to increase in intensity and frequency. - Sea level is projected to rise and coastal flooding will become more acute.	- Impacts to infrastructures, buildings, loss of life. - Impact on fresh water resources of outlying islets - Impact on agriculture production. - Indirect impacts such as the disruption of essential services across various sectors of the economy.	- Important cumulative losses, especially on roads and other transport infrastructure and on residential buildings. - A recent coastal flood event (2021) has caused losses greater than US $3 million, and this only for the State of Chuuk.
Drought	- Population, fresh water and agriculture assets in the outlying island atolls in the FSM are particularly vulnerable to droughts. - Severe drought events have an impact on the FSM energy sector (i.e., hydropower in Pohnpei) and essential education services.	- Droughts pose a high level of risk to FSM population and subsistence assets. - The frequency of severe drought will decrease slightly, but the duration of events will remain approximately the same	- Impact on fresh water resources, particularly for outlying islets - Impact on agriculture production. - Indirect impact on services delivery (energy, education) and water supply.	- Severe droughts have important cumulative losses, especially in terms of subsistence agriculture, access and delivery of fresh water and energy and health (waterborne diseases). - Estimates indicate that average annual loss from drought is 4.6% of the nation's GDP and this is likely to increase by the end of the century.[196]

5.5 Sectoral Vulnerabilities

The most vulnerable sectors considered in the SNC are freshwater delivery and agriculture (for food and water security), health, and transportation (roads and seaports). The SNC also considered the high vulnerability of the FSM's coastal areas to climate change, including coastal settlements, infrastructures and habitats such as mangroves. Climate change projections indicate that risks from threats such as sea level rise, tropical cyclones and storms, extreme air temperatures, ocean warming and acidification are most likely to increase the vulnerability on the FSM's key sectors, exacerbating the adverse impacts of climate change on public health, human settlements, infrastructures, fisheries and agriculture production, power supply and the economy at large. The impacts from climate change to the FSM fragile biodiversity, ecosystems, and natural habitats are being exacerbated through anthropogenic mangrove removal, sand extraction, overfishing and other unsustainable development activities that exacerbate the nation's vulnerability.

According to article 2 of the Paris Agreement, to significantly reduce the risks and impacts of climate change, the increase in global average temperature should be held to well below 2 ºC above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 ºC above pre-industrial level. However, the NDC synthesis report from the UNFCCC Secretariat (2021), anticipated a substantial increase, of about 16%, in global GHG emissions in 2030 compared to 2010, leading to a temperature rise of about 2.7°C by the end of the century. The latest IPPC report (IPCC- 6th report on Impacts, Adaptation and Vulnerability, 2022), indicates that even for low greenhouse gas (GHG) emission pathways, the vulnerability of communities in small islands may exceed adaptation limits before 2100.

Table 8. Summary of FSM's sectoral vulnerabilities.

Sector	Climate Change Vulnerabilities
Fresh water resources	Projected changes in rainfall patterns in Micronesia are masked by the regional interannual variability and multi-decadal variability (i.e., ENSO and Pacific Decadal Oscillation), but studies suggest an increase in rainfall alternated to severe drought periods. Sea level is likely to increase by approximately 10 inches by 2050, exacerbating coastal erosion and affecting water resources. This will be particularly severe for fresh water resources of FSM low-lying atoll islands since almost all islets lie within a 2-meter zone of potential sea level. Impacts to fresh water resources are likely to be severe, particularly for low-lying islands, which already rely on depauperate water lenses.
Agriculture	Increasing sea level, air temperature, droughts and storm surges on low-lying coastal areas and atolls have contributed to food insecurity by affecting agroforest systems such as taro patches. The risk from these threats is likely to become more acute. Sea level rise will result in salinization of agricultural land in low-lying islands and high islands. These areas have already experienced impacts from storm surge and extreme high tides. Land loss via erosion is also likely, further reducing the availability of land to grow crops. Extreme temperatures are likely to have an impact on more sensitive crops through increased evaporation of soil and stress to crops. Similarly extreme rainfall may impact agriculture increasing the chance of landslides, disturbing surface soil and reducing overall soil productivity. Pests' outbreaks are also likely to occur under extreme conditions further exacerbating the impact on crops.
Sector	Climate Change Vulnerabilities

Biodiversity and natural environment	An increase in temperature beyond 2°C by 2100 is likely to boost local extinction, particularly that of marine organisms. Marine heatwaves will lead to species extirpation, habitat collapse, and potential local extinction. Sea level rise under emission scenarios that do not limit warming to 1.5°C increase the risk of coastal flooding, erosion, as well as habitat and ecosystems loss (IPCC, 2021[168]). Salinization of soils and groundwater can compromise coastal ecosystems, through adverse impacts to coastal carbon sinks (i.e., mangroves, saltmarshes, seagrass meadows) upon which community livelihoods and endurance depend. The FSM is an important biodiversity area with numerous endemic species which are at risk of extinction under warming of 2°C or more, above the pre-industrial period.
Health	Health assets are exposed to climate change hazards due to the insufficient maintenance of facilities, lack of climate proofing approach during construction and in some cases the use of poor material. Climate change is also likely to increase risks for human health. Higher rainfall conditions and a warmer climate can boost mosquito breeding, increasing the risk for outbreaks of vector borne diseases (dengue, chikungunya and zika), particularly in urban areas where population density is higher. The risk of waterborne diseases such as cholera and typhoid will increase during extreme rainfall through contamination of water, during and after flooding events. Temperature will continue to rise and heat stress will particularly affect the most vulnerable such as elders, children, expecting women and persons with comorbidities as well as those working outside (i.e., farmers, fisher-men and women). Higher temperatures may also lead to increased respiratory disease and diarrheal disease and gastroenteritis.
Transportation	The combination of rising sea level and more intense typhoons will place coastal assets (roads, seaports and airports) and communities at a higher level of risk. Sea level rise and associated impacts such as coastal erosion and inundation threatens infrastructure of FSM's low-lying coastal areas and islands. An increase in intensity of tropical storms or typhoons poses a concrete risk to transportation with many infrastructures built with poor construction standards and largely not climate proofed. In the FSM the road network faces a range of vulnerability issues, due to their coastal location that increases the exposure to sea level rise, storm surge, wave action during spring tides and typhoons. Additionally, extreme rainfall events can cause inland flooding and landslides while extreme weather and rising water tables in some locations are accelerating pavement deterioration.
Energy	Climate change extreme events are expected to impact energy infrastructure assets in the FSM's states due to their coastal location that increases the risks posed by rising sea level, storm surges, extreme winds and rainfall, typhoons. Increased erosion and flooding will further destabilize key infrastructures.

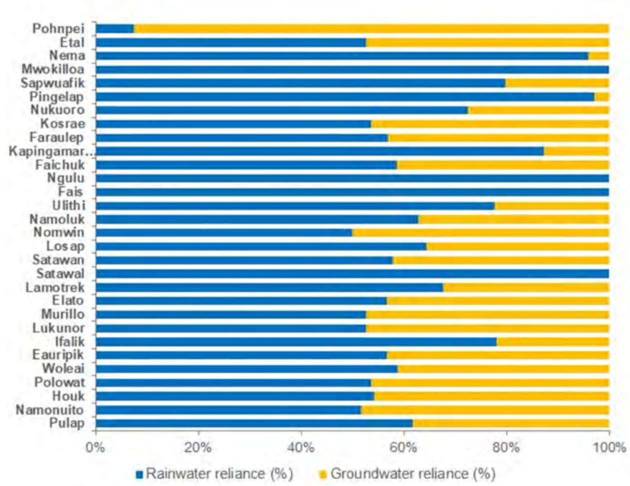
Freshwater

In the FSM, access to safe drinking water varies considerably between and within the four FSM's states due to geologic and geographic settings, socio-economic status, technology, government capacity, village-scale governance, and knowledge base. Households in remote areas are less likely to have constant access to safe drinking water and this condition is exacerbated for poorer households. Water vulnerability is very high particularly in outlying islands and rural remote areas, but migration to high islands and the largely unplanned urban growth is increasing pressure on high islands water resources, affecting water security in urban areas (SPC,

[168] IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. Zhai, A. Pirani, S.L. Connors, C. Péan, S. Berger, N. Caud, Y. Chen, L. Goldfarb, M.I. Gomis, M. Huang, K. Leitzell, E. Lonnoy, J.B.R. Matthews, T.K. Maycock, T. Waterfield, O. Yelekçi, R. Yu, and B. Zhou (eds.)]. Cambridge University Press. In Press.

2020[169]; Fig. 19).

Public water supplies are limited to high islands and in many cases water systems are underdeveloped and with limited coverage, leaving out part of the population. In Chuuk, public water supplies are available only on the island of Weno with about 8% of households obtaining drinking water from the public water supply systems, which are provided by the Chuuk Public Utility Corporation (ADB, 2020[170]). In Pohnpei, the Pohnpei Utilities Corporation water system covers about two-thirds of the island, providing water to 61% of the island's residents (Deloitte, 2018[171]). Therefore, a significant part of the population in the FSM still relies on rainwater tanks as the source of drinking water, as well as wells (groundwater), streams and springs. This is particularly the case for outlying islands where households have access to individual or community rainwater harvest systems for drinking water, while groundwater from the islets water lens is generally unsuitable for drinking, due to poor water quality and/or salination from saltwater intrusion (Fig. 19). However, it also applies to high islands; for instance, in 2015 in the State of Kosrae more than 62% of the households accessed drinking water from rainwater tanks (Bell, 2015[172]).



Site Name	Water vulnerability
Pulap	Extreme
Namonuito	Extreme
Houk	Extreme
Polowat	Extreme
Woleai	Extreme
Eauripik	Extreme
Ifalik	Extreme
Lukunor	High
Murillo	High
Elato	High
Lamotrek	High
Satawal	High
Satawan	High
Losap	Moderate
Nomwin	Moderate
Namoluk	Moderate
Ulithi	Moderate
Fais	Moderate
Ngulu	Moderate
Faichuk	Moderate
Kapingamarar	Moderate
Faraulep	Moderate
Kosrae	Low
Nukuoro	Low
Pingelap	Low
Sapwuafik	Low
Mwokilloa	Low
Nema	Low
Etal	Low
Pakin	Low
Pohnpei	Low
Oroluk	Low

Figure 19. Percentage of households that utilize rainwater and groundwater as a water source for any of their water needs, either for potable or secondary water needs, and water vulnerability at selected sites (Source: SPC Atoll Water Inventory, 2020).

Along with an increased population and modern lifestyles, demand for water continues to increase while its supplies are threatened. Water security depends on several factors, specifically the availability of rainwater, the reliability of the network of rainwater catchment systems, and the availability of fresh groundwater as a source to use during periods of low rainfall.

Climate change projections show that in the FSM temperatures will continue to rise, as will the sea level, sea temperatures and ocean acidification. Extreme temperatures will likely be more frequent, as well as changes in precipitation patterns, prolonged inter-annual sea level inundations, and tropical cyclone frequency and intensity are expected to exacerbate coastal erosion, increasing the risk of flooding events which affect freshwater availability across the country. The establishment and maintenance of water infrastructures that are resilient to climate change and natural disaster are crucial for FSM adaptation. Relocation of most vulnerable water service infrastructure has been indicated as adaptation solution to future climate change impacts for the state of Kosrae (Ramsay, 2013[173]).

[169] Pacific Community. Atoll Water Inventory: Background and Methodology. https://storymaps.arcgis.com/stories/9f34ad66403140a5b394fe26b1ebf696
[170] Asian Development Bank (2020). Federated States of Micronesia: Chuuk Water Supply and Sanitation Project. Project Number: 53284-002.
[171] Deloitte & Touche LLP (2018). Pohnpei Utilities Corporation. Financial statements, additional information and independent auditors' report. Years ended September 30, 2017 and 2016. Deloitte & Touche LLP, Tamuning, Guam. http://www.fsmopa.fm/files/fy2018/PUC%20FS17%20[FINAL%2006.28.18].pdf
[172] Bell, B. (2015). Kosrae CBA of water infrastructure and related analysis of water pricing policy. Household survey on Kosrae water quality issues by Municipality. Nimmo-Bell & Company Ltd.
[173] Ramsay D., Webb A., Abraham S., Jackson R., Charley B. (2013). Kosrae Shoreline Management Plan: repositioning for resilience. National Institute of Water & Atmospheric Research Ltd, New Zealand.

The long-term average air temperature over the FSM is projected to rise 1-2°C by 2050, potentially intensifying impacts from ENSO events with adverse effects on water resources across the country. In the years of drought events, FSM's low-lying atolls were particularly affected since their fragile freshwater resource base can be quickly depleted when there is a lack of rainfall becoming more vulnerable to saltwater intrusion. FSM's low-lying atolls communities depend on safe drinking water supplies for their survival and well-being and the only source of fresh water to recharge natural systems—freshwater lenses—and man-made rainwater catchments come from rainfall.

During the 2016-ENSO event, drought conditions were reported throughout the FSM impacting both water quality and quantity. Potable water was shipped to many of the outer islands of Yap and Pohnpei States, and water rationing was started in some areas of Yap Proper, Chuuk and Pohnpei. In Kapingamarangi, one of the outlying remote islands of Pohnpei state, drinking water supply was depleted and water supplies had to be delivered by ship from Pohnpei (SPC, 2018[174]). In such instances, communities across the FSM used a variety of coping mechanisms to deal with decreased drinking water availability such as reverting to the use of wells water, where possible, but also utilizing coconut water as supplement to the rainwater. FSM's states response was varied, for example in Yap a State El Niño Mitigation Plan was prepared to guide the emergency response to water scarcity.

Typhoons and tropical storms magnify the impacts of droughts, since damage to infrastructures, rainwater catchment systems and crops (i.e., coconuts) further reduces the opportunity to access safe drinking water. Drought has an important social dimension since it can affect genders differently. For instance, productivity of women may be adversely affected by time taken away from productive activities such as paid employment, since women may have to spend more time fetching water for their family. Similarly, children and youth education can be adversely affected since water rationing may require schools to be closed. This was the case, in 2016, in Pohnpei State, where schools were closed for several months, impacting access to education.

In the FSM's coastal areas, freshwater contamination from saltwater intrusion is frequent following typhoons, sea swells, anomalous tides, storm surges, and coastal flooding events are exacerbated by the loss of coastal ecosystems and coastal erosion. Following Typhoon Wutip (2019) an Initial Damage Assessment (IDA) indicated damaged areas in Pohnpei, Chuuk and Yap states due to storm surges, strong winds and saltwater inundation. Groundwater resources of 11 outlying islands across Chuuk and Pohnpei were severely impacted, although they were rapidly recovering due to heavy rainfall events in the region. At the time of the IDA, water lenses of 4 out of the 11 islets were still slowly recovering (USAID, 2019[175]).

Vulnerabilities of the water sectors are varied and dependent by the age and design of the infrastructures and low climate-proofing standards. For instance, sewage systems in low-lying areas are subject to significant submersion during flooding events increasing the probability of runoff intrusion into the water treatment plants and the likelihood of polluting the environment. Poor watershed management and intense runoff causing soil erosion are likely to decrease the quality of water sources, compromising its treatability and increasing the costs for water treatment facilities. Increasing the resilience of island water systems will require upgrading, repairing and in some context relocating water infrastructures, while considering climate-related construction standards in designing and developing these infrastructures. Increasing water capacity of outlying islands will also be crucial to increase their adaptive capacity. Under the FSM Infrastructure Development Plan (IDP) for 2004- 2023 water development and management was considered as a top priority for the nation and this priority was reflected in the States IDP. States water management plans (WMP) would be an important strategy to address the issues of saltwater intrusion and protect freshwater aquifers. Examples of WMP exist at local level; for instance, the

[174] Pacific Community and Government of the Federated States of Micronesia (2018). Project design document: Securing water resources ahead of drought in Yap and Pohnpei States, FSM. European Union- North Pacific Readiness for El Niño (RENI) project. https://ccprojects.gsd.spc.int/wp-content/uploads/2018/12/PDD-FSM-FINAL.pdf

[175] USAID and FEMA (2019). Typhoon Wutip Joint Damage Assessment Summary. Federated States of Micronesia (FSM).

Adaptation Fund[176] a project implemented by the FSM government is working with the communities of the inhabited atoll islets of Nukuoro and Kapingamarangi to develop water management plans to enhance their water security.

Most impactful water intervention requires investments in the most vulnerable locations, particularly for increasing rainwater harvesting capacity and enhancing alternative water sources (e.g., from groundwater and/or desalination). The type of intervention is determined by the remoteness, geography and geology of the islands (Fig. 20). Given the FSM's strong focus on water security, several projects have been and are being implemented by the government of the FSM in collaboration with communities and state governments to increase their water adaptive capacity.

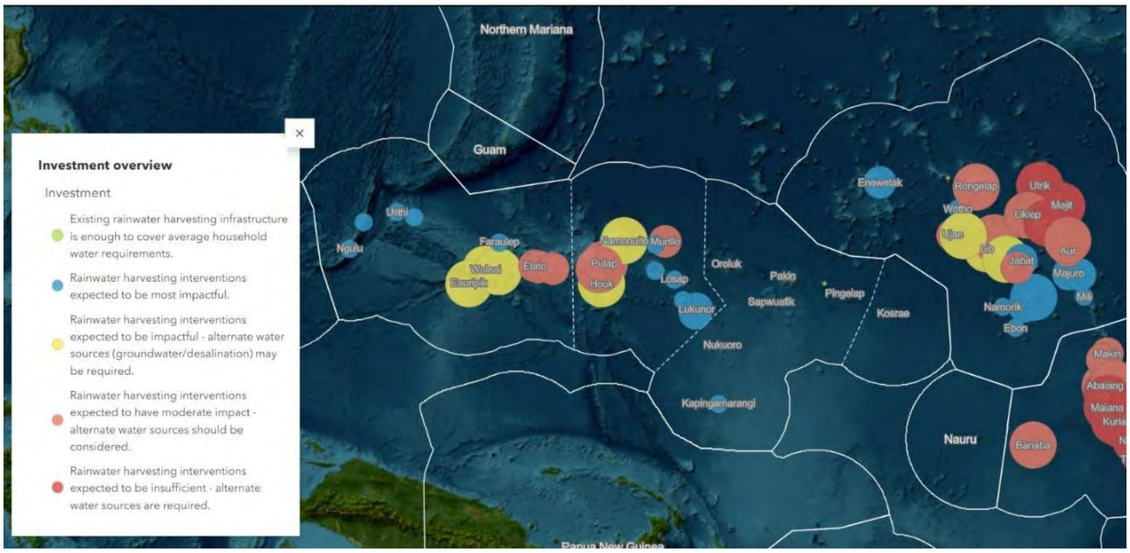


Figure 20. Water security interventions to reduce water vulnerability in the FSM (Source: SPC Atoll Water Inventory. https://storymaps.arcgis.com/stories/9f34ad66403140a5b394fe26b1ebf696).

Agriculture

Agriculture plays an important role in the FSM as a source of food for communities and livelihood. In the FSM agriculture is central to ensuring food security and it is a risk-coping strategy that provides resilience to economic shocks and disasters, with traditional subsistence practices serving as social safety nets, while preserving traditional culture and knowledge (Patagan, 2022[177]).

The FSM government considers agriculture as a key priority for the nation's long-term economic development; the sector is one of the three prioritized areas for development under the FSM's National Strategic Development Plan 2003-2023. This contributed to the adoption of the FSM Agriculture Policy 2012-2016 which recognizes the crucial role played by agriculture for livelihood and food security, and the importance of a community-based and culturally sensitive approach to propel the development of this sector. About 77% of the FSM population live in rural areas and are engaged in either pure or mixed subsistence production for their livelihoods. This sector consists largely of subsistence activities based on localized, small-scale production in family farms and home gardens (FSM Agricultural Policy 2012–2016). Local foods are primarily composed of traditional crops (i.e., taro, breadfruit, yam, banana, etc.), which generally have greater nutritional and health qualities compared to imported convenience starch foods, such as rice and flour-based products. The informal sector plays an important and often unacknowledged role in the economy, with 92% of agricultural workers being unpaid. Since 2005 the agriculture sector had an upward trend of 1.2% per year, indicating that subsistence production in the

[176] https://www.adaptation-fund.org/project/enhancing-climate-change-resilience-vulnerable-island-communities-federated-states-micronesia/
[177] Patagan R. (2022). Social protection in the Federated States of Micronesia: Spotlight in subsistence and food security. In: Pacific Economic Monitor, December 2022. Asian Development Bank, Manila, Philippines.

FSM has increased, whereas commercial agriculture remains underdeveloped (IAC, 2019[178]).

A vulnerability assessment conducted by the FAO and summarized in the GCF proposal for the project "*Climate resilient food security for farming households across the Federated States of Micronesia (FSM)*", reports the levels of vulnerability for agriculture in the four FSM States and indicates that all States have high sensitivity, medium adaptive capacity, and high vulnerability for this sector (MCT, 2021[179]).

Most of the FSM outlying island atolls lie within the 2-meter zone of potential sea level rise, and all lie within a 5-meter zone of storm surge, further increasing the vulnerability of agricultural systems to the impacts of natural variability and climate change for the most remote communities in the FSM. Coastal flooding impacts have been reported as a key factor limiting agriculture productivity for 5-15% of FSM households (IAC, 2019). Extreme weather events (typhoons, storms, drought, flooding) have already affected people's food security and livelihoods by damaging staple crops and terrestrial and marine ecosystems (MCT, 2021). Climate hazards are projected to severely threaten FSM communities' food security—primarily because of crop loss, degraded arable land, price/supply shocks, and forced migration of outlying communities. There is a strong correlation between the extreme climate vulnerability of FSM and the livelihoods of communities, as a large share of the population heavily relies on natural resources. Household vulnerability to poverty and hunger is most often associated with threats to livelihoods and would increase over time with repeated shocks that erode productive assets.

Agriculture productive lands are increasingly subject to flooding as well as seawater inundation and intrusion from sea level rise. Low-lying atolls are especially vulnerable to inundation events and even losing arable land from projected sea level rise and extreme tide events. Due to rising sea level the risk of saltwater intrusion from the outlying islands water table is of concern for staple crops like taro (Henry and Jeffery, 2008[180]). The SNC already reported on past inundations that induced a decline of taro production in outlying islands (SNC, 2015) and these events are projected to increase by 2030 (MCT, 2021). However, flooding hazard from sea level rise on high islands is still of concern since most of the agricultural areas are located around the coastal zone and are already enduring increased flooding and drainage problems. In the near future, climate impacts to food systems are likely to generate a rapid increase of communities that migrate or relocate from the low-lying islands to the high islands, increasing the need for enhanced food systems on high islands. However, in some of the states, the existence of a strong communal support system that includes the rights and obligations tied to food production and exchange can mitigate hunger and malnutrition associated with localized impacts of sea level rise in vulnerable coastal villages (Perkins and Krause, 2018).

Projections of increased sea level rise (Fig. 21), under all climate scenarios, and an increase in extreme high tide events due to climate change, indicate that FSM's agricultural sector vulnerability to climate change will increase in the future. Currently about 97% of high tides are less than 2 meters, but by 2030 and 2050, due to sea level rise, dangerous high tide events are expected to exceed the 2-meter threshold 12% and 27% of the time respectively, substantially increasing the risks for saltwater inundation and/or intrusion from storm surges, extreme high tides and swells, threatening crop productivity on FSM atolls and lowland areas of high islands, where most of the fertile soil is located,[181] thus increasing the risk for food security and loss of agricultural production.

[178] FSM Statistic Division (2019). Integrated agriculture census 2016. Department of Resource and Development (FSM RD), Palikir, Pohnpei, FM.
[179] Micronesia Conservation Trust -MCT (2021). SAP020: Climate resilient food security for farming households across the Federated States of Micronesia (FSM). Green Climate Fund, Funding Proposal. https://www.greenclimate.fund/sites/default/files/document/funding-proposal-sap020.pdf
[180] Henry R., Jeffery W. (2008). Waterworld: the heritage dimensions of 'climate change' in the Pacific. Historic Environment 21 (1), 12-18. https://australia.icomos.org/wp-content/uploads/Waterworld-The-Heritage-Dimensions-of-Climate-Change-in-the-Pacific-vol-21-no-1.pdf
[181] 210 Federated States of Micronesia State-Wide Assessment and Resource Strategy 2010 – 2015 +. https://www.stateforesters.org/wp-content/uploads/2018/08/FSM-FAP.pdf

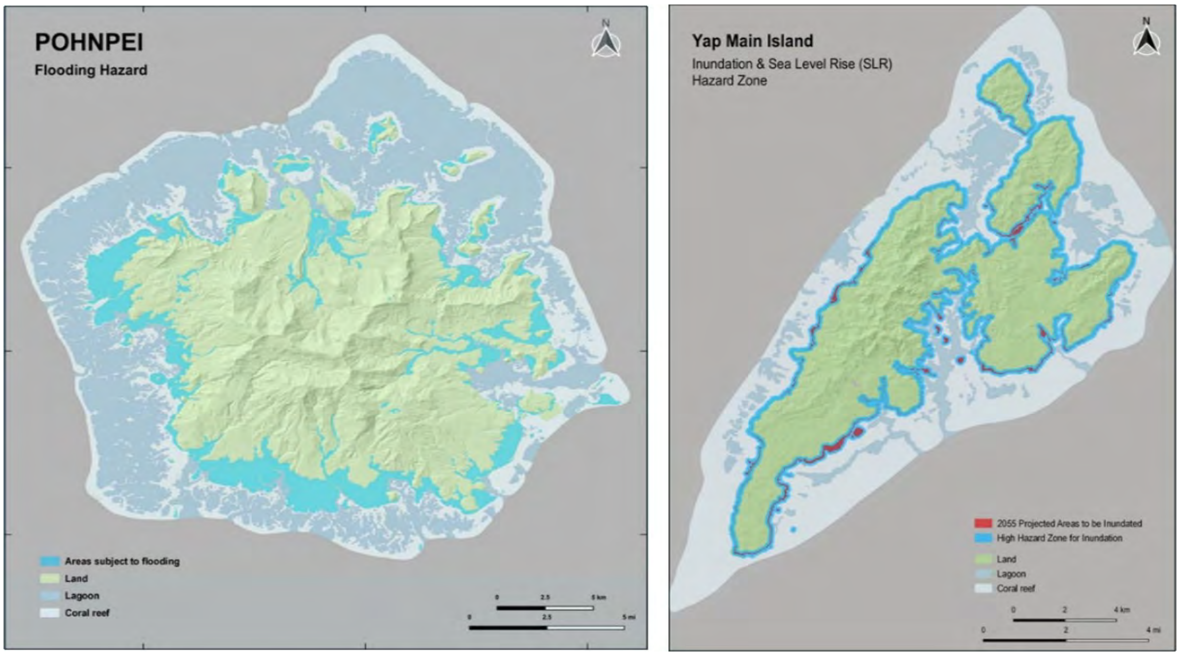


Figure 21. Sea Level Rise and Flood Hazard Maps for Pohnpei and Yap (Map source: MCT, 2021).

The projected sea level rises for the main island of Pohnpei indicate that there will be coastal changes due to sea level rise by 2055 as well as saltwater inundation of low-lying areas (Fig 21). The main island of Chuuk and the other islands located in Chuuk Lagoon are also projected to experience coastal changes due to sea level rise by 2055 along with saltwater inundation, which will affect several agroforest and urban cultivated areas along the coastline. The main island of Kosrae is projected to experience sea level inundation of low-lying areas up through 2090 (Biza, 2013[182]).

In Yap main island 68% of areas suitable for traditional taro production are located in the watershed at 5 m elevation or under (Fig. 22). These areas are prone to saltwater intrusion reducing taro productivity and yield. The projected sea level rise for Yap main islands indicates that there will be inundation of large parts of existing coastline and low-lying areas, with severe consequences for the already impacted agroforest activities. Traditionally, in Yap main island, women tend to taro patches, with 62% of women engaged in the production of this important staple crop. In all the states, women play an important role in managing home gardens, which are generally close to the coastal areas and therefore prone to saltwater inundation. The loss of these agricultural systems would have a direct impact on the loss of the FSM's traditional knowledge for food production, also impacting the role that women play in their households and communities, further increasing their vulnerability to climate change impacts. Therefore, an assessment on saltwater intrusion in taro patches was conducted for the main island of Yap. The Taro Patch Salinity Project evaluated traditional practices in watershed management and made recommendations through a series of resource maps for a comprehensive watershed–based approach to food security and adaptation that integrated traditional food production knowledge with modern geospatial science and technology (Ruegorong et al, 2016; Perkins and Krause, 2018).

[182] Biza S. (2013). Vegetation and land cover vulnerability geospatial analyses due to sea level rise modeling. Final report. College of Micronesia, FSM.

Figure 22. Vulnerability of Yap taro patches to saltwater intrusion. (Map Credit: US Forest Service, Yap Institute of Natural Resources, Yap Division of Agriculture & Forestry, and Queens University; Link to the map: https://storymaps.arcgis.com/stories/762ed9cd19bc4ae7a96b77974500d29e).

Although projections for El Niño–La Niña events are still uncertain, droughts will likely still occur in the future adding further pressure to agricultural systems already stressed by the impacts of extreme events and sea level rise. The Second National Communication (2016) reported that intense droughts during ENSO years caused, especially in the more water deficient outer atolls, severe food shortages (including staples such as taro, breadfruit, banana, yam, and sweet potato), impacted terrestrial habitats, triggered wildfires, and increased the distribution and incidence of pests and diseases that affect crops and livestock. For instance, in Pohnpei, an Emergency Declaration was issued in 2016 due to severe drought damaging crops and water on Pohnpei main island and the outer islands estimated to be $11.4million. More than 40 wildfires were reported (SPC, 2016[183]). The FSM Integrated Agriculture Census (IAC, 2019) indicated that 2-47% of households in the FSM already report issues with drought as a key negative driver for agriculture productivity. Specifically, the severe drought event triggered by El Niño in 2016 had impacts on food security for 45% of households in Yap and 21% of households Chuuk (IAC, 2019). Droughts can also alter rates of carbon, nutrient, and water cycling—all of which can impact agricultural production, critical ecosystem functions that underpin agricultural systems, and the livelihoods and health of FSM communities. Under high emission scenario, projected increases in temperature of 1.5 and 2°C are likely to pose a significant physiological stress to many agroforest staple crops cultivated in the FSM (i.e., taro, yam, breadfruit, etc.; Taylor et al, 2016[184]). Specialty crops such as vegetables, kava, betelnut and medicinal herbs, are more vulnerable to increased temperatures and droughts and have a higher value per unit of land/water increasing the risk for economic loss in drought (Taylor et al, 2016).

Most staple food crops and horticultural products are highly vulnerable to extreme weather events, accounting for many of the losses that occur in the Pacific (Table 9). For instance, Typhoon Maysak destroyed 90% of crops, including staple foods in both Chuuk and Yap affected areas, requiring temporary food assistance to be provided to about 29,000 people in FSM. The FSM government assisted communities in the outer islands providing support and material to reestablish agroforest systems where these were lost or partially damaged (i.e., seeds, seedlings, hand tools). Intensifying rainfall and storm events from climate change also exacerbate the risk of landslides in high islands, where some of the agriculture activities are now encroaching into the steep mountainous slopes, increasing deforestation, and reducing the health of the watersheds. In 2018, Tropical Depression Jelawat passed over the FSM, bringing heavy rainfall to Pohnpei that resulted in flooding, landslides and damage to agriculture. An agriculture damage assessment conducted in Pohnpei identified the needs for agricultural damage rehabilitation assistance in landslide and flood-affected areas. Again, in 2019, Typhoon Wutip caused landslides that impacted agricultural fields in Pohnpei, Chuuk and Yap, requiring further rehabilitation

[183] The Pacific Community and Government of Pohnpei (2016). Pohnpei Joint State Action Plan for Disaster Risk Management and Climate Change. The Pacific Community.
[184] Taylor M., McGregor A., Dawson B. (2016). Vulnerability of Pacific Island agriculture and forestry to climate change. The Pacific Community (SPC), Noumea, New Caledonia.

assistance (USAID, 2019[185]). Previous reports on extensive crop damage and loss, due to extreme weather-induced landslides include Tropical Storm Chata'an in 2002 and Typhoon Sudal in 2004. Furthermore, the projected increases in mean annual rainfall are likely to have a significant damaging effect on crop production in locations where rainfall is already high to very high (MCT, 2021).

The projected extreme weather events including storm surges and king tides, and the resulting salinization of fertile soil, are most likely to have the greatest impact in the short- to medium-term timescale (2030–2050; Table 9), compared with changes in mean temperature where significant impacts are not expected before 2050 (Bell and Taylor, 2015;[186] Taylor et al, 2016). Nevertheless, extreme warming could alter the distribution of native plants and animals in forest ecosystems and increase the threat of invasive species (Taylor et al, 2016).

Table 9. Impacts of climate change on the production of agricultural products (Source: Bell and Taylor, 2015)

Crop or livestock	Short term (2030)	Medium term (2050)	Long term (2090)
Staple food crops			
Taro	Low to moderate	Moderate to high	High
Swamp taro	Moderate to high	High	High
Giant taro	Insignificant to low	Low	Low
Breadfruit	Insignificant to low	Low to moderate	Low to moderate
Banana	Low	Low to moderate	Low to moderate
Wild yams	Insignificant to low	Low	Low
Domesticated yams	Moderate to high	High	High
Cassava	Insignificant to low	Low to moderate	Low to moderate
Sweet potato	Moderate	Moderate	Moderate to high
Export commodities			
Coconut	Low	Low to moderate	Low to moderate
High-value horticulture crops			
Papaya	Low to moderate	Moderate to high	High
Mango	Low to moderate	Moderate	Moderate to high
Citrus	Insignificant to low	Low	Low
Pineapple	Insignificant	Low to moderate	Low to moderate
Watermelon	Low to moderate	Low to moderate	Moderate
Tomato	Moderate	Moderate to high	Moderate to high
Kava	Low	Moderate	Moderate
Betel nut	Insignificant to low	Low	Low
Livestock			
Pigs	Low	Moderate	Moderate
Poultry	Moderate	High	High

Subsistence farming in the FSM is crucial to maintain population dietary requirements, combat the rampant increase in Non-Communicable Diseases (NCDs) and reduce the economic burden that increased costs of imported food can have on households. Reduced food security, from climate change threats, will have a wide impact on FSM's population. Loss of arable land, declining crop yields, spread of pests affect food security and

[185] USAID (2019). USAID/OFDA Program Summary. Federated States of Micronesia and Republic of the Marshall Islands. https://reliefweb.int/report/micronesia-federated-states/usaidofda-program-summary-federated-states-micronesia-and-3
[186] Bell J and Taylor M. 2015. Building climate-resilient food systems for Pacific Islands. Penang, Malaysia: WorldFish. Program Report: 2015-15.

FSM population health, potentially decreasing local nutritious food intakes and promoting dietary changes with further upsurge in the incidence of NCDs in the country.

Fisheries

Climate change is expected to produce drastic changes in the marine environment via warming sea waters, ocean acidification, sea current variability and reduced nutrient availability. The impacts will be felt by marine organisms, affecting the supply of coastal fish to local communities. Coastal fisheries in the FSM support protein intake and livelihood for high and low-lying islands communities. A large number of households engage in subsistence fishing and in many communities both men and women contribute to these fishing activities.

In recent decades, coral reefs and fish populations have been damaged due to unsustainable fishing practices and natural disasters. For instance, coral reefs in Chuuk State have been negatively impacted by extreme climatic events such as Typhoon Maysak and the invasive Crown-of-Thorns starfish that by preying on live coral can destroy entire areas of reefs, is of increasing concern in all states. Increased sea surface temperatures in 2016, caused corals to bleach across the country and in some areas bleaching-associated mortality was observed (Eakin et al., 2016[187]).

The 6th IPCC report (2022[188]) indicates that projected climate change, combined with non-climatic drivers, will cause loss and degradation of much of the world's coral reefs, severely affecting coastal fisheries. Under warming of 1.5 °C coral reef degradation is catastrophic with projected loss of 70-90% of coral reefs globally. Under 2°C, ocean acidification will impact reefs, fisheries and biodiversity with severe implications for island communities, economies and cultures.

For the FSM, climate change projections indicate that under the very high GHG emission scenario (RCP8.5) sea surface temperatures will increase by approximately 1-2°C by 2050, resulting in degradation of coral reefs, which reduces their ability to support fish. Aragonite saturation will reach the threshold that inhibits the development of many marine organisms that produce calcium carbonate shells and skeletons (Table 4). Both warming oceans and ocean acidification affect the fitness of fish species, including their reproduction and growth (Oue, 2018[189]). The occurrence of less frequent, but more intense typhoons will have direct impacts on coral reef and mangrove ecosystems, which hold juveniles of many local fish and marine organisms. Heavy rainfall will cause greater sediment and nutrient runoff further damaging coral reefs and seagrass habitats. The projected sea level rise will adversely impact mangroves and seagrass growth, which are nursery areas for many coastal fish species. Under a high GHG emissions scenario in the Pacific mangroves are expected to decrease by 50-70% by 2050 and seagrass habitats by 5–35% by 2050 (Bell et al., 2018[190]). These changes will cause coastal fisheries production to decline by 20–35% by the end of the century (Bell et al., 2016[191]). Fishing communities in the outlying islands and remote areas, as well as elderly and children in low-income households, will be the most vulnerable to these changes that will likely increase the risk of malnutrition.

In the case of the economically vital tuna fishery, climate change is forecast to change migration patterns, potentially affecting FSM economy that relies heavily on income from foreign fishing licensing fees. The

---

[187] Eakin M., Liu G., Gomez A., De La Cour J., Heron S., Skirving W., Geiger E., Tirak K., Strong A. (2016). Global Coral Bleaching 2014-17. In: Encounter, 31 (1), Number 43, April 2016. The News Journal of the International Society for Reef Studies, ISSN 0225-27987. https://coralreefs.org/wp-content/uploads/2019/01/Reef-Encounter-43-April-2016-HR.pdf

[188] IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.

[189] Oue Y.P. (2018). "Pacific in Peril: Micronesia's Food Security, Development, and Health under A Changing Climate" (2018). Student Theses 2015-Present. https://fordham.bepress.com/environ_2015/66

[190] Bell J.D., Cisneros-Montemayor A., Hanich Q., Johnson J.E., Lehodey P., Moore B.R., Pratchett M.S., Reygondeau G., Senina I., Virdin J., Wabnitz C.C.C. (2018). Adaptations to maintain the contributions of small-scale fisheries to food security in the Pacific Islands. Marine Policy 88, 303-314.

[191] Bell J, Taylor M, Amos M, Andrew N. (2016). Climate change and Pacific Island food systems. CCAFS and CTA. Copenhagen, Denmark and Wageningen, the Netherlands. https://cgspace.cgiar.org/bitstream/handle/10568/75610/Pacific%20Booklet%20Final%20web.pdf?sequence=6&isAllowed=y

distribution and abundance of tuna species is influenced by natural climate variability through the influence of climate drivers like El Niño–Southern Oscillation (ENSO), which affects the survival of tuna larvae. Warmer waters in the Western Pacific are likely to shift the spawning grounds for tropical tuna (skipjack, yellowfin and big eye) to the central and eastern equatorial regions of the Pacific, which for the FSM could potentially lead to decreases in tuna biomass within its Exclusive Economic Zone, reducing the economic benefits the nation derives from tuna fishing (Bell et al, 2021[192]).

In the FSM, the average annual tuna-fishing access fees, for the period 2015−2018, contributed 47.6% to the government revenue. Bell et al. (2021), estimated that under the extremely high GHG emission scenario (RCP8.5) in the FSM purse-seine tuna catch will decline by 13% by 2050 (Fig. 23), corresponding to 5.9% decline of government revenue from tuna fishing access fees.

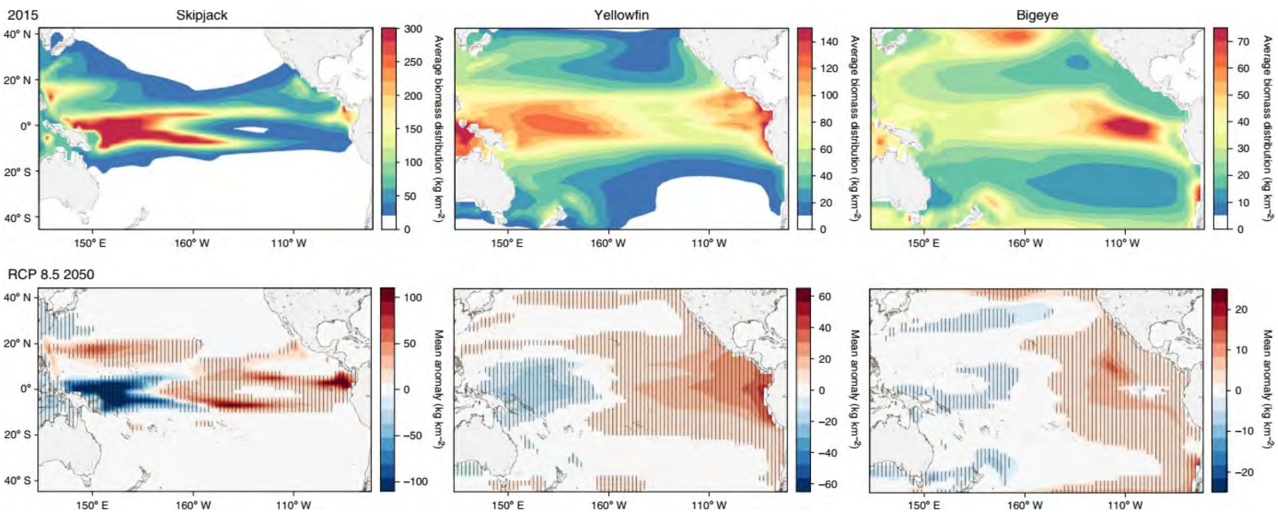


Figure 23. Effects of climate change (RCP8.5) on the average biomass distributions of the three tuna species (skipjack, yellowfin, bigeye) caught by purse-seine fishing in the Pacific Ocean. (Image source: Bell et al., 2021).

Biodiversity and natural environment

In the FSM, biodiversity goes beyond the provisioning of materials for human welfare and livelihoods, it is interwoven into daily life, and is an intrinsic part of the diverse traditional cultures and practices that remain strong across the FSM (FSM R&D, 2020[193]). Marine and terrestrial food production depends on biodiversity for the genetic diversity of marine organisms, crops, nutrient recycling and disease control and prevention. Therefore, in order to increase the FSM's adaptive capacity to climate change, it is of paramount importance to protect, conserve and sustainably use the nation's biodiversity and ecosystems. The FSM has a rich and unique genetic, species and ecosystem biodiversity, that harbors a considerable variety of endemic plants and animals, which if lost, will be extinct. Island biodiversity is extremely fragile as species are generally limited to a small geographical area, with low population numbers and already under pressure from human-induced threats such as pollution, habitat fragmentation and land-use changes.

The rate at which climatic changes are occurring is beyond the adaptive threshold of many island plants and organisms, making them highly vulnerable to climate change. Threats to species and ecosystems, particularly in biodiversity hotspots like the FSM, will increase with increasing warming, escalating the risk of local extinction. FSM's ecosystems are highly vulnerable to climate change and are expected to be at high risk in the near term

[192] Bell J, Taylor M, Amos M, Andrew N. (2016). Climate change and Pacific Island food systems. CCAFS and CTA. Copenhagen, Denmark and Wageningen, the Netherlands.
[193] FSM Department of Resources and Development (2020). The Federated States of Micronesia Sixth National Report to the Convention on Biological Diversity. https://www.cbd.int/doc/nr/nr-06/fm-nr-06-en.pdf

at 1.2˚C global warming levels due to mass plants mortality, coral bleaching and mass mortality events from marine heatwaves (IPCC, 2022[194]).

Climate change can have adverse effects on species, environmental networks, and ecosystems by impacting the basic physiological functions of plants and organisms (Kumar et al., 2020[195]), as well as by altering the provision of ecosystem services for the communities living on high and low-lying islands (Franco and Sawdey, 2017[196]). For instance, plants are vulnerable to mean and extreme air temperature increases, droughts and heavy rainfall, which can modify the time of fruiting, decrease plant fitness, and increase their exposure to diseases and pests. Drought can alter the ecological balance of natural systems and harm wildlife and plant species, as well as the services that ecosystems provide to human communities. In the marine environment, the unbalance of physiological functions from projected increase of sea surface temperatures and ocean acidification combined with non-climatic drivers (i.e., overfishing, destructive fishing practices), will cause loss and degradation of much of the world's coral reefs (IPCC, 2022). The 6th IPCC report (2022) indicates that under warming of 2˚C virtually all coral reefs in the region may be lost (98% loss) with severe implications for biodiversity and island communities, economies and cultures. Ocean acidification will impact the rate at which many marine organisms construct their skeletons, resulting in a slower recovery of reefs damaged by bleaching or other agents (Kumar et al., 2020). Furthermore, increases in the intensity of storms and cyclones concurrently cause further damage to coral reefs reducing their structural complexity.

The degradation of ecosystems such as mangroves, coral reefs, estuaries, seagrasses, and wetlands due to climate change can adversely affect dependent species and reduce ecosystem services provision of food, fresh water, medicinal resources, flood and storm protection, erosion regulation, pest control, micro-climate regulation (Brander et al., 2021[197]). Climate-driven impacts on terrestrial and marine ecosystems have caused economic losses and projected changes in climate will have serious implications to the livelihoods and well-being of FSM's population, potentially altering cultural practices. A study conducted by Brander et al. (2021) indicates that in the FSM, projected climate change–induced loss of coral reef ecosystem will potentially cause a reduction in annual income from harvested resources of almost USD$ 8.8 million per year, which may increase migration of those communities that are most dependent on natural resources for subsistence and income.

Healthy ecosystems will be better able to respond and cope with changing conditions; therefore, their sustainable use and protection, through the provision of conservation areas, is an essential route to building the nation's resilience to climate change. For example, healthy watershed forest ecosystems are vital for protection against potential landslides caused by increasingly intense precipitation and extreme events under changing climatic conditions (FSM R&D, 2020). Communities across the FSM have always used protective strategies such as locally managed areas and seasonal closures, to ensure their continued security. As they face new challenges and a world imperiled by climate change, the FSM's Protected Areas Network (PAN[198]) is seen as a key component in promoting communities to scale up traditional approaches and protect traditional knowledge in support of the nation's biodiversity and ecosystems. Furthermore, innovative forms of biodiversity protection in the FSM are the Yela Forest conservation easement and the implementation of fire breakers to safeguard watershed biodiversity in Tamil (Yap). In Kosrae the Yela Forest valley includes the last standing forest of *Terminalia*

[194] IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. Cambridge University Press, Cambridge, UK and New York, NY, USA, 3056 pp., doi:10.1017/9781009325844.

[195] Kumar L., Jayasinghe S., Gopalakrishnan T. (2020). Climate change and impacts on biodiversity on small islands. In: L. Kumar (ed.), Climate change and impacts in the Pacific, Springer Climate, https://doi.org/10.1007/978-3-030-32878-8_12

[196] Franco, C. and Sawdey, S. (2017). Assessment of ecosystem services and water resources in a rural area of Chuuk lagoon: Oneisomw analysis. The Nature Conservancy and USDA-NRCS.

[197] Brander, L.M., Guisado, V., Franco, C., Aulerio, M., Dijkstra, H.M. Hagedoorn L.C., Hughes, L., Gilders, I. and van Beukering, P.J.H. (2021). The impact of habitat degradation on household income and migration intention in Micronesia. Report for The Nature Conservancy (TNC) Micronesia.

[198] In the FSM the Protected Areas Network is implemented through state law or regulations guided by the FSM's Protected Areas Network National Guiding Policy Framework.

carolinensis in the world; to protect this hotspot of biodiversity the USDA Forest Service's through the Forest Legacy program launched the first conservation easement in the FSM. Maintaining healthy and functioning forest systems increases their resilience to climate change. Native forests and mangroves can require at least 10-15 years to fully recover from natural and climatic shocks and provide the same level of ecosystem services they did prior to a catastrophic event, provided that no additional pressures from human development and polluting activities occur.

Health

Climate change threatens to disrupt the FSM's social, economic and ecological systems of high islands and low-lying atolls, enhancing the risk of outbreaks of vector- and water-borne diseases, cardiovascular and respiratory diseases, infectious diseases, malnutrition, and mental illness.

The most vulnerable sectors of society such as children, the elderly, the chronically ill, people with cognitive or mobility impairments, pregnant and postpartum women, people with mental illness, people of lower socioeconomic status and those living in remote locations are particularly vulnerable to impacts of climate change. The FSM population living in the outlying islets are particularly affected by climate change threats and impacts due to the distance from the main hospitals and inadequate access to health services, particularly in the aftermath of major disasters.

The National Climate Change and Health Action Plan for FSM (2012) identifies the high vulnerability of the FSM to particular climate change related health impacts, such as (i) vector-borne diseases (dengue fever, Zika and Chikungunya viruses), (ii) water-borne diarrheal pathogens, gastroenteritis and leptospirosis, due to effects of increased temperature and changed rainfall patterns, (iii) food-borne disease (*Salmonella, E. coli, Staphylococcus aureus*) due to increased temperatures, and (iv) malnutrition due to extreme and slow-onset climate change events that have implications on food security and access to nutritious food. An increase in inpatients with viral diseases (Chikungunya virus) was reported during the 2013-2014 ENSO event. The outbreak was recorded for Yap State with 2,385 cases recorded between 2013 and 2014, corresponding to more than 20% of the population affected (SPC, 2021[199]). Internal migration and urbanization can increase population densities fueling vector-borne diseases in urban settlements.

The most recent hospital records indicate that in the FSM the highest incidences of disease are from diarrhea and gastroenteritis of infectious origin (SPC, 2021); previous studies conducted in the state of Pohnpei have showed a connection between gastroenteritis outbreaks and extreme rain events, suggesting that the incidence of these outbreaks will likely increase under future climate projections (ADB, 2015[200]). Human leptospirosis is an emerging infectious disease in the FSM and projected increases in annual rainfall, air temperature and humidity, which all contribute to a potentially endemic environment, will likely worsen the diffusion of this disease (Colt at al., 2014[201]).

Since the FSM SNC (2016), the damages incurred from typhoons, floods and droughts impacted the delivery of health services, with significant implications for community well- being due to longer term consequences such as food and water scarcity and forced relocation/migration. In the FSM health assets and population are increasingly exposed to extreme weather events, such as floods, storms, wildfires or extreme temperatures, which in the immediate have implications on community susceptibility to diseases and illness and are causing people to relocate/migrate with short- and long-term implications such as depression, anxiety, distress, trauma and post-

[199] SPC (2021). Project Preparation for increasing resilience to the health risks of climate change in the Federated States of Micronesia. Green Climate Fund, Approved Project Preparation Service Application. https://www.greenclimate.fund/document/project-preparation-increasing-resilience-health-risks-climate-change-federated-states

[200] Asian Development Bank (2015). Climate Proofing: A Risk-based Approach to Adaptation. Pacific Studies Series. https://www.adb.org/sites/default/files/publication/28796/climate-proofing.pdf

[201] Colt, S., Pavlin, B.I., Kool, J.L. et al. (2014). Human leptospirosis in The Federated States of Micronesia: a hospital-based febrile illness survey. BMC Infect Dis 14, 186. https://doi.org/10.1186/1471-2334-14-186

traumatic stress disorder (PTSD; Box 1). Slow onset climate change events, such as rising temperature and sea level are now forcing residents in coastal areas to leave their homes increasing the risks of mental illness associated with the loss of a sense of place, lack of social support, inadequate health systems, economic hardship and lack of access to housing. Micronesians demonstrate significant socio-cultural resilience through their culture, tied kinship, and strong association with their land that

provides a sense of place and identity. Island communities in the FSM have an inseparable connection to and derive their sense of identity from the lands and resources of their islands (Filho et al., 2022[202]). Filho et al. (2022) reported that climate change threatens this familial relationship with ancestral resources, disrupting the continuity required for the health and well-being of these communities. Therefore, forced migration, relocation or resettlement from the roots of communities cultural, psychological and spiritual well-being has emotional and psychological implications. In such instances, gender-based violence may increase in connection with distress and anxiety caused by severe climate events.

Box 1: Anxiety and loss caused by major climate change events in outlying islands of the FSM.

An assessment conducted in 2006 captured the high level of anxiety and stress that some Moch's residents, an outlying island of Chuuk State, felt following an extreme high waves event ('big waves') in 2002. Anxiety and sense of loss derived from a strong feeling of unsafety for them and their families, the lack of information on the level of assistance if evacuation was needed in following events, and the stress associated with unknown possibilities of where to resettle if evacuated from the island (Henry et al., 2008). Concerns were also raised regarding the loss of subsistence practices, the loss of traditional knowledge and the possibility of passing down this knowledge to the youngest, loss of land ownership and family burial ground (Henry et al., 2008)

"*That's my late husband over there, laying to rest...if we leave, waves just come and destroy and there will be no history.*
It is going to be very sad for me just to borrow land from someone."

Henry et al., 2008*

*Henry R., Jeffery W., Pam C. (2008). Heritage and climate change in Micronesia. A Report on a Pilot Study Conducted on Moch Island, Mortlock Islands, Chuuk, Federated States of Micronesia January, 2008 Department of Anthropology, Archaeology and Sociology School of Arts and Social Sciences, James Cook University, Australia. https://www.islandvulnerability.org/fsm/henryetal.2008.pdf

Although there are no direct data for the FSM, in Chuuk violence was reported by some women and girls as a result of droughts since to fetch water, women and girls have to walk longer distances to wells potentially becoming victims of assault (McLeod et al., 2018[203]). Other Pacific nations reported that domestic violence cases tripled (CARE, 2015[204]) in connection with tropical cyclones and that displaced individuals were at higher risk of gender-based violence than those that remained in their communities (IFRC, 2016[205]).

Examples of formal support to communities that are forced to relocate exist in the FSM. A project funded by the USAID's Pacific-American Climate Fund and implemented by the College of Micronesia (COM)-FSM Yap

[202] Filho W.L., Krishnapillai M., Minhas A., Ali S., Nagle Alverio G., Ahmed M.S.H., Naidu R., Prasad R. R., Bhullar N., Sharifi A., Nagy G.J., Kovaleva M. (2022). Climate change, extreme events and mental health in the Pacific region. International Journal of Climate Change Strategies and Management, 15 (1), pp. 20-40.

[203] Mcleod E., Arora-Jonsson S., Masuda Y.J., Bruton-Adams M., Emaurois C.O., Gorong B., Hudlow C.J., James R., Kuhlken H., Masike-Liri B., Musrasrik-Carl E., Otzelberger A., Relang K., Reyuw B.M., Sigrah B., Stinnett C., Tellei J., Whitford L. (2018). Raising the voices of Pacific Island women to inform climate adaptation policies. Marine Policy 93 (2018) 178–185. https://www.sciencedirect.com/science/article/pii/S0308597X18300344

[204] CARE. Rapid Gender Analysis Cyclone Pam Vanuatu, 2015. http://care.ca/sites/default/files/files/RGA%20Cyclone%20Pam%20Vanuat%207%20April%202015.pdf

[205] International Federation of Red Cross and Red Crescent Societies- IFRC, Unseen, Unheard. Gender-Based Violence in Disasters. Asia-Pacific Case Studies, International Federation of Red Cross and Red Crescent Societies, Asia Pacific

Cooperative Research and Extension, empowered displaced atoll population at Gargey settlement on Yap Proper in utilizing adaptation strategies and build their resilience to climate change impacts (Krishnapillai, 2017[206]). The project trained about 800 people from the atoll islands, who have migrated to Yap main island, in soil management, climate-smart gardening and water harvesting techniques, helping them to face hardships by accessing nutritious and reliable food sources, as well as to overcome distress associated with relocation (Krishnapillai, 2018[207]).

Malnutrition-related illness linked to climate change is common when extreme weather events disrupt supply of fresh local crops, forcing the population towards a greater intake of processed foods that are high in salt and sugar and with low nutritional values. Furthermore, with climate change causing increases in sea surface temperatures, rising sea-levels and ocean acidification, exacerbating the impacts of already overfished coastal fish stocks, fish supply may become limited. Fish is an important source of protein in the FSM and a substantial reduction of local fish supply would mean reduced intake of protein, with adverse effects to the health of children, elders, chronically ill people and other vulnerable sectors of the FSM's society.

Extreme weather events have prolonged effects on communities and health-care services; their impacts increase the vulnerability to successive events (Filho et al., 2022). For example, the damage from Typhoon Maysak, in 2015, did not allow adequate time for recovery when a severe drought affected the FSM in 2016. In Chuuk lagoon, households impacted by Maysak suffered from damage to roof water catchment and water storage tanks, leaving them with little capacity to respond to the prolonged drought event of 2016. In such instances some communities in Chuuk rationed water use and reverted to the use of water from wells (existing and new) for drinking or utilized coconut water as supplement to the rainwater. This increased exposure to infectious diarrhea and gastroenteritis. For instance, an assessment[208] conducted in 2017 in Oneisomw's community (Chuuk lagoon) reported that nearly 50% of the households in Oneisomw suffered from recurrent diarrhea, with increased incidence of the cases during the 2016 drought event. Lack of water can also lead to the closing of health facilities, which is a special concern in the most remote areas.

Many medical facilities in the FSM such as hospitals, medical centers, and dispensaries are located within 500 m of the coast, including some of the larger public hospitals (i.e., Pohnpei State Hospital and Yap Memorial hospital; Fig. 24). Locations along the coast make hospitals highly susceptible to sea level rise, particularly during high tides and storm surges. Tropical storms and floods pose additional threats to such critical infrastructure. Damages to health facilities reduce regular health service delivery, restricting access to healthcare during the emergency and well beyond the event. The FSM remote low-lying coral atolls are particularly vulnerable because most dispensaries or health centers are located within close proximity of the coast (<100m). In general, in the FSM the exposure of health assets to natural hazards is high, not only due to their proximity to the cost, but also because of insufficient maintenance of the facilities, lack of climate proofing approaches during construction, and in some cases the use of poor construction material. These risks are further exacerbated for the FSM remote outlying islands, where it is difficult to access technical support, skilled labor and transport of material, which all considerably increase the costs of building maintenance. An assessment conducted in the outlying islands of Kapingamarangi and Nukuoro (Pohnpei State), in 2020, under the Adaptation Fund project "*Enhancing the Climate Resilience of vulnerable island communities in Federated States of Micronesia*" identified the urgent need for renovating the dispensaries of these islands for emergency purposes (DECEM, 2020[209]).

[206] Krishnapillai M.V. (2017). Climate-Friendly Adaptation Strategies for the Displaced Atoll Population in Yap. In: Leal Filho, W. (eds) Climate Change Adaptation in Pacific Countries. Climate Change Management. Springer, Cham. https://doi.org/10.1007/978-3-319-50094-2_6
[207] Krishnapillai M.V. (2018). Enhancing the Climate Resilience of Atoll Communities on Yap Island, FSM. https://www.climatelinks.org/blog/enhancing-climate-resilience-atoll-communities-yap-island-fsm
[208] Franco, C. and Sawdey, S. (2017). Assessment of ecosystem services and water resources in a rural area of Chuuk lagoon: Oneisomw analysis. The Nature Conservancy and USDA-Natural Resources Conservation Service
[209] FSM Department of Environment, Climate Change and Emergency Management (2020). Mission Report: Assessment of Pohnpei Southern Islands region Public Infrastructures (PIs) and Adaptation Fund (AF) project sites on Nukuoro and Kapingamarangi. FSM DECEM, Palikir, FM.

Figure 24. Satellite image showing the location of Pohnpei state hospital (A) and Yap Memorial hospital (B) within 500m and 50m of the coast, respectively (Source: Google Earth).

The interactions between climate change and noncommunicable diseases (NCDs) is another area of concern as climate change could potentially exacerbate the existing and rapidly increasing burden of NCDs in the FSM. The FSM is experiencing an epidemic of non-communicable diseases (NCD), with rates of obesity, diabetes, and hypertension among the highest in the world.[210] Climate change impacts will further hinder local food production from agriculture and fisheries, potentially increasing rates of NCDs as more people will likely rely on imported food with implications to health, financial, social, and environmental costs in the future. The rise in temperature and wetter conditions can also affect the ability to exercise and undertake outdoor work (Taylor, 2021[211]). This, in the future, rises the risk of increased rate of mortality associated with NCDs (UNDRR, 2022[212]).

Transportation

The FSM is highly dependent on functioning and reliable transportation systems for its economy and economic development. In the FSM, maritime, air and road transportation are crucial to support trade and promote commercial activity by facilitating the movement of goods and people, and providing safe and efficient access

[210] Pacific Islands Health Officers Association. Declaring a regional state of health emergency due to the epidemic of non-communicable diseases in the United States-Affiliated Pacific Islands. Board Resolution. 48–01. 2010. 2018. http://medicaid.as.gov/wp-content/uploads/2015/10/PIHOA-Resolution-48-01-NCD-Emergency-Declaration.pdf
[211] Taylor, S. (2021). The Vulnerability of Health Infrastructure to the Impacts of Climate Change and Sea Level Rise in Small Island Countries in the South Pacific. Health Services Insights, 14: 1–7. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8186115/pdf/10.1177_11786329211020857.pdf
[212] UN Office for Disaster Risk Reduction (2022). Disaster Risk Reduction in the Federated States of Micronesia. Status Report. Asian Disaster Preparedness Center. https://www.undrr.org/media/81878/download

to schools, health facilities and other essential services. However, the FSM transportation systems are extremely vulnerable to extreme hydrogeological-climatic events and need to be strengthened to improve the adaptive capacity of the nation.

In the FSM, the maritime sector and road networks play a central role in national development and social cohesion and service delivery, sustaining the commerce, trade and mobility of the country. Ports located in the main islands are essential for domestic shipping, especially in Chuuk, Pohnpei and Yap, which each consist of several remote outlying island atolls. All states' high islands have ports for international ships, cargo vessels, fuel tankers. In the aftermath of extreme natural and climatic events maritime transport is essential for outlying island communities to access food, water, energy supply, and emergency response services. The road network in the FSM is also of critical importance to the nation's economic development, providing for the day-to-day wellbeing of the population by increasing access to economic activities and social services. Roads are located primarily in the coastal zone and users already suffer regular temporary breaks of serviceability by flooding that damage bridge and/or road pavement, interrupting access to essential services such as hospitals and schools (World Bank, 2021[213]). Some states have only one circumferential route, therefore, a few damages at the road can create major disruptions in the flow of people, goods and services. Most of the airports, used for domestic and international flights, are in coastal areas on reclaimed land. Some of the remote outlying islands have airstrips that lie within the 2-meter zone of potential sea level rise and are located approximately within 500 meters of the coast. Sea level projections indicate that by 2050, the FSM's states will experience coastal changes causing increased erosion and saltwater inundation of low-lying areas. This will increase the risk of inundation and damage to aviation infrastructures.

Climate change poses increasing threats to the transport sector and operations in the FSM. Due to their coastal location, port, road and airport infrastructure assets are exposed to marine and land hazards controlled by climate variability and change, such as rising mean and extreme sea levels, typhoons, storm surges, extreme winds, heavy precipitation, floods, droughts and heat waves. Climate projections predict elevations in air temperature, increased rainfall and rising sea levels. Sea level rise combined with natural year-to-year variability will accentuate the impact of storm surges and coastal flooding, accelerating coastal erosion with consequent deterioration of these key infrastructures.

From an operational perspective, increasing extreme climatic events will (i) disrupt port operations more frequently affecting ports service performance and posing a concrete hazard for ship, cargo and crew, as well as to the wellbeing of outlying island atolls communities; (ii) cause, washouts of low-lying and coastal roads and bridges, as well as landslides on roads located on unstable soils, with more frequent network disruptions; (iii) disrupt international airports and domestic flights operations posing concrete hazard to the infrastructure built on reclaimed land and in proximity to the coast. In addition, costs for maintenance of transport infrastructures are likely to increase, potentially requiring more consistent and frequent maintenance activities to prevent costly rehabilitation and/or reconstruction.

Considering these impacts, adaptive engineering measures are needed to ensure that infrastructures can withstand current and future environmental and climate risks. The FSM is working to upgrade seaports and sections of its road networks, particularly those that had suffered from a lack of systematic maintenance and strategic planning, and therefore, are most vulnerable to the impact of climate change. Increasing the resilience of this sector is a key priority for the FSM which has secured funds for improving the efficiency and safety of roads, bridges, shipping and port facilities, thus, to maintain land and marine transport connectivity in each state.

Since the Second National Communications climatic events have affected portions of the road networks in the urban, rural and coastal areas. For instance, the only road connecting Malem and Utwe municipalities in Kosrae

[213] World Bank (2021). Federated States of Micronesia Prioritized Road Investment and Management Enhancements Project. Project Information Document (PID). Report No: PIDA30097. https://documents1.worldbank.org/curated/en/557451612226895530/pdf/Project-Information- Document-Federated-States-of-Micronesia-Prioritized-Road-Investment-and-Management-Enhancements-Project-P172225.pdf

is subjected to severe coastal erosion and periodically inundated in coincidence with extreme high tides (king tides), swells and winds, cutting off the Utwe residents from the rest of the island and its services. In 2019, when typhoon Wutip passed over Pohnpei, the intense rain generated landslides that damaged bridges and roads pavement, interrupting the road network and increasing the costs for part of Pohnpei's residents to reach Kolonia, the island economic center where offices, schools, banks, and other essential services are located.

Energy

Energy plays a vital role in economic growth and development, as it is a significant input for the proper functioning of economic and social activities. The FSM still relies on fossil fuel for energy production, but production from renewable energy is growing year by year. Power plants are in the main islands of the four states and connected to the electricity grid. Renewable energy production varies among states; solar photovoltaic panels are deployed across the nation, from high to low-lying islands, while hydropower and wind power are available in Pohnpei and Yap, respectively.

In the FSM, energy infrastructures are exposed to natural hazards and their vulnerability varies depending on the level of maintenance, age and exposure of the infrastructure. The hydropower station, located along Nanpil river in Pohnpei, was installed in 1986, and its operation was disrupted in 2003 due to heavy flooding, which damaged the equipment. Refurbishment was carried out in 2008 and again in 2014. Pohnpei's hydropower station supply approximately 11% of energy to the state grid systems[214] and it is negatively affected by flooding and droughts that can limit its operation. Yap's onshore wind farm was funded by ADB and completed in 2018. Constructed to withstand typhoons, it consists of 3 turbines that can generate approximately 825 kW. The states' diesel power stations are vulnerable to flooding, droughts and typhoons. The transmission and distribution lines are particularly at risk of damage from strong winds, storms, typhoons that increase the risk of fallen trees and direct damages to the line as well as increased temperatures that can negatively affect transfer capability. Solar systems are vulnerable to strong winds, storms and typhoons that can damage the system. Particularly in remote areas, where maintenance is inadequate and damaged systems are not refurbished or replaced, energy supply can be severely affected.

The risks for the energy sector will increase with extreme weather events and changes in rainfall patterns and temperatures due to climate change. These risks have economic and service delivery implications which are of high concern for the FSM. Climate change–related risks concerning this sector include (i) the reductions in generation efficiency; (ii) the potential damage to network infrastructure from more intense storms and tropical cyclones; (iii) the likely damage to coastal assets due to increases in sea-level and storm surge; and (iv) increased disruption in the generation and transfer capability due to increased temperatures.

Tourism

The FSM tourism industry is a growing sector which faces important challenges due to the remoteness of the country, high airfares and limited infrastructure for tourists. Historic and natural sites, as well as businesses working with tourists, are largely located in coastal areas and exposed to climate hazards such as storms, typhoons, strong winds, rising sea level and flooding. Similarly, climate-induced impacts affect sea, air and road transport potentially impacting travel costs and tourists' destination choices (see Transportation section).

Tourist attractions, both historic and natural sites, are highly vulnerable to climate change. Important historic sites, including the World Heritage Site of Nan Madol (Pohnpei) or Lelu ruins (Kosrae), are located along the coastline and projected to be threatened by coastal flooding or erosion, due to sea level rise (Fig. 25). Natural tourist attractions, such as coral reefs and mangroves, are threatened by increased sea temperature, which causes coral mass bleaching events, as well as sea level rise and ocean acidifications affecting pristine marine

[214] Government of Pohnpei (2016). Pohnpei Joint State Action Plan for Disaster Risk Management and Climate Change. The Pacific Community.

environments. Internationally known diving attractions such as the Chuuk lagoon can be negatively affected by the effects of climate change on the marine environment.

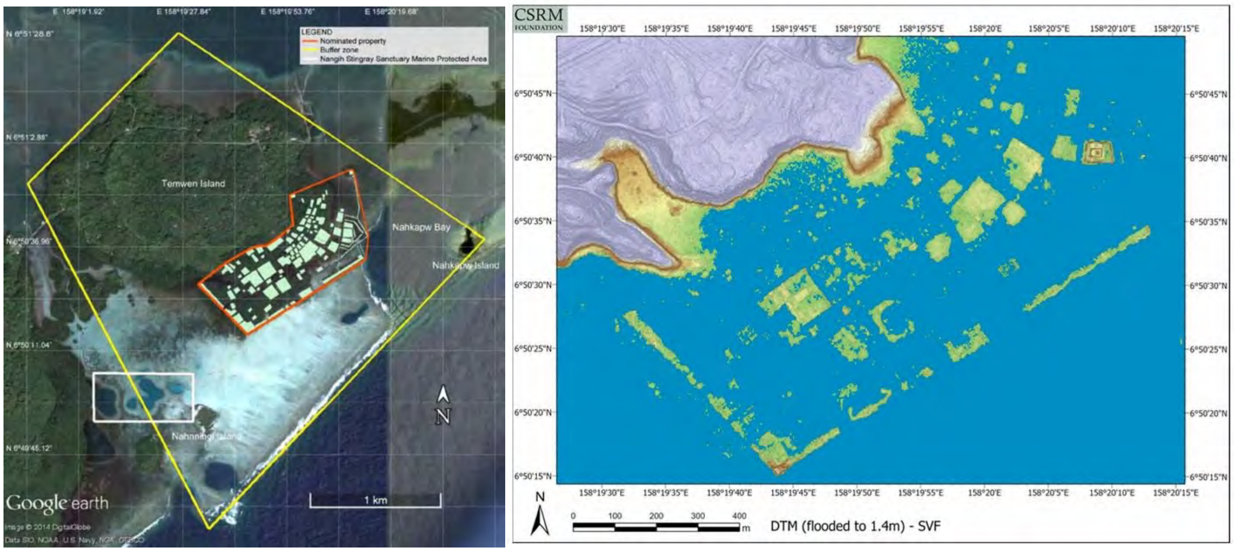


Figure 25. Left: Location of Nan Madol. Right: Image from a LiDAR-derived data product that quantitatively and visually simulates inundation phenomena that threaten Nan Madol, such as normal and extreme tides and storm surges. (Image source: Comer et al., 2019[215]).

5.6 Human-Induced Vulnerabilities and Resilience

In the FSM unplanned and unsustainable development practices increase the country's vulnerability to climate change. The assessments conducted during the development of the four States Joint Action Plans for Disaster Risk Management and Climate Change,[216] completed between 2016 and 2017, provide insights on specific human induced vulnerabilities and on socio-cultural resilience in the FSM (Table 10). Development practices, such as building in hazardous areas, can enhance levels of vulnerability and even worsen the impacts of coastal hazards, especially because most of the critical infrastructures are located close to the coast.

[215] Comer, D.C.; Comer, J.A.; Dumitru, I.A.; Ayres, W.S.; Levin, M.J.; Seikel, K.A.; White, D.A.; Harrower, M.J. (2019). Airborne LiDAR Reveals a Vast Archaeological Landscape at the Nan Madol World Heritage Site. Remote Sensing, 11, 18: 2152. https://doi.org/10.3390/rs11182152

[216] Yap Joint State Action Plan for Disaster Risk Management and Climate Change; Chuuk Joint State Action Plan for Disaster Risk Management and Climate Change; Pohnpei Joint State Action Plan for Disaster Risk Management and Climate Change; Kosrae Joint State Action Plan for Disaster Risk Management and Climate Change.

Table 10. Human-induced vulnerabilities, climate change impacts and socio-cultural resilience identified by the states of Yap, Chuuk, Pohnpei and Kosrae in the FSM (Source: States Joint Action Plan for Disaster Risk Management and Climate Change.)

State	Human-induced drivers of vulnerability	Climate change Threats and impacts	Socio-cultural resilience
Yap	- Sand and coral rubble removal from the reef flat - Beach mining -removal of sand, gravel and cobbles for construction aggregates - Dredging on the reef flat - Inappropriate building of seawalls, exacerbating erosion or resulting in further development in high-risk areas - Stream outlet repositioning or changing swamp drainage pattern and flow - Land reclamation in flood prone areas - Road development reclaiming land across mangrove/wetland areas	- Food production in the outlying islands of Yap is already impacted by sea level rise, storm surges and salt-water intrusion which are forcing outlying islanders to move to mainland Yap, increasing pressures on the resources of Yap Proper. - The traditional food production system of mainland Yap has been reduced in extent and productivity with recent high waters destroying taro production areas. This condition is expected to be exacerbated by climate change.	- In Yap formal ceremonial exchange systems are named ”sawai.” The *sawai* allows for migration of communities between vulnerable islands. - “Kinship and exchange networks between islands of varying vulnerability enable communities to deal with extreme events and natural disasters. In the past, mechanisms such as travel, migration and formal ceremonial exchange systems served communities well in dealing with extreme events. Today, the heritage practice of keeping ‘exchange paths’ active through kinship relations can be seen as a source of resilience and a strategy to cope with climate change.” - Food preservation for offsetting seasonal variations in food availability, to provide nourishment in times of disasters when crops are likely to be destroyed or damaged. Food preservation
Chuuk	- Building and farming in mountainous or coastal areas which can cause erosion - Deforestation - Removal of natural shoreline including rocks and sands - Poor sanitation and waste management	- Food production, especially on the outlying atolls, is vulnerable to climate change impacts such as sea level rise, storm surges and salt-water intrusion, which are already occurring. - Migration has already begun from outer islands to more urban areas of Chuuk State, increasing pressures on its resources.	
Pohnpei	- Sand and coral rubble removal from the reef flat - Beach mining -removal of sand, gravel and cobbles for construction aggregates - Dredging on the reef flat - Inappropriate building of seawalls, exacerbating erosion or resulting in further development in high-risk areas - Stream outlet repositioning or changing swamp drainage pattern and flow - Land reclamation in flood prone areas - Road development reclaiming land across mangrove/wetland areas	- Migration has already begun from outer islands to more urban areas of Pohnpei State, increasing pressures on its resources.	

Kosrae	- Sand and coral rubble removal from the reef flat, particularly along Kosrae's east coast between Finaunpes and Mosral. - Beach mining -removal of sand, gravel and cobbles for construction aggregates - Dredging on the reef flat in particular in Tafunsak village - Land reclamation in flood prone areas - Road development reclaiming land across mangrove/wetland areas - Shoreline protection solutions which disregard coastal hazard risk reduction	- Inundations of large sections of the road network from high tides is of particular concern in Lelu Island, Utwe, Walung, Tafunsak and Pukusruk. - Although Kosrae is rarely affected by cyclone events, with the last major cyclone being in 1905, vulnerability is extraordinarily high, with existing coastal defenses that would do little to shelter land or property if a major tropical storm hit the island in the future.	methods such as fermentation of breadfruit in pits or leaving yams in the ground to ensure food is available in times of disasters. - In Kosrae social capital has been shown to be positively associated with household willingness to participate in climate change adaptation activitie

Social Disintegration and Mental Health

Social disintegration involves the reduction of the importance of extended kin-groups in the organization of everyday life as the activities once organized by kin-groups are displaced by involvement in modern, formal institutions such as the school, the state, and the market, leading to lower levels of social support in society. Social-cultural disequilibrium occurs when a society's cultural norms, values and aspirations no longer adequately regulate individuals' expectations for the level of reward they can reasonably expect through locally available opportunities for meaningful social and economic participation, producing a state of increased anomie among a society's members.

Social researchers are recognizing social disintegration and social-cultural disequilibrium as factors that impact mental health and well-being and thus potentially associated with the epidemic rise of suicide in Micronesia. Suicide rates since 1960 in Micronesia have undergone an epidemic-like increase especially among 15-24-year-old males. With the post-war social change in the FSM, the communal village-level of organization largely disintegrated, causing adolescent socialization functions to be absorbed by the nuclear family, leading to increased intergenerational domestic discord. In the FSM, suicide rates are among the highest in the world.

Economic Vulnerabilities and Out Migration

The country's economy remains highly dependent on foreign assistance (i.e., US Compact Grant, financial programs, multilateral and bilateral grants), which contributed to 38% of the government's total revenue in 2018 (EconMAP, 2021). Since 1986, the Compact of Free Association (COFA) with the United States has provided external financial transfers to support the FSM Government in delivering key services, particularly education and health, and substantial public sector investment at the state level.

Since 1986, with the establishment of the Compact of Free Association between the Federated States of Micronesia and the United States, thousands of Micronesians have migrated from FSM to Hawaii, Guam and mainland US. With the average wage in FSM around $2 an hour and responsibilities to support extended families, many Micronesians choose outward migration to attend universities and seek higher paying jobs. If the estimated total FSM migrant population of nearly 50,000 stands, then it would constitute a population half as large as the resident population in FSM. In summary, nearly one out of every three Micronesians today lives outside the country.

Out migration continues to be a serious issue. The 2015 Country profile for FSM shared that the size of the FSM population living abroad in Guam, CNMI, Hawaii and mainland US was around 50,000. This total included those who moved from FSM and children born to them in their new homes.

Assessing climate change impacts on local food systems over time

FSM is actively engaged in assessing FSM's populations' food security vulnerability to climate change and to identifying and implementing adaptation measures.

2010 food security survey on 14 atoll islands

In 2010, the FSM Government conducted food security vulnerability and adaptation assessments on 14 atoll islands in the States of Pohnpei, Chuuk and Yap, as part of the preparations for completing the Second National Communication to the UNDPF.

That survey was the first comprehensive ecosystem approach to assess the likely impacts of climate change on food security for outer island atoll communities throughout FSM. Assessments were undertaken by seven working groups, covering the following thematic areas: Socio-economic Enumeration; Water Security and Coastline; Soils; Forest and Vegetation; Pests / Invasive Species; Marine Rapid Ecological Assessment; and Disaster and Risk Management.

Methods used to survey atoll communities in 2010. The islands covered in the assessment were: (a) Pohnpei Atolls: Nukuoro, Sapwuahfik; (b) Chuuk Atolls: Kuttu, Namoluk, Losap, Nomwin, Pisarach, Pollap; and (c) Yap Atolls: Satawal, Elato, Lamotrek, Gaferut, Falalop (Woleai), and Fadrai (Ulithi). The selection of islands was undertaken in consultation with the affected states, as well as the National Government Departments of Transportation Communications and Infrastructure, Resources and Development, and OEEM. The major criteria for selection were island attributes being: (i) representative of other islands as well as representing some unique characteristics; (ii) islands that can capture the various attributes that fill out the baseline data; (iii) islands that are considered most vulnerable; (iv) geographic location so that travel distances and time were minimized; and (v) overall cost and duration of the study.

The vulnerability and adaptation assessment included the agroforestry and marine food stock that supports atolls' food security and resiliency. A specific objective was to determine disease impacting local crops such as taro, breadfruit and bananas, which are main food sources on atolls (Englberger et al., 2010). Vulnerability of food security was assessed using the four determinants of food security—food availability, food access, food utilization and stability (Halavatau, 2010). Results from the 2010 survey showed that with regard to food availability, most households on the atolls grew their own food. The main staple crops were used to assess vulnerability of domestic production to climate change.

The survey revealed that forests and planted trees helped local communities adapt to climate change through livelihood diversification and provision of ecosystems services. Sustainable management of forest and tree resources increases the resilience of people and eco-systems to cope with extreme weather patterns and therefore safeguarding food security.

Atoll staple crops were found to be vulnerable to climate change and especially the impacts of sea level rise in terms of increasing salinity (Halavatau, 2010). Important data was collected on local food staples, including heat, rain and saltwater tolerance of swamp taro, breadfruits, pandanus, and bananas.

Increasing soil salinity from saltwater intrusion was found to be the greatest threat to crop productivity on the atolls of FSM. Increasing soil salinity of atoll soils to 6ds/cm kills crops like cassava, pawpaw and yams. And when soil salinity is increased to 12ds/cm (a condition caused by sea water inundation), only coconut and the dryland giant taro can survive.

All atolls were found to be food secure from the point of view of food availability, but the dependance on imported processed foods (especially cereals) was high. Easy access to processed, imported food also adversely impacted community engagement in local agriculture and food production. The 2010 analyses showed that stability of food supply in the atolls is affected by shipping and by natural disasters such as cyclones and droughts.

With regard to household food access, a household can access food either by producing its own food or by procuring food. Indicators to measure household access include access to land, household food production and household incomes. At least 70% of households in the atolls own land, with sizes ranging from 0.2 acres to over 10 acres (0.1 to four hectares). A majority of the land is of average to good quality. Most of the households who own land produce their own food. Most households produce enough food crops and catch enough marine foods, but local meat production is not enough for all of the atolls.

Adaptation measures include addressing food production issues, as discussed under food availability. Each atoll should also develop income opportunities to improve the purchasing power of households.

With regard to food utilization, indicators such as dietary diversity, perception of food sufficiency and security, and number of meals per day can be used. However, the study used meal frequency. This revealed a risk of moving into reliance on imported foods. Atoll populations also face increased occurrence of NCDs in a substantial percentage of the households.

In 2010, the atolls families surveyed were understood to be vulnerable to climate change impacts on their food security in the following ways:

- Local food production was recognized as vulnerable to climate change due to:
  - Sea level rise
  - Poor soil
  - Pests
  - Disease
- Household food access was also vulnerable because of limited income
- Food consumption was vulnerable because of a dependence on imported foods
- There is also a trend of NCDs on the atolls related to overeating and maybe changing dietary patterns to imported low quality foods.

Increasing food security was seen as a major priority for all four states especially with respect to climate change and sea level rise (FSM Department of Forestry, 2010). Most of the agricultural areas that were located around coastal areas were already enduring increased flooding and drainage problems (FSM Department of Forestry, 2010).

In 2010, it was expected that high islands of the FSM will need to begin now to prepare for rapid population increase in the form of climate change refugees from low-lying islands, while at the same time, enhancing and adapting their own food production systems.

Another challenge the rural areas faced was accessing arable or cultivable land to grow food. This was understood to be especially serious in the atoll communities with high population density. The other problem faced by atoll communities was the dynamic nature of the islands, leaving them vulnerable to sea level rise and other impacts of climate change. Evidence showed that most taro patches were already affected by saltwater inundation. There was little effort to address food processing of seasonal food crops like breadfruit, which is abundant and wasted during the fruiting season.

5.7 2022-23 Green Climate Fund Baseline Food Security Survey

As of 2021, the FSM is the recipient of the Green Climate Fund for Climate Resilient Food Security for Farming Households across the Federated States of Micronesia. The project is a comprehensive national effort to focus on increasing the resilience of FSM's most vulnerable communities to climate change–induced food insecurity. Planned measures include introducing sustainable agricultural practices and developing a climate-resilient food system. More than 600 farming families and local food producers impacted by climate change (Rutgers University et al. 2023) were surveyed for the baseline assessment for this project.

This baseline household food security assessment was conducted by Rutgers University in collaboration with each of the state governments and local NGOs, by way of interviews with 150 farming families in each state. Additional data was captured by way of focus group discussions with women’s associations, agricultural/farmers’ associations and fishers’ associations, along with key players involved in commercial food production analysis and report dissemination, as described in detail below. The core criteria for selection of the communities from which farming families were interviewed was done in consultation with the state government, local NGOs and MCT to ensure (i) geospatial distribution across each of the states to ensure representation across each of the townships/districts; (ii) inclusion of communities living in coastal areas; (iii) inclusion of communities that had been impacted by prior environmental challenges / weather / storms; (iv) inclusion of communities that participated in prior national surveys as a result of their vulnerability.

Methods used to survey farming families in Pohnpei and Yap State 2022–2023:

The baseline Climate Resilient Food Security for Farming Household surveys for the islands of Yap State were primarily focused on the 10 municipalities of the four inhabited islands of Yap Proper. In addition to the 10 municipalities of Yap Proper, a group was surveyed to gather data on residents on Yap Proper who originated from Yap's inhabited Neighboring Islands (Outer Islands). The 10 municipalities of Yap Proper that were covered by the enumerators are Gilman, Kanifay, Dalipebinaw, Rull, Weloy, Fanif, Tamil, Gagil, Maap and Rumung. The households surveyed to represent the municipality of Rumung were not permanent residents on the island of Rumung (which can only be accessed by boat); other municipalities (primarily Maap and Weloy) were their primary residence and they would travel to Rumung on certain weekends or holidays.

In Pohnpei state, the study population solely covered 40 households from Sokehs, 30 households from Kitti, 30 households from Madolenihmw, 30 households from U and 30 households from Nett who are food crop farmers, growing the crops for home consumption, sale or both. Given the time constraints and needs of the baseline study, the interviewees were mostly subsistence farmers who were available during the time the enumerators were in their communities and volunteered to participate in the survey. The surveys were conducted in local languages at the personal households of the farming family residents by local, trained enumerators.

The survey was extensive relative to the questions and the average survey process took 1.5 hours. The survey was constructed to better understand households' current situations and perceptions as to changes over the last decade relative to food security; current food production, availability and consumption; individual perception and understanding of if and how the weather and the environment has changed; and barriers and constraints faced as they relate to climate change as well as consumption and trade. The survey tools (household, commercial and focus groups) were developed using a participatory process designed by Rutgers University that involved input from all stakeholders (local NGOs, community interest groups, members of government) to ensure questions were relevant and the voices of the local communities heard. In addition, the survey tools were constructed to capture important data relative to each of FSM's priority sectors. The study procedures included responding to an in-person in-depth survey assessing the household's food security, involvement in food production, current practices and constraints, dietary diversity, the household members' perceptions of climate change and what, if anything, had changed for them and their families over the last decade. Each of these farming households were asked a series of questions, largely quantitative with some open-ended questions included, in the context of climate change within all four FSM states.

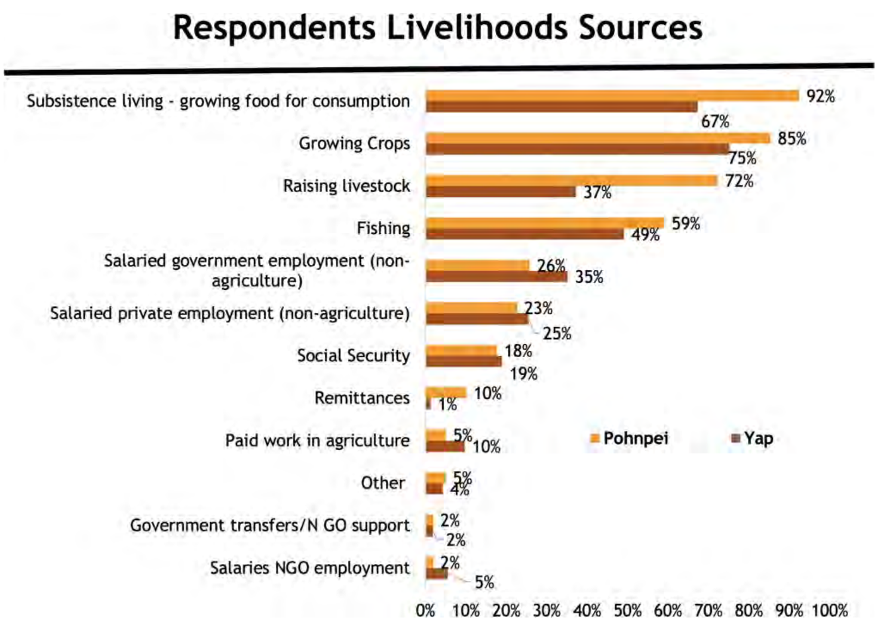
In addition to a national survey on households, a second smaller baseline production survey for commercial producers and intermediaries with reference to climate change was also undertaken in the FSM. The primary purpose of these surveys was to document the impact of climate change on farming families, food production and profitability and perceptions of changes over the last decade and what the greatest concerns of vulnerable communities are. As such, considering the demographic, economic and cultural factors, two sets of questionnaires were prepared separately to survey farming households and targeted FSM food producers, in context to what their major constraints and opportunities are.

All those involved in the survey design and implementation were trained first and certified in the Collaborative Institutional Training Initiative (CITI program, see https://about.citiprogram.org/). IRB approvals were requested and received from Rutgers University and from the College of Micronesia. Informed consent was obtained prior to survey implementation. A reiterative process in developing the questions with stakeholders across the FSM was used, as well as the training and pilot testing of the questions, which permitted further revision of the final survey instruments. Surveys were written in English yet administered in local languages as needed to ensure accuracy in capturing responses across the FSM. The farming family questionnaire had many sections that cover respondent details; land access and use; asset and livestock ownership; vegetable production and preference with reference to climate change; processing and value addition; marketing; labor allocation to top vegetables; farmer training and extension needs; access to financial capital; constraints in vegetable farming, and household demographics. Similar questions focused on fisheries and aquaculture were also administered to ensure a holistic assessment of vulnerability.

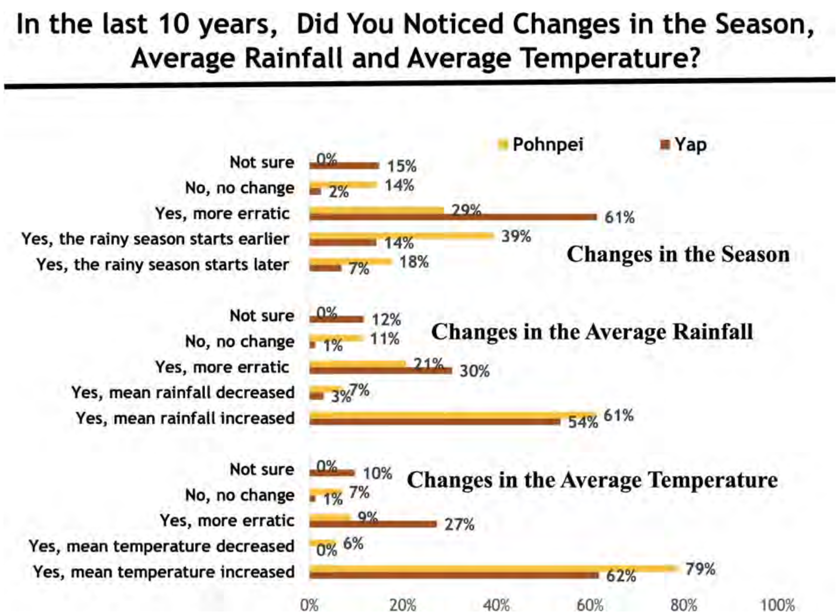
Climate Change Trends Impacting the FSM's Farming Families

Results from the 2022–2023 Green Climate Fund food security baseline survey (from >600 farming households across FSM) include 70% of farming households reporting that their ability to grow their own foods has been impacted by climate change, resulting in yield loss and increased food insecurity.

As an illustrative example, results from 2022 surveys of Pohnpei farming families and Yap farming families are compared. From an income vulnerability perspective, most households engage in subsistence agriculture, growing food for their consumption. Most grow a combination of food products (plants, livestock and poultry); and about half are engaged in fishing. Over a quarter of the respondents were either salaried government employees or employed in the private sector. A small proportion receive income from social security and remittances; low "hourly" wages remain a concern heard across the FSM.

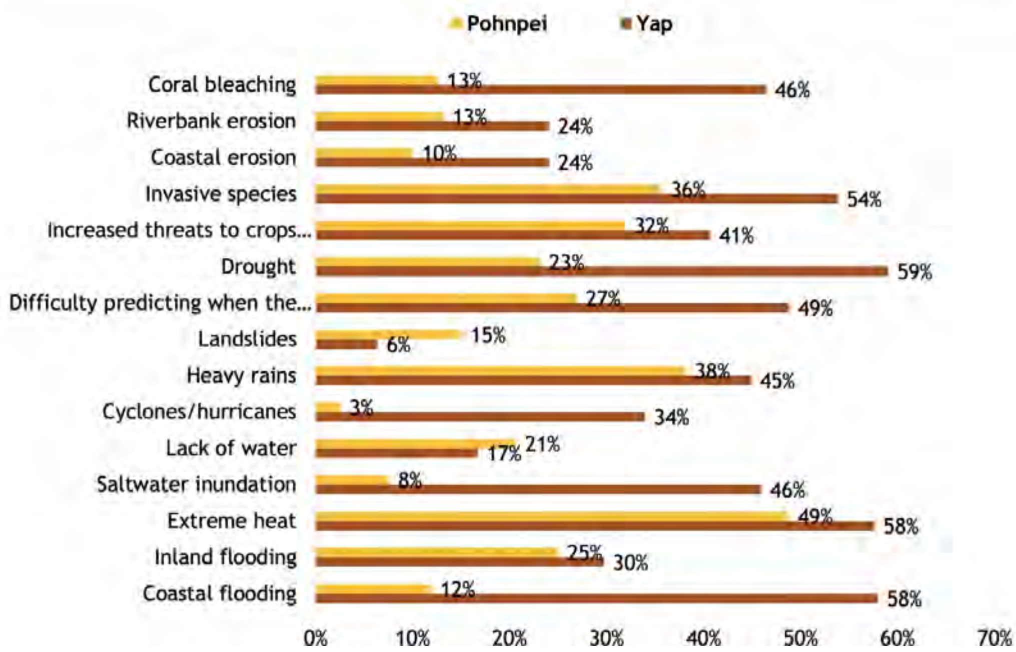


The majority of households believe in climate change, with over 70% of FSM households indicating that climate change is causing a lot of problems when it comes to their ability to produce food. They see it as largely due to changing weather patterns, including extreme heat, drought, heavy and excessive rains, inclement weather and, for those in outer islands or closer to the ocean, as expected, greater issues arose relative to salt inundation (intrusion), coastal erosion, flooding, and for some areas, cyclones/storms/hurricanes. Over 30% of respondents indicated they may have to move or stop food production due to the challenges from climate change. This has led, as noted in the 2010 survey, and continues today to lead to the migration from the outer islands and atolls to the main larger islands and furthermore to a continued migration out of the FSM.

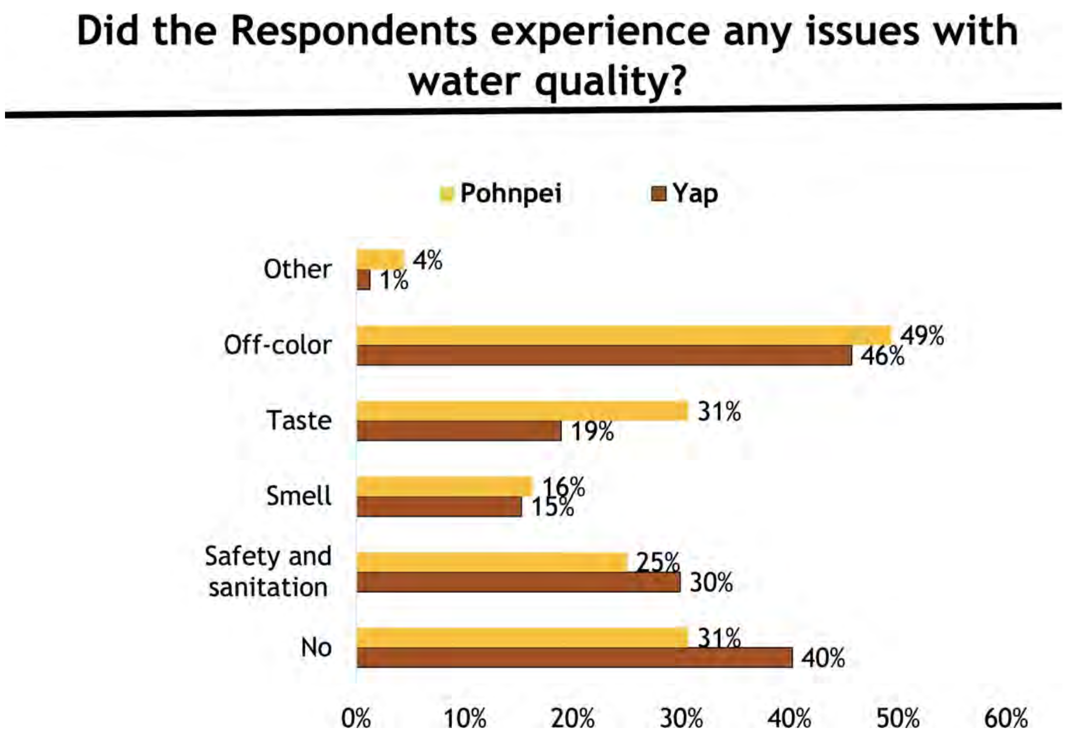


Not surprisingly, findings in both the 2010 and the 2022–2023 surveys revealed significant disruption and negative consequences due to climate change relative to environmental degradation, crop loss and food insecurity. When aggregating the results across the FSM, it's important to recognize that the specific geospatial location of the survey impacts the responses. Providing the same survey to households across the nation and across different locations within each state provided insights into several commonly observed themes; relatedly, the physical differences of the geography in which each respondent lives and farms sheds light on the relative differences in concerns/observations. For example, households in all the states were very concerned about excessive heat, invasive species, pests and diseases. Yet, in Yap, respondents expressed far greater concern about coral bleaching, coastal erosion, coastal flooding, drought, erratic rainfall, cyclones and hurricanes, and saltwater inundation than those from Pohnpei.

Issues that Local Food Producers are Facing in FSM



Water quality: While some areas in the FSM receive among the highest rainfall in the world, with Pohnpei known for its rich water resources, clearly, access to clean and safe drinking water remains a critical concern across the FSM. The lack of water in the atolls and outer islands is due to periods of drought across the FSM, during which water is limited, particularly public water, and continues to contribute significantly to vulnerability among many in the FSM. This was observed in 2010 and again in 2022–2023. In 2022–2023, over 15% of those surveyed reported they had issues with water shortages. While excessive rains were reported as a real concern that food producers face, leading to crop loss, in the 2022–2023 survey, nearly half of the households also reported issues with water quality, from off color being the most common concern, to other issues, including taste and smell. Slightly more than 25% responded they were concerned with water safety and sanitation. Further probing suggested that those concerns largely relate to likely contaminants from effluent runoff coming from livestock, swine and poultry waste and entering into water sources. Yet, to some respondents, it could also include the intrusion of salt and brackish water into fresh water. The 2010 survey focused on local water availability. In the 2022–2023 survey, respondents, including those who reported water shortages to be an issue, were asked if they did anything to collect rainfall or groundwater for home or agricultural use. Only a few constructed water collection systems to capture excessive rainfall for use in times of drought. The introduction and construction of household and farm fresh-water collection systems should be considered. The lack of fresh and safe water impacts not only direct consumption by families but the ability to provide irrigation to plants and terrestrial-based crops as well as for use in feeding poultry and livestock. Systems for storing water for later use would reduce vulnerability to water shortages.



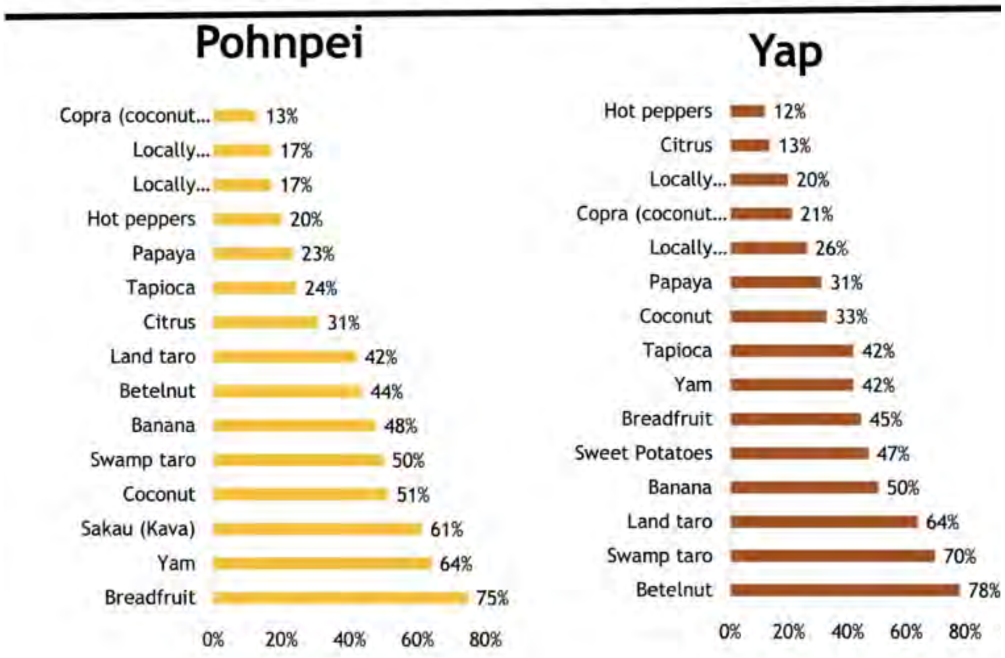
Summary of significant findings from 2022–2023 GCF food security baseline survey:

Families throughout the FSM still rely heavily on local food crops for family consumption (reaching as high as 98%) and also for social cohesion by way of traditional exchange (reaching as high as 80%). This dependency on local land for food makes these families vulnerable to climate change. Migration from outer islands and atolls to the main, larger islands cause disruption to this traditional historic process.

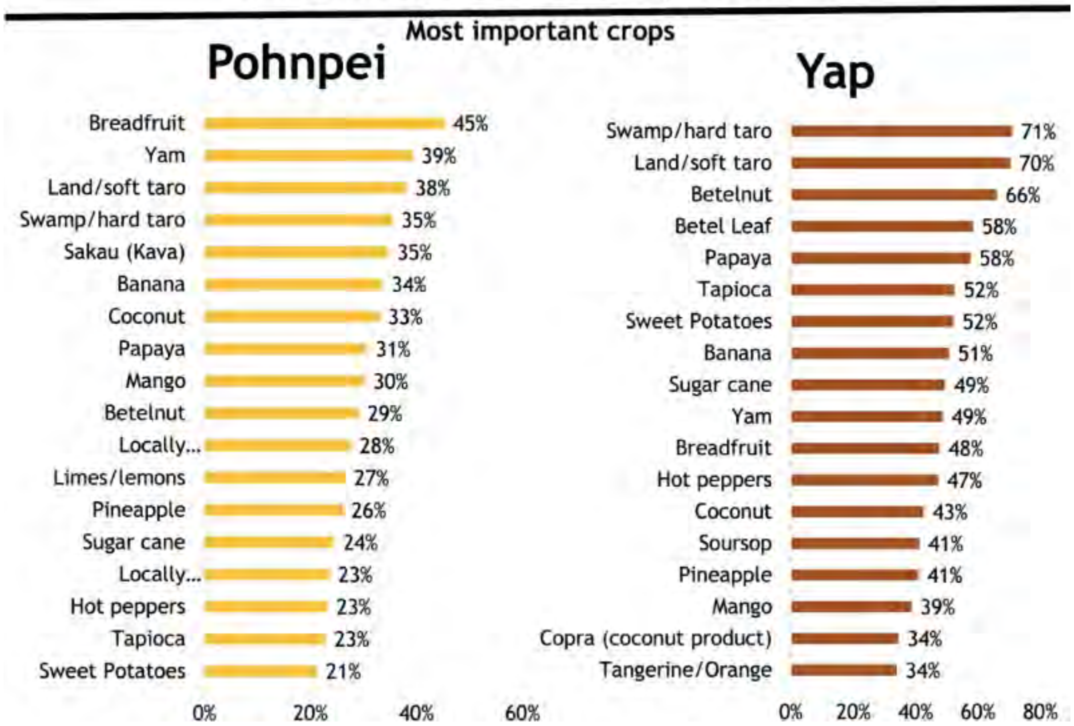
Across the FSM, farming families (about 50%) reported that extreme heat and drought followed by heavy rains were the climate factors most threatening their food production. The extent of excessive rains and flooding that leads to crop loss varied across each state and within the municipalities, as the actual location of the households has such a significant impact on their responses and observations. Nearly 80% of those surveyed shared that in the last 10 years they have experience an increase in temperature, while 61% said they noticed increased rainfall. These results further illustrate that the observations reported in the 2010 survey continue to impact households across the FSM today.

As an illustrative comparison, families in Pohnpei and Yap showed significant crops loss on all the foods they produced, though the underlying causes were not always the same. In Pohnpei, crop losses were reported to range from as high as 45% from breadfruit, and in Yap, 71% of crop loss was from swamp/hard and land/soft taro. Some losses are directly related to climate change; others simply reflect the poorer soil conditions and/or lack of agricultural inputs to ensure a higher level of nutrition. The incidence of insects and diseases, losses from excessive salt in the water and more each continue to contribute to overall loss in productivity. Lack of sufficient local and low-cost options for food preservation also contribute to crop loss and food vulnerability. In short, as reported in the 2010 survey and in the 2022–2023 survey as well, farmers across the FSM are experiencing significant changes in climate that are directly impacting their crops, specifically drought, coastal flooding, extreme heat, coral bleaching and invasive species. Yet, the relative contribution to the losses among these and other factors are site-specific. In Yap, for example, coral bleaching and coastal flooding is a greater barrier than one finds in Pohnpei.

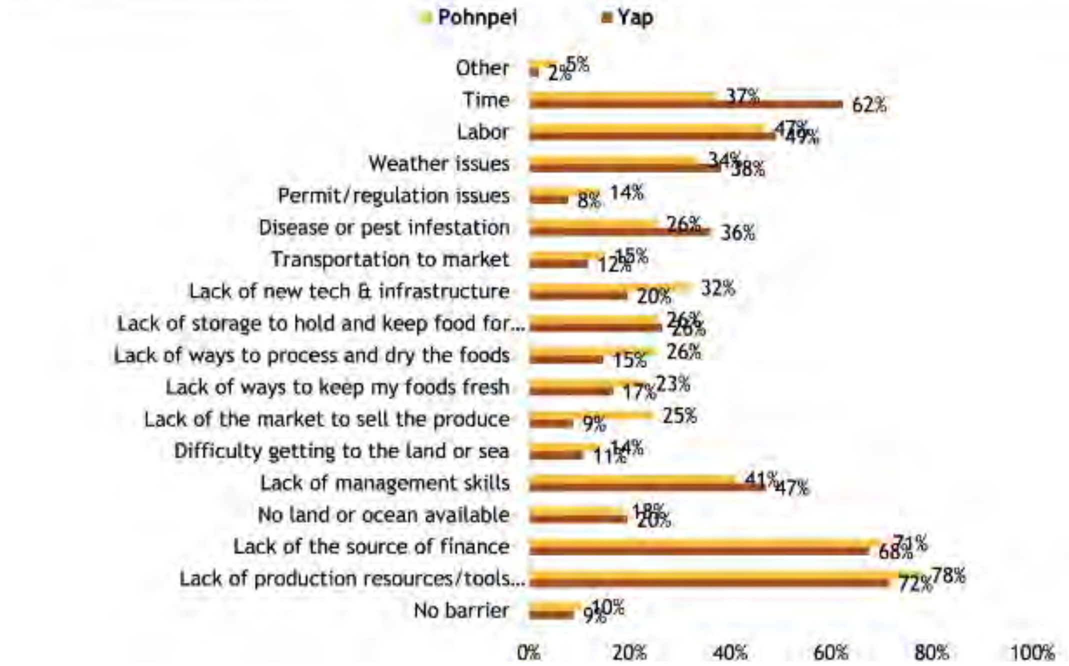
which crops are most affected by climate?



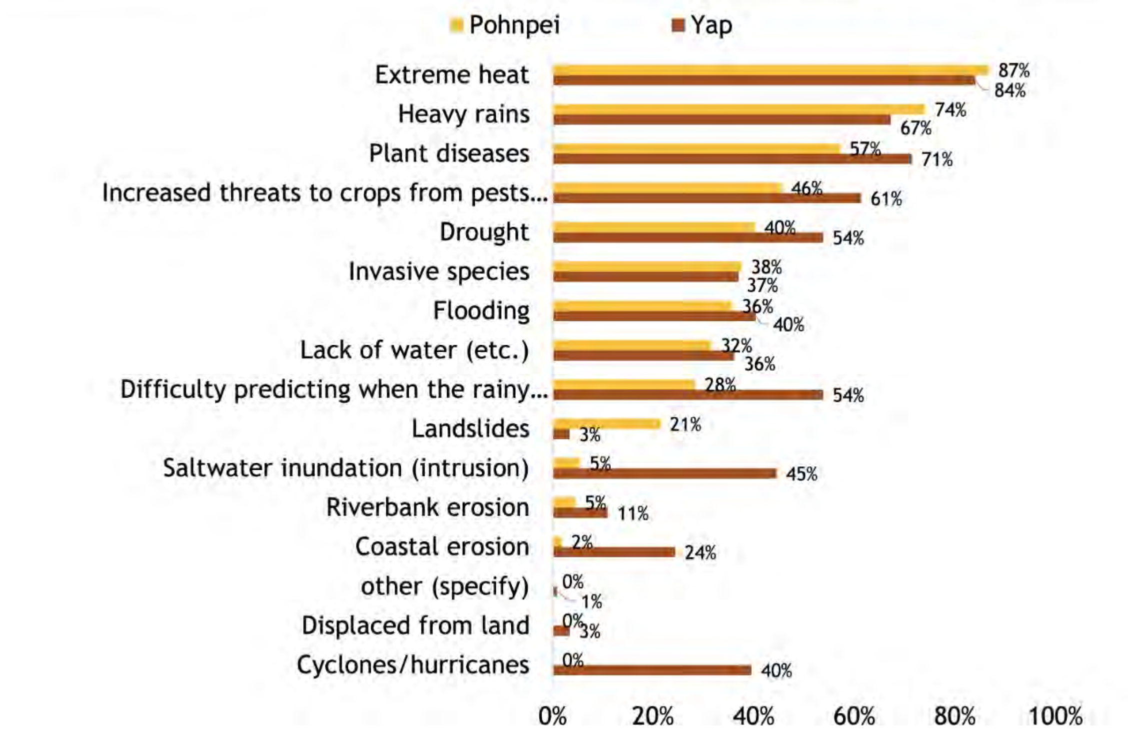
Is there ever a crop loss ?



Barriers to Food Production



how did climate contribute to your crop loss?



Atoll / Outer Island comparison between the Second National Communication (SNC) to the United Nations Framework Convention on Climate Change and the 2022–2023 Green Climate Fund (GCF) baseline food security survey:

In 2010, the government conducted vulnerability and adaptation assessments on 14 atoll islands in the states of Pohnpei, Chuuk and Yap, as part of the preparations for completing the SNC. In the 2022–2023 GCF baseline food security survey, we aggregated the 14 respondents from the outer islands of Yap and Pohnpei and tabulated the results. In Yap, the outer island permanent residents of Yap main island came from the villages of Ruu, Makiy, Daboch, Gargey, Gitam and Madrich. The Outer Island household residents of Yap Proper chose to live on Yap Proper rather than on the Outer Islands for reasons pertaining to employment, education, healthcare and commerce. The Outer Island household surveys represent members from the following Outer Islands: Faraulep, Woleai, Falalop, Fadrai, Euripek, Satawal and Ifalik.

The 2010 survey identified major variations in the presence of invasive plant species among the islands. There were 12 invasive plant species identified, competing mainly with giant swamp taro, and therefore affecting productivity. At the time of the survey, most insects were present in low numbers. In the 2022–2023 GCF baseline survey, 40% of the respondents indicated that invasive species are a major problem, while 60% of the respondents indicated they are a minor problem. The same survey also indicated 47% of the respondents felt that the increased threat to crops from pests and diseases is a major problem.

The 2010 survey assessed the vulnerability of food security. While swamp taros thrived under excess precipitation with less evaporation, the yield of breadfruit was less than optimal under drought conditions. Banana plants adapted to atoll conditions can withstand temperature and rainfall changes but do not perform well under high salinity. Coconut can withstand temperature changes, rainfall, and to some extent salinity. In the 2022–2023 GCF baseline survey, 45% of the outer island respondents indicated they incurred crop loss in swamp taro due to climate change. 67% of those respondents indicated that extreme heat contributed to crop loss in the case of swamp taro. In the case of breadfruit, 42% of the respondents indicated that they incurred crop loss due to climate change, while 50% of the respondents indicated that they had banana yield loss due to climate change. In breadfruit, heavy rains, pests and diseases contributed to major crop loss compared to other factors. The major contributing factors for crop loss in the case of bananas were drought and pests and diseases. Only 36% of the respondents noticed crop loss in the case of coconuts due to climate change factors such as pests and diseases.

The 2010 survey indicated that on average, all atolls are food secure from the point of view of food availability but the contribution of imported foods to diet is quite significant, ranging from 17 to 43%. With limited transportation services, the observed trend of increasing dependency on imported food is a major concern. With regard to household food access, most of the households that own land produce their own food. Most households produce enough food crops and catch enough marine foods, but local meat production is not enough for all atolls. In the 2022–2023 GCF baseline survey of outer islanders, 57% of respondents indicated "availability" as a barrier preventing them from attaining healthy and nutritious foods. In this survey, only a few individuals indicated that they worried about not having enough healthy and nutritious food to eat, couldn't afford to eat healthy and nutritious food and were hungry because there wasn't enough money to buy food. More than 67% of the respondents indicated that their diet contains a majority of imported food. At the same time, in the latest survey, 33% of respondents indicated that it is more difficult to access food under current conditions. About 71% of the respondents indicated that they are concerned about climate change impacting their food.

While the 2010 survey indicated that those living on the atolls and outer islands had ample land to grow food, in 2022, outer islanders were less sure that they had enough land for growing and/or harvesting crops. In the current GCF baseline survey, the majority of outer islander respondents shared that their ability to grow food on their land has been impacted by a change in climate and that climate change has impacted their crop yield. Across the FSM, land is shared among family members and communities and this sharing provides a safety net for accessing food built upon the traditional culture in the FSM. Such an issue also can raise other challenges, such as the ability to sell and/or transfer land from the head of the household to children or family members. The legal and regulatory difficulties expressed across the FSM relative to the transfer of land through sales or gifting to another family member appears to have limited the investment in "land" that could be used to build hotels, businesses and agricultural facilities and the clearing out of invasive plant species that limit agroforestry productivity.

Although the 2022–2023 GCF baseline survey focused on the main islands, there were some outer islanders who moved to the main island for several reasons including, and in part due to, a changing climate. Others from atolls and outer islands left the FSM altogether. The population loss is significant. While there are many underlying causes of migration, the 2010 survey observed the movement from outer islands and atolls to the main islands and forecasted that the higher elevation islands will need to accommodate and prepare for an influx due to a population shift. About 67% of these outer islanders responding to the 2023 GCF baseline survey for farming households noted they grow crops for subsistence living. The number of respondents with higher education was slightly higher when compared to respondents from Pohnpei and Yap. Issues such as coastal flooding, extreme heat and lack of water were big problems for those who moved from the outer islands to the main islands. The top limitations for expanding crop production were the availability of land, tools and equipment and feed for their livestock. Yet, adverse weather plus insects and diseases and a litany of other complaints were commonly reported across the FSM, and these concerns were largely also expressed in the earlier 2010 survey. Crop loss was a significant issue facing outer islanders and others across the FSM, from increasing brackish and salt water intrusion, to insects and diseases, and lack of postharvest options beyond the traditional food security approach used successfully with taro and other products. Lack of sufficient income, coupled with higher expenses for many commodities and supplies due to the additional shipping charges to the more remote areas, further contribute to the difficulty in reducing vulnerability.

Surveys were intentionally conducted in Yap targeting outer islanders from Faraulep, Woleai, Falalop, Fadrai, Euripek, Satawal, and Ifalik—and villages of Ruu, Makiy, Daboch, Gargey, Gitam and Madrich who had moved to the main island Yap.

2022 Survey of Outer Islanders living on main Island Yap: Has your ability to grow food been affected by climate change?

Question	Responses	Percent
Has your ability to grow food been affected by a change in climate?	No	40.00
	Yes	60.00
	Total	100.00
Has a change in climate impacted your crop yield?	No	26.67
	Yes	73.33
	Total	100.00

From the 2022–2023 GCF food security and climate impact among farming families baseline assessment results, 90% of the respondents indicated that the climate will impact the food that they eat. In Yap, less than 1% of the respondents indicated that they ate less than their preferred food and were hungry because there wasn't enough money. Respondents in Yap felt the main obstacles in production were the unavailability of the tools and equipment, feed for the livestock and the lack of knowledge to operate their business.

Chapter 6

Adaptation and Resiliency

Photo credit: Dena Seidel, Rutgers University

UNDP

Empowered lives.
Resilient nations.

6.1 Interventions to Adapt to Climate Change

Since the Second National Communication, the government of the FSM has implemented a number of projects to strengthen the adaptive capacity[217] of its economic sectors and population. National and state governments are working in close collaboration with international and regional institutions, statutory bodies, academia, NGOs and community groups to enhance adaptive capacity throughout the nation.

The FSM's policies and plans include linkages between climate change, development, and sustainable use of natural resources, showing a determination toward addressing climate risks and challenges. The FSM's Nationwide Integrated Disaster Risk Management and Climate Change Policy was endorsed in 2013, posing the FSM as one of the pioneer countries to adopt an integrated approach to handling disaster risk and climate change in the Pacific. This prompted the four states to develop and endorse, in 2016–2017, their Joint State Action Plans (JSAP) for Disaster Risk Management and Climate Change. The JSAPs have a strong focus on identifying sector vulnerabilities and adaptive and appropriate solutions to climate change (Table 1). In the four FSM states, water resources, agriculture, fisheries, biodiversity, and terrestrial and coastal ecosystems, together with built assets, were identified among the vulnerable sectors to climate change.

Table 1. Climate risks and adaptive capacity for the four FSM's States (Joint States Action plans, 2016-2017).

State	Climate Threat	Sensitivity	Vulnerability	Adaptive capacity
Yap	Typhoons, flooding, drought, and high seas storm surges in its outlying islands.	High	High	Medium
Chuuk	Droughts, typhoons, tropical storms, storm-waves, flooding, landslides, and high sea surges in its outlying islands.	High	High	Low in all sectors, medium in fishery, coastal ecosystems and biodiversity
Pohnpei	El Niño–related droughts, typhoons and tropical storms, variable rainfall patterns, extreme high tides during La Niña.	High	High	Medium
Kosrae	Landslides, higher than normal high tides, large sea swells, increased impact of storm surges and flooding as a result of sea level rise, drought, tropical storms.	High	High	Medium in all sectors, low in private sector (nature-based tourism)

Building resilience is the primary goal of the FSM. In doing so the national and state governments have worked toward mainstreaming climate change into national, state and local plans and strategies, and examples of community-based adaptation plans, aligned to the states' JSAPs, exist in the four states. The focus of these plans is to implement adaptation solutions that reduce existing vulnerabilities and enhance preparation and response to major climate change disaster risks.

[217] The IPCC glossary defines Adaptive Capacity as the ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. Source: IPCC, 2022: Annex II: Glossary [Möller, V., R. van Diemen, J.B.R. Matthews, C. Méndez, S. Semenov, J.S. Fuglestvedt, A. Reisinger (eds.)]. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 2897–2930, doi:10.1017/9781009325844.029

At the National level, the FSM Strategic Development Plan (SDP) 2004-2023 was prepared as a socioeconomic and economic blueprint for development in the FSM. The SDP includes a section "Environment Sector Strategic Plan," which recognizes that together with human-induced pressures, natural hazards, such as those associated with extreme weather events, high tides and sea level rise are responsible for environmental degradation. Among the nine areas of strategic focus identified in the Environment Sector Strategic Plan, mainstreaming climate change and adaptation strategies is included in the Strategic Goal 1: "adaptation strategies that address unacceptable risks to the natural environment and built assets, including those arising from natural hazards such as weather and climate extremes, variability and change developed and implemented (climate-proofing) in all states."

The FSM Infrastructure Development Plan (IDP) 2016-2025 identifies the costs for improving the nation's infrastructure assets in order to increase adaptive capacity. The IDP focuses on necessary improvements of States' infrastructures in sectors that are vulnerable to climate change and natural disasters, with a particular emphasis on (i) water supply and development of new source also to reduce the risk of water borne diseases; (ii) roads and maritime infrastructures to increase the overall resilience and response to natural and climate hazards; (iii) schools and education facilities to enhance their resilience to potential natural disasters and the impacts of climate change; (iv) hospitals and health facilities (i.e., dispensaries) maintenance and upgrades to enhance their resilience to potential natural disasters and the impacts of climate change.

The FSM is currently developing its National Adaptation Plan. At the state level, the Joint State Action Plans (JSAP) for Disaster Risk Management and Climate Change present the guiding principles for FSM's States adaptation, reflecting the unique adaptation needs[218] of each state driven by their geographical setting, population density and growth, remoteness, and connection of outlying islands to main centers, available natural resources, and economic opportunities. The four states are highly vulnerable to climate threats and disasters (Table 3) and adaptation actions in key sectors such as health, education, environment, and infrastructures are costed in the JSAPs (Table 2). The total estimated cost of adaptation for the four FSM states, in 2015, was US $108,723,809, and the greatest financial cost arises for increasing infrastructures adaptive capacity in the four states (Fig. 26). Also relevant are the financial costs for adapting the environment, agriculture, and fisheries sectors to climate change risks, indicating the commitment of the states to protect their environment for maintaining the flow of services and enhance food security opportunities for the subsistence and well-being of their communities.

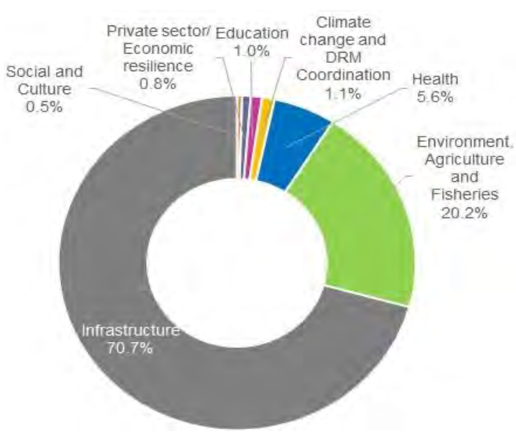


Figure 26. Distribution of estimated adaptation costs by sector

Efforts to address adaptation priorities are reflected in the expenditure for climate change adaptation, mitigation and disaster risk management (Fig. 27).

[218] The IPCC glossary defines adaptation needs as the circumstances requiring action to ensure safety of populations and security of assets in response to climate impacts. https://www.ipcc.ch/report/ar6/wg2/downloads/report/IPCC_AR6_WGII_Annex-II.pdf

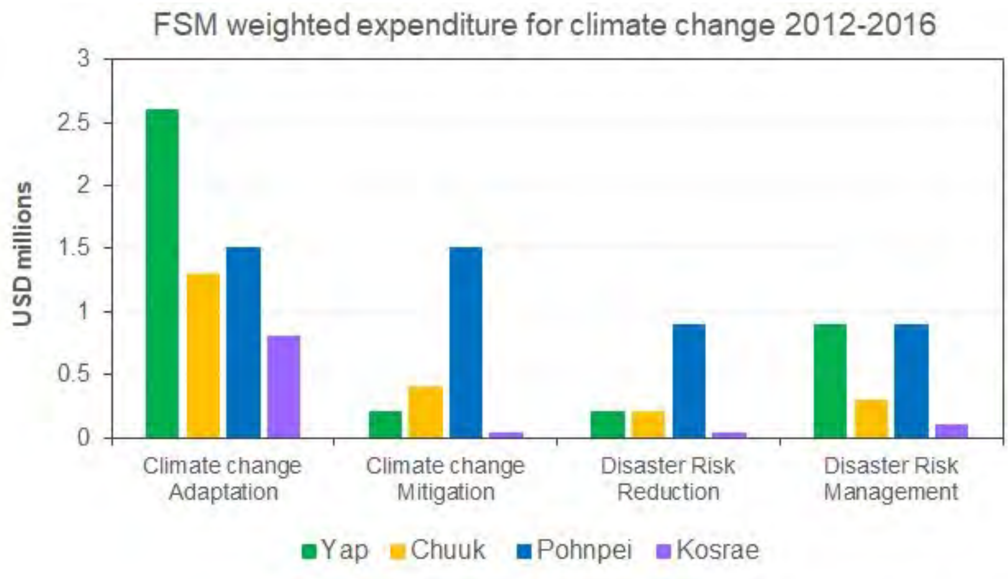


Figure 27. FSM State governments' climate change and disaster risk management expenditure, relative to the total expenses of each state and weighted by the element of vulnerability to climate change and disaster, 2012-2016 (Source: SPC and PIFS, 2019[219]).

[219] Pacific Community (SPC) and Pacific Islands Forum Secretariat (PIFS) (2019). Federated States of Micronesia: Climate Change and Disaster Risk Finance Assessment. The Pacific Community Suva, Fiji, 2019.

Table 2. Summary of adaptation strategies identified in the JSAPs of the four FSM's States and estimated costs of adaptation by sector (US$).

State of Yap: estimated costs of adaptation strategies by sector		
Sector	State adaptation priority strategies by sector	Estimated cost of adaptation (US$)
Health	1. Strengthen Yap health sector policy and technical capacity to cover risk assessment and planning 2. Raise the level of public education and technical awareness about health-related risks and the links to climate change events, trends and disasters 3. Improve health programs for people with special needs in Yap	$ 241,660
Education	1. Develop and implement an ongoing climate change and DRM education and awareness program through the formal education system 2. Develop and implement an ongoing climate change and DRM education and awareness program for communities 3. Promote and encourage student enrolment in technical vocational training to include risk assessment and planning 4. Develop DRM and CC technical capacity of Consulting Resource Teachers (CRT) and mobility personnel for evacuation preparedness	$ 340,144
Resources and Development & Environment	1. Improve data and knowledge management to better support disaster risk management and climate change adaptation 2. Provide more effective management of resources through understanding of integrated approaches such as ecosystem based or whole island/state approaches 3. Strengthen policy and technical capacity, and community awareness of invasive species management in various climate and disaster scenarios 4. Address and improve management of solid waste, sanitation and hazardous waste 5. Address food security issues in Yap and the risks provided by climate change and other events	$ 1,023,725
Private sector	1. Strengthen the business environment in Yap to ensure it is conducive to a robust private sector 2. Improve collaboration between private sector and businesses for effective and sustainable partnerships for climate change awareness and disaster preparedness 3. Enhance the tourism sector in Yap and to promote conservation areas	$ 48,648
Social and Culture	1. Develop a strategy that considers options for relocation and migration from outlying islands 2. Promote and strengthen cultural and traditional practices to enhance socio-cultural resilience	$ 261,234
Infrastructures	1. Review existing building codes and improve awareness of appropriate standards for all infrastructure 2. Strengthen technical and policy capacity to address infrastructure issues in Yap 3. Improve critical infrastructure in Yap to withstand disasters and climate change 4. Enhance sustainable energy use in Yap through promotion of renewable energy and energy efficiency programmes	$ 4,554,302
Coordination of DRM and Climate Change activities	1. Strengthen policy environment for disaster risk management and climate change 2. Improve coordination on disaster risk management and climate change adaptation 3. Strengthen climate and disaster risk preparedness and response capacity	$ 383,334
State of Kosrae: estimated costs of adaptation strategies by sector		
Sector	State adaptation priority strategies by sector	Estimated cost of adaptation (US$)
Health	1. Strengthen policy and technical capacity of the health sector in Kosrae 2. Strengthen and support the use of local traditional medicine 3. Raise the level of public education and technical awareness about health-related risks and the links to climate change and disasters	$467,057
Education	1. Develop and implement an ongoing climate change and DRM education and awareness program through the formal education system	$377,987

State of Kosrae: estimated costs of adaptation strategies by sector

Sector	State adaptation priority strategies by sector	Estimated cost of adaptation (US$)
Environment	1. Improve coordination on disaster risk management and climate change adaptation 2. Strengthen climate and disaster risk preparedness and response capacity 3. Reinstate Fire Department 4. Strengthen policy and technical capacity for shoreline management including monitoring and enforcement of regulations 5. Strengthen policy, technical capacity and community awareness for management of invasive species 6. Strengthen waste management	$943,044
Private sector	1. Strengthen communication and partnerships between private sector and government to enhance sectoral adaptation 2. Improve private sector risk management through the uptake of appropriate insurance policies 3. Improve the regulatory environment to support local private sector and encourage appropriate levels of foreign investment	$602,647
Social and Culture	1. Develop a strategy that considers options for relocation 2. Improve and strengthen cultural and traditional practices and knowledge, particularly in the agricultural sector 3. Strengthen family and community well-being, particularly by strengthening adaptive capacity of women, children and disables	$243,148
Infrastructures	1. Review existing building codes and improve awareness of appropriate standards for all infrastructure 2. Strengthen technical and policy capacity to address infrastructure issues in Kosrae 3. Improve critical infrastructure in Kosrae to withstand disasters and climate change 4. Improve drainage at key locations 5. Improve telecommunications capacity 6. Review options for alternate energy sources 7. Strengthen the efficiency and effectiveness of existing energy sources 8. Strengthen management of fresh water resources	$1,179,480

State of Pohnpei: estimated costs of adaptation strategies by sector

Sector	State adaptation priority strategies by sector	Estimated cost of adaptation (US$)
Health	1. Effective response to disease in case of disaster	$ 346,600
Education	1. Communities aware about climate change and effects and disaster risk management 2. Integrate climate change and disaster risk reduction in school curriculum 3. School children educated on food security	$ 202,412
Environment	1. Shoreline protection of outer islands 2. Ensure water security of Pohnpei 3. Ensure energy security of Pohnpei 4. Clean streams and rivers on main island	$ 238,843
Agriculture and Fisheries	1. Strengthen food security in Pohnpei	$ 652,334
Social Protection	1. Safe shelters for community in time of disaster 2. Effectively respond to and care for vulnerable groups in case of disaster 3. Community friendly and accessible emergency number 4. Marine safety 5. Settlement options for relocation of outer island communities to mainland	$ 458,163

State of Pohnpei: estimated costs of adaptation strategies by sector		
Sector	State adaptation priority strategies by sector	Estimated cost of adaptation (US$)
Economic Resilience	1. Encourage environment friendly actions through tax incentives 2. Strengthen the business environment in Pohnpei to ensure it is conducive to a robust 3. private sector	$ 65,604
Infrastructures	1. Improve critical infrastructure in Pohnpei to withstand disasters and climate change 2. Zoning laws in place to reduce risks of climate change and disaster risk 3. Infrastructure and state development codes reduce risk to climate change and disaster risk 4. Uniform land information through centralized GIS 5. Enable settlement from low lying land (at risk) to higher grounds 6. Improve management of solid waste 7. Functional communication for outer islands in time of disaster	$ 15,637,320
Climate change and DRM coordination	1. Disaster Task equipped to effectively respond to disaster 2. Objective 8.2: All sectors in Pohnpei receive consistent guidance on responding to disaster or emergency 3. Objective 8.3: Local preparedness and response plans developed across Pohnpei State 4. Objective 8.4: Communities experienced in preparedness and disaster response 5. Objective 8.5: Pohnpei State and Municipalities equipped with necessary supplies and resources to 6. respond to disaster 7. Objective 8.6: Strengthen early warning systems in Pohnpei State 8. Objective 8.7: Increase awareness and coordination in accessing funding sources	$ 851,544

State of Chuuk: estimated costs of adaptation strategies by sector		
Sector	State adaptation priority strategies by sector	Estimated cost of adaptation (US$)
Health	1. Environmentally friendly sanitation coverage 2. Health security for Chuuk	$ 5,057,270
Education	1. Skilled labour to support disaster and climate change preparedness and response	$ 172,000
Environment	1. Ensure water security for Chuuk 2. Improve waste management and promote environmentally friendly recycling	$ 2,762,817
Agriculture and Fisheries	1. Mangrove planting for shoreline protection 2. Mountain protection and rehabilitation 3. Strengthen fire response 4. Sustain productive agriculture	$ 16,270,318
Private sector	1. Strengthen Private Sector capacity to support disaster preparedness and response 2. Increase Private Sector awareness on disaster risk and climate change 3. Encourage disaster preparedness and environment friendly actions through tax incentives	$ 117,552
Infrastructures	1. Shoreline protection 2. Improve infrastructure in Chuuk State to withstand disaster risk and climate change 3. Infrastructure to support development / settlement in higher grounds	$ 55,224,622

Although the FSM National Disaster Response Plan (2016) focuses on the preparedness and response phases rather than risk reduction, as a signatory to the Sendai Framework for Disaster Risk Reduction (SFDRR), the FSM has prioritized actions to better prepare for climate-related disasters. In the FSM, responses to disasters are coordinated at National and State level. At National level, the Division of Emergency Management under DECEM is the designated Agency responsible for disaster risk management, preparedness and response, coordinating national activities and assisting states' disaster offices. The Disaster Risk Reduction Status report (UNDRR, 2022[220]) provides an overview of the activities implemented or being implemented by the FSM to strengthen DRR and identifies four areas of action that align with the nation's priorities (Table 3).

Table 3. FSM priorities for Disaster Risk Reduction (Source: UNDRR, 2022).

Priority	Status	Action
1. Understanding Disaster Risk	FSM has limited resources and capacity to conduct assessments for collecting and analyzing comprehensive risk information at the subnational level. **2017**: pilot assessment conducted in Yap state outlying atoll islands	Expand resources for implementing comprehensive Disaster risk management policies and practices in order to get a **better understanding of disaster risk in its components such as vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment**.
2. Strengthening Disaster Risk governance to manage DR	**2013**: Nationwide Integrated Disaster Risk Management and Climate Change Policy of, the Climate Change Act 2013, and the Strategic Development Plan (2004-2023) are other policies that aim to strengthen the risk governance in FSM. **2016**: National Disaster Response Plan prepared to provide an overview of the national institutional arrangements to respond to an emergency event. **2016-17**: State disaster response plans developed for each state to prepare and respond to emergencies or disaster events within the states. Committees established at the municipal, village, and outlying island levels to carry out the preparedness, relief, and response operations.	Ensure the coherence of national and local legal frameworks, regulations and policies to guide, encourage, and **incentivize public and private sectors to take action towards reducing disaster risks in all sectors**
3. Investing in Disaster Risk Reduction for resilience	Establishment and installation of **early warning systems** with support from the International Organization for Migration (IOM) to improve broadcasting capability, equipment protection, and sustainability. **2018**: The United Nations Economic and Social Commission for Asia and the Pacific cooperated with the FSM government to build and operate an online geo-portal for early warning systems and disaster risk management. **2019**: Maritime Investment Project (2019) consisting of US$ 38.49 million by the International Development Association and the International Bank for Reconstruction and Development to	**Expand public and private investment in disaster risk prevention and reduction** through structural and non-structural measures **to enhance the resilience of persons, communities, countries and their assets.** These cost-effective measures are helpful in saving lives, preventing and reducing losses, and ensuring adequate recovery and rehabilitation.

[220] UN Office for Disaster Risk Reduction (2022). Disaster Risk Reduction in the Federated States of Micronesia: Status Report 2022, United Nations Office for Disaster Risk Reduction (UNDRR), Sub-Regional Office for the Pacific. https://www.undrr.org/media/81878/download

Priority	Status	Action
	improve the safety, efficiency and climate resilience of maritime infrastructure and operations and to provide an immediate response to an eligible crisis or emergency if they occur. **2021**: UNDRR launched CREWS Pacific SIDS 2.0:[221] Strengthening Hydro-Meteorological and Early Warning Services in the Pacific Project, which aims to enhance the effectiveness and inclusiveness of Pacific Island and Regional Early Warning systems for local and vulnerable populations by improving the early warning capabilities of national and regional hydro-meteorological centres and strengthening governance structures. Compact of Free Association (COFA) with the United States: stipulates that the US provides economic assistance to the FSM over the 20 years to 2024. One of the focuses is to strengthen FSM's climate resilience through disaster management.	
. Enhancing disaster preparedness for effective response to "Build Back Better" in recovery, rehabilitation and reconstruction.	**2018**, International Development's Institutional Strengthening in Pacific Island Countries to Adapt to Climate Change (ISACC) Project: implemented by SPC and supported by the U.S. Agency, training on the Monitoring and Evaluation (M&E) of national, regional, and global resilience systems and the associated capacities within FSM. Partnerships for **"Strengthening School Preparedness for Tsunami in Asia and the Pacific**" project: supported by the Japan-UNDP Partnership Fund the project aims to provide a reliable source of information and comprehensive advice for preparedness against tsunami. The FSM is included in the second phase of the project. **Weather Service Offices**: the WSO are supported financially by the US Government through the US National Oceanic and Atmospheric Administration (NOAA), located in Pohnpei, Chuuk and Yap with a total of 32 staff employed in the three offices. The **Pacific Islands Meteorological Strategy (PIMS) 2017-2026**: provides the development priorities of the Pacific Island National Meteorological and Hydrological Services (NMHSs). PIMS sets out the strategic context and direction for strengthening NMHSs **Gender Equality**: assistance to promote GE provided by Australia with the strategic objective to "improve political, economic and social opportunities for women." Focus of the assistance is on supporting FSM government for (i) development of legislation providing more significant legal protection against gender violence and prosecution of perpetrators; (ii) development and an initial provision of essential referral services to victims of gender-based violence; (iii) complete scoping study to identify critical barriers to scaling up women's businesses, strengthening and developing women's business.	"Build Back Better" through integrating disaster risk reduction measures following disaster recovery, rehabilitation, and reconstruction phases.

The Updated Nationally Determined Contribution (2022[222]) includes FSM contributions to sectors that are relevant to the national adaptation strategy, linking mitigation and adaptation benefits in areas such as food and water security, environment, health, transportation and emergency management and response (Table 4). The

[221] CREWS Pacific SIDS 2.0 is a collaboration with the Pacific Community (SPC), Secretariat of the Pacific Regional Environment Programme (SPREP), World Bank (WB), Australian Bureau of Meteorology (BoM), and Global Facility for Disaster Reduction and Recovery (GFDRR).
[222] FSM Department of Environment, Climate Change and Emergency Management (2022). Updated Nationally Determined Contribution of the Federated States of Micronesia for the period through 2030. FSM Government, Palikir, Pohnpei, FSM.

FSM has made progress in enhancing its adapting capacity, but important gaps remain in terms of adaptation, due to constrained funding and capacity. Nevertheless, the FSM has worked to strengthen its resilience to climate change, in line with its policies and plans, and a summary of completed and active adaptation projects is presented in Table 5. This is not an exhaustive list, but rather a representation of the progress the nation has made since its last National Communication.

Table 4. Summary of the benefits of the FSM Updated NDC to adaptation (DECEM, 2022)

Target	Contributions by 2030	Benefits to adaptation
Food security	- Establish and/or strengthen farmer cooperatives across all four FSM States - Establish and support state-level farmer associations to provide training in climate-smart agriculture practices, and establish local seed banks - Improve market access for farmers by facilitating development of commercial agreements with local purchasers - Increase annual production of coconuts and coconut-based products to improve resilience of the food system to climate change impacts	- Increased resilience to climate change impacts on local food production, including sea level rise, saltwater intrusion into fresh water lens, and changes in precipitation patterns - Increased resilience to price spikes and shortages of key food imports caused by climate change impacts on the global food system
Water security	- Provide universal access to clean drinking water through refurbishment of existing water infrastructure and extension of network to unserved and underserved areas	- Increased resilience of the local water supply to climate change impacts, including sea level rise, storm surge, saltwater intrusion into fresh water lens, and more severe drought
Ecosystem management	- Effectively manage 50% of marine resources and 30% of terrestrial resources, including restricting commercial fishing in up to 30% of the FSM marine environment - develop non-entangling and biodegradable Fish Aggregating Devices (FAD) to be used by all purse seine flag vessels in the FSM EEZ - Achieve full tuna fishery transparency, through electronic monitoring of all FSM-flagged longline fishing vessels - Develop Integrated Land Management Plans and Shoreline Development Plans to effectively protect and sustain terrestrial and coastal ecosystems - Expand the number of Protected Areas and their coordination through Protected Area Networks	- Increased resilience of fisheries to climate change impacts by improving sustainability, reducing by-catch, reducing IUU fishing, and providing protected areas for stocks to recover - Preservation of ecosystems services and livelihoods - Preservation of food supply/security - Improved capacity of governments and communities to respond to climate change impacts on coastal and marine ecosystems - Improved climate resilience of livelihoods and businesses reliant on coastal and marine ecosystems - Improved flood resilience through protection of mangroves and implementation of other nature-based solutions - Reduction of coastal erosion - Improved resilience to more extreme droughts through water conservation / groundwater protection

		- Increased resilience of coral reefs, mangrove forests, and wetlands to climate change impacts
Health	- Establish a surveillance system, including a laboratory facility, to detect and monitor VBD, WBD, and FBD to enable rapid response and control of outbreaks - Provide training in the detection and treatment of VBD, WBD, and FBD to all medical personnel and public health officials - Equip all hospitals and other relevant medical facilities to receive and effectively treat patients suffering from VBD, WBD, and FBD	- Improved preparedness of the public health system to respond to VBD, WBD, and FBD outbreaks, which are projected to increase due to climate change
Transportation	- Climate-proof all major island ring roads, airport access roads, and arterial roads - complete climate-proofing of major ports	- Resilience to flooding from sea level rise and king tides - Maintenance of public and commercial services during weather-related emergencies
Emergency management & response	- Complete an update of the National Disaster Response Plan - Complete comprehensive nationwide GIS mapping - Update vessels and/or secure additional vessels for inter-state transportation and emergency response operations, incorporating renewable energy technology	- Enhancement of emergency management and disaster response to extreme weather events, including improved delivery of essential supplies and services (e.g., food, water, medical, transportation) - Improved monitoring of coastal erosion, sea level-rise, groundwater supplies, and other natural resources

Table 5. Summary of the most recent Adaptation projects implemented by the FSM government by targets.

Project targets	Project Name	Funding organization	Years of implemen-tation	Description	Project amount in USD or Euro	Project status
Water	EU-GCCA Pacific Small Island States (PSIS): increasing Coastal Water Security for Climate Change in Selected FSM State Outlying islands	European Union	2011-2016	To contribute to water security as a climate change adaptation strategy for FSM and to increase access and sustainable use of quality water in the outlying islands of FSM states. A total of 11,671 project beneficiaries of which 294 from Yap outlying island of Fais, which became better able to effectively cope with droughts and extreme events.	Euro 720,584	Completed
Water	North Pacific Readiness for El Niño (RENI) Project	11th European Development Fund	2017-2020	The project aimed to enhance the resilience of FSM communities to the shocks and insecurities resulting from droughts by strengthening water security. A total of 1,247 project beneficiaries from the most vulnerable and remote low-lying islands of the FSM became better able to cope with droughts.	~ Euro 740,000	Completed
Land and marine systems - Biodiversity and agriculture	FSM Ridge to Reef	Global Environment Facility (GEF)/ UNDP	2015-2022	To strengthen local, State and National capacities and actions to implement an integrated ecosystems management through "ridge to reef" approach on the High Islands of the four States of the FSM. The focus of the project was on integrated ecosystem management and rehabilitation, and protected area management	US$ 22.7 million	Completed
Disaster risk reduction	Pacific Adaptation Project (PAP): Institutional Strengthening in Pacific countries to adapt to climate change (ISACC)	United States Agency for International Development (USAID)	2015-2020	The project supported efforts to develop the capacities of FSM to effectively plan, coordinate and respond to the adverse impacts of climate change. It supported the progression of national climate change priorities and worked on multisectoral coordination for climate finance. A climate and DRM finance assessment was undertaken.	–	Completed
Disaster risk reduction	EDCR FSM Project: Enhancing Disaster and Climate Resilience in the Federated States of Micronesia through improved Disaster Preparedness and Infrastructure.	Government of Japan	2019-2022	The project aimed to improve the capacity for preparedness and mitigation of FSM to man-made, geo-physical, climate related hazards and to climate change impact. The project funded the new extension building (worth US$164,570) to enhance the capacity of the National Emergency Operational Center (NEOC) under DECEM. High Frequency (HF) and a Very High Frequency (VHF) radios were also supplied and installed at DECEM to concretely improve disaster communication with key emergency operation facilities in the FSM.	–	Completed
Fisheries	Pacific Regional Oceanscape Program FSM	World Bank	2015-2020	The project aimed to strengthen the management of oceanic and coastal fisheries and their habitats, and specifically to strengthen the	US$ 5.5 million	Completed

Project targets	Project Name	Funding organization	Years of implemen-tation	Description	Project amount in USD	Project status
				National Oceanic Resource Management Agency (NORMA) responsible for the management of oceanic fisheries.		
Fisheries, ecosystem services	Practical Solutions for Reducing Community Vulnerability to Climate Change in the Federated States of Micronesia	Adaptation Fund/MCT	2018-2022	The project aims to ensure that all four State Governments and the National Government in the FSM have the mechanisms in place to develop and successfully implement a robust nearshore fisheries management and nationwide protected areas network inclusive of proper enforcement and sustainable finance mechanisms. The project also seeks to provide communities with the resources and support needed to implement successful eco-based adaptation actions to protect their marine ecosystems and increase resilience to climate change impacts	US$ 970,000	Active
Disaster risk reduction, Adaptation	Intra-ACP GCCA+ Pacific Adaptation to Climate Change and Resilience Building (PacRES)	European Union	2018-2022	To increase the resilience of Pacific ACP countries to climate change and achieve the UN's Sustainable Development Goals in particular Goal 13: "Take urgent action to combat climate change and its impacts" in order to reduce poverty and promote sustainable development.	–	Active
Water	Enhancing the Climate Resilience of vulnerable island communities in Federated States of Micronesia	Adaptation Fund	2018-2023	The project aims at reducing the vulnerability of the selected communities to risks of water shortage and increase adaptive capacity of communities living in Woleai, Eauripik, Satawan, Lukunor, Kapingamarangi, Nukuoro, Utwe, Malem to drought and flood-related climate and disaster risks.	US$ 9.0 million	Active
Water	GCCA+SUPA: Scaling up community resilience to water stress and climate related extreme events in Chuuk State	European Union	2019-2023	The project is part of the Global Climate Change Alliance Plus Scaling Up Pacific Adaptation (GCCA+SUPA). In the FSM the project aims to scale up water security measures in the outer islands of Chuuk State, with a focus on the outlying islands of Polowat, Pulusuk and Pulap. It is estimated that the project will benefit 3,026 persons directly and 45,628 persons indirectly.	~ Euro 500,000	Active
Project targets	Project Name	Funding organization	Years of implemen-tation	Description	Project amount in USD or Euro	Project status
Water	Chuuk Water Supply and Sanitation Project	Asian Development Bank	2020-2022	The project aims to improve water supply and sanitation services in Weno, Chuuk. Weno is the second-largest urban center of the FSM and home to some 14,000 people.	US$ 12.8 million	Active
Agriculture	Climate resilient food security for farming households across the Federated States of Micronesia (FSM)	Green Climate Fund	2021-2026	The project is a comprehensive national effort to focus on increasing the resilience of FSM's most vulnerable communities to climate change-induced food insecurity. Planned measures include introducing sustainable agricultural practices and developing climate-resilient agriculture value chains.	US$ 9.4 million of which US$ 8.6 million GCF and US$ 810,000 co-financing	Active

Project targets	Project Name	Funding organization	Years of implemen-tation	Description	Project amount in USD	Project status
Agriculture, Water	Climate change adaptation solutions for Local Authorities in the Federated States of Micronesia	Green Climate Fund	2021-2028	By building the capacity of local authorities to deliver climate change adaptation services thus to enhance their technical expertise the project aims to reduce climate vulnerability, lower health risks and increase socioeconomic development for vulnerable communities through improved food and water security, enhanced disaster risk reduction and recovery, and building local adaptive capacity to respond to climate change.	US$ 19.7 million of which US$16.6 million GCF and US$3.1million co-financing	Active
Transportation (maritime)	Maritime Investment Project	World Bank – IDA253	2019-2024	The project aims improve the safety, efficiency and climate resilience of maritime infrastructure and operations in the four states of FSM in compliance with the International Ship and Port Facility Security (ISPS) Code.	US$ 38.49 million and additional financing of US$2.5 million	Active
Transportation (roads)	Prioritized Road Investment and Management Enhancements (PRIME) Project	World Bank	2021-2028	The project aims to improve the resilience of the country's primary road network to natural disasters and climate change by providing funds to upgrade the design and construction of FSM's roads on the primary road networks.	US$ 40 million	Active
Project targets	Project Name	Funding organization	Years of implemen-tation	Description	Project amount in USD or Euro	Project status
Transportation (roads)	Strategic Climate-Oriented Road Enhancements (SCORE) Project	World Bank	2022-2028	The project aims to upgrade the design and construction of FSM's strategic priority secondary roads in each state thus to improve resilience to climate-related hazards or events. The SCORE project is complementary to the PRIME project.	US$ 35.25 million	Active
Fisheries, Environment	Blue Prosperity Micronesia			This government-led program sets out to optimize ocean uses, protect 30% of the FSM's waters, strengthen fisheries management, and expand capacity to achieve the sustainable use of ocean resources.	–	Active

Community vulnerabilities and adaptation measures

In the FSM, communities throughout the country are particularly vulnerable to climate-induced impacts, with outlying communities most at risk from rising sea level, storm surges, typhoons and extreme tides. Most of the nation's population is located within 500 m and 1 km of the coastline and almost all outer island atolls residents live within less than 500 m of the coastline exposed to sea level rise, and storm surge (Kumar et al., 2020;[223] Andrew et al., 2019[224]). The impacts of climate change are likely to have implications for everyday life and subsistence activities. Climate change disasters and slow-onset effects impact natural resources on which a large part of the FSM communities rely for subsistence, as well as homes, livestock and other important economic assets, such as boats.

Furthermore, within a community, the impacts of natural disasters and climate change do not have an equal effect. The extent of the impact some people face is further aggravated by the existing vulnerabilities and inequalities they already face in society. Gender, age and disability are factors that can further increase vulnerability throughout the population. During times of natural disasters, the elderly and disabled are more at risk because of their limited mobility and lack of access to shelter and evacuation centers. The impacts of climate change affect people unequally, having a greater effect on the poorest households. Poverty incidence in the nation is considerably high (41%), with higher poverty incidence in female headed households (51%), reducing their ability to cope with and recover from asset losses following climate change– induced impacts and likely increasing producing a significant increase in poverty. Furthermore, climate change has a significant effect on subsistence activities (i.e., agriculture and fishing) potentially increasing out-migration from the most damaged areas. Catastrophic events have the potential to push more people into poverty, increasing the number of those migrating to the main centers or in other countries. Out-migration affects social settings by changing the make-up of households, villages, and communities, with increased burden for women, who already are engaged in unpaid work (e.g., women are responsible for taking care of children, elders and disabled), family and customary responsibilities.

In the FSM, communities are at the forefront of combining traditional practices and cutting-edge science, to build the resilience of their communities and ecosystems in the face of biodiversity loss and climate risk (Mc Leod 2018[225]). Local adaptation efforts are driven by communities with financial and technical support from the government. Often, women are leading these conservation and management efforts, particularly those that focus on food and water security. These efforts contribute to local development priorities and create co-benefits for multiple sustainable development goals (SDGs).

Community-based adaptation is a widely used approach throughout the FSM given the land tenure status, with more than 90% of land and part of coastal marine systems privately owned in some of the states, and the extensive traditional knowledge and reliance on ecosystems for subsistence. This approach has promoted communities' adaptive capacity to climate change, captured the adaptation needs of communities, and built their capacity to respond to emerging climate change threats. The essential role of traditional knowledge in conservation of biodiversity and adaptation to climate change is explicitly recognized in the FSM plans and strategies. Most climate change adaptation and natural resource management policies and strategies take into account the role that communities and traditional knowledge play in coping with natural hazards. For example, in both the FSM Nationwide Climate Change Policy of 2009 and the following Nationwide Integrated Disaster Risk Management and Climate Change Policy of 2013 communities have a central role for climate change adaptation. Furthermore, the Nationwide Integrated DRM and CC policy recognizes that implementation is a shared

[223] Kumar L, Gopalakrishnan T, Jayasinghe S (2020). Population distribution in the Pacific islands, proximity to coastal areas, and risks. In Ed: Kumar L (2020). Climate change and impacts in the Pacific. Springer Climate. Doi: https://doi.org/10.1007/978-3-030-32878-8
[224] Andrew NL, Bright P, de la Rua L, Teoh SJ, Vickers M (2019) Coastal proximity of populations in 22 Pacific Island Countries and Territories. PLoS ONE 14(9): e0223249. https://doi.org/10.1371/journal.pone.0223249
[225] Mcleod E. et al. (2018). Raising the voices of Pacific Island women to inform climate adaptation Policies. Marine Policy 93, 178–185.

responsibility between government, private sector, civil society and communities due to the cross-cutting nature of disaster and climate risk management.

Nationwide Climate Change Policy, 2009

"*The focus of this Policy is to mitigate climate change especially at the international level and adaptation at the national, state and community levels to reduce the FSM's vulnerability to climate change adverse impacts. In this context, FSM reaffirms its social and cultural identity and its people's rights and desire to continue to live sustainably on their islands*"

Nationwide Integrated Disaster Risk Management and Climate Change Policy, 2013

As guiding principle this policy pose "*Special attention to gender issues and the needs of marginalized groups, such as small atoll communities, the disabled and the elderly*" AND "*Recognizing the rights of island communities to their ancestral lands, while acknowledging the role that migration has played, and will continue to play, as an adaptation strategy to a changing environment*"

In the FSM, climate change adaptation is implemented by communities with support from national, state and local governments (Table 5) as well as local and international NGOs and institutions (Table 6). Several adaptation projects have been implemented by a network of government institutions, academia, and non-governmental and community- based organizations, which approach adaptation from grass root and with attention to traditional knowledge and ecosystems. Community-based adaptation projects include ecosystem-based adaptation (EbA), enhanced water and food security, and sustainable management of natural resources, among others. Below are some examples.

- The USAID Pacific-American Climate Fund (PACAM) funded projects in Yap, Chuuk and Pohnpei to enhance food security and provide alternative livelihoods. The Yap Climate Adaptive Agriculture and Resilience (CARR) project, implemented by the College of Micronesia (COM)-FSM Yap Cooperative Research and Extension division, aimed to increase the adaptive capacity of outlying islands displaced communities through climate-smart gardening activities, thus, to ensure access to nutritious food. The project trained 120 households, from atoll communities, in soil management, climate-smart gardening and water harvesting techniques to build their resilience to climate change impacts. In Chuuk, the *Climate Change Adaptation through Family, Gardens, Food, and Health Project,* implemented by the Chuuk Women Council, provided communities with three plant nurseries to support 45 home gardens with the goals of improving food security through climate resilient gardening methods with a co-benefit of increasing access to nutritious food options. In Pohnpei, Marine and Environmental Research Institute of Pohnpei (MERIP) implemented a project that aimed to reduce Pohnpei's coastal communities and ecosystems vulnerabilities to climate change by increasing the number and sizes of aquaculture farms growing sponges and marine ornamentals. The project engaged rural fishers and farmers in alternative livelihoods to reduce pressure on natural resources and make communities and ecosystems more resilient to climate change.

- The International Climate Initiative (IKI) of the German Federal Government funded the Nature Conservancy, Micronesia Office, to implement EbA projects throughout the FSM, with the goal of building the resilience of communities and ecosystems to climate change. In Chuuk, the Oneisomw community established a Locally Managed Marine Area (LMMA) with the goal of sustainably use and protecting marine resources for future generations. The LMMA plan developed by the community with technical support from Chuuk Conservation Society, a local NGO, builds upon traditional methods for the management of marine resources. The community had worked also to identify and rehabilitate their drought resilient water resources to increase their resilience to droughts. In Kosrae, the community in Malem municipality developed a natural resource management plan through the Local Early Action Plan (LEAP) tool that helps communities to mainstream climate change into their management plans. Based on the vulnerabilities identified in the LEAP, Malem community developed a municipality-wide solid waste management plan to reduce illegal dumping in coastal areas thus to increase the resilience of coral reefs to climate change. As part of the plan, household trash collection is now implemented. In Yap, the Tamil community established a protected area in the watershed and developed a management plan and regulations to protect their groundwater resources. In Pakin, an atoll close to Pohnpei high island, the community worked together to enforce regulations of their Marine Protected area and enhance their agroforestry, as means for food security.

- The Government of the FSM, through the Division of Environment in DECEM, implemented a GEF funded Ridge-to-Reef (R2R) project in the four high islands in the FSM. The project "*Implementing an integrated "Ridge to Reef" approach to enhance ecosystem services, to conserve globally important biodiversity and to sustain local livelihoods in the FSM*" was designed to "engineer a paradigm shift in the approach to and management of natural resources from an ad-hoc species/site/problem centric approach to a holistic ecosystem-based management "ridge to reef" approach" with the goals managing the whole island systems thus to enhance ecosystem goods and services, including resilience to climate change impacts. Among the several community-based activities financed by the FSM R2R, the rehabilitation of wetland areas impacted by climate-related flooding in Kosrae involved 304 community members, 114 of which were women and 190 were men. This promoted partnership between women and men and increased awareness on wetland conservation across genders and ages. In Yap, community members implemented the rehabilitation of coastal wetland in Tamil for coastal protection and food security, and in Weloy the rehabilitation of watershed areas by establishing buffer zones for water protection.

- In Kosrae, the Women in Farming Kosrae (WIFK), a local NGO that includes members from different Kosrae's communities, identified among their climate vulnerabilities, and nature-based adaptation needs, the improvement of soil health to enhance home gardening (vegetables and some other crops). Therefore, WIFK (i) implemented ecosystem-based methods for inland erosion control by planting lemongrass for creating buffer zones around flood-prone areas as well as revegetating degraded areas; (ii) promoted the use of portable dry litter piggeries (PDLP), an innovative low-cost technology, for the production of compost for house gardens and farms.

Table 6. Examples of multistate climate change adaptation projects implemented by NGOs since the Second National Communication

Organization	Project Name	Years of implementation	Description
The Nature Conservancy	Building the Resilience of communities and their Ecosystems to the Impacts of Climate Change in Micronesia and Melanesia	2015–2018	Funded by the International Climate Initiative (IKI) of the German Federal Government, this 3-year project aimed to increase the adaptive capacity and resilience of island communities and their ecosystems to climate change impacts via the provision of action guidance and recommendations on investments in ecosystem-based adaptation (EbA).
Micronesia Conservation Trust	Enhancing sustainable coral reef monitoring and management capacity for the Micronesia Challenge, and beyond	2015–2016	Funded by the United State National Oceanic and Atmospheric Administration this program advanced the Micronesia Challenge by enhancing local coral reef management and monitoring capacity in the FSM
	Implementation of Micronesia Challenge and Climate Adaptation	2014–2017	Implementation of Micronesia Challenge and climate adaptation plans for forest areas in the Federated States of Micronesia, funded by the United States Forest Service. MCT administered grants to local conservation organizations in the FSM to work with communities to develop and implement Forest Stewardship Landowner Plans.
	Advancing marine and terrestrial management in Micronesia	2015–2017	Funded by the United States Department of the Interior, Office of Insular Affairs. The program leveraged the PIMPAC-Micronesia program for capacity building and sustainable management of natural resources for increasing the resilience of FSM's communities to climate change
	Strengthening and enabling the 2030 Micronesia Challenge	2022–2025	This GEF funded project The project aims to enhance national and regional marine resource management towards the Micronesia Challenge 2030 targets through (i) supporting develop national policies, plans and tools to support national integrated management of marine resources under Micronesia Challenge 2030 targets; (ii) strengthen the capacities, communication, and planning to ensure regional coordination of the MC2030; (iii) monitoring and evaluation, knowledge management and communication of knowledge products generated through the project.
Catholic Relief Services	Increasing Resilience Among Vulnerable Communities in FSM	2023-	CRS bolsters the capacity of local authorities and communities on FSM's Yap and Chuuk Island to prepare for and recover from frequently occurring natural hazards, such as drought and typhoons. Funded by USAID, through a $2.4 million USD grant, will work to increase the disaster resilience of vulnerable communities in FSM, by helping 38 communities, in Chuuk and Yap states to effectively prepare for and respond to disasters. Activities will include creating community and household disaster response plans, increase access to savings and lending opportunities, promote climate smart agriculture, and increase water, sanitation, and hygiene (WASH) knowledge and access.

6.2 Efforts to Identify Least-Cost Adaptative and Resiliency Measures

Culturally Based Adaptation Mechanisms

Building upon the traditional adaptive practices of the FSM's indigenous people / local communities (IPLCs) is an efficient and community-based approach to climate change preparedness that helps ensure local engagement and adoption. Throughout the FSM, local cultures impacted by sea level rise and saltwater intrusion are being forced to respond. Assessing the adaptive capacity to climate change for FSM's communities will benefit from the inclusion of localized cultural adaptation mechanisms that have developed in response to specific social and ecological challenges (Perkins, R. M., & Krause, S. 2018). For instance, the traditional practice of *sawei* in Yap State can be seen as an adaptation of mutual reciprocity between and among groups from disperse island communities where traditional patterns of support still exist (Krause, 2016) and group identity is often more valued than individuality (Lazrus, 2015). The FSM's IPLCs include kinship systems and traditional sociopolitical organizations with culturally based protocols for social interactions and practices that support and protect members of the community during times of stress. For these reasons, intangible cultural heritage, which helps guide IPLCs' adaptive responses to climate change, should always be considered when designing adaptation strategies.

Protecting Natural Infrastructure

Forests: Preserving and protecting the FSM's intact forests is a cost-effective means to increase long-term resiliency to climate change. Intact forests that maintain a diversity of trees have a significant role in mitigating the impacts of climate change while providing food security as part of traditional agroforestry systems. Without protections, the FSM's forests are threatened by destructive human activities associated with agricultural clearing, firewood collecting and logging. Good stewardship of the available land is necessary to maintain sustainable agricultural and agroforestry productivity, ensure economic growth, protect biological and cultural diversity, maintain the watersheds that provide clean water and meet the increasing food demands of the FSM's growing population.

All the FSM states face the problem of unsustainable harvesting of forest resources. Yap is experiencing the greatest exploitation of upland trees for lumber. Yap is already experiencing an unsustainable number of sawmills, and a foreign-owned sawmill has recently been set up in Kosrae. All states are requesting an assessment of the level of timber that could be sustainably supported (or the lack of such potential). Such information is urgently needed in Yap and Kosrae, and it is important that other states have information from such an assessment upfront, before timber extraction projects are proposed or just initiated. There is also a need to plant more trees to provide a sustainable supply of timber, tree crops and forest habitat, and to protect the best tree planters, namely fruit bats and birds (FSM Department of Forestry, 2010).

Mangroves: On the FSM's volcanic islands where the largest populations of people reside, coastal mangrove forests provide natural infrastructure and protection to local communities by preventing coastal erosion and absorbing the impacts of storm surges. Throughout the FSM, mangroves are essential to island ecosystems, providing habitat to many species the people of the FSM depend upon, including a wide variety of fish and shellfish. Mangrove forests also effectively sequester more than their share of atmospheric carbon, storing the carbon deep in the ocean mud floor. Mangroves' complex and dense root systems filter water, improving local water quality while helping to bind and build coastal soils.

Yet mangroves are under great threat throughout the FSM. Mangroves are often harvested for fuelwood and construction and they are impacted by changing ocean conditions. The unsustainable harvesting of mangroves for firewood is greatest in Kosrae and Chuuk. Most FSM states have developed, or are developing, mangrove management plans. Expert advice on coastal management of the nation's mangrove forests is urgently needed to guide these conservation activities in the FSM.

Coral Reefs: Restorative ecological actions that preserve and rehabilitate the FSM's coral reefs, beaches and ocean fronts while providing opportunities to enhance reseeding and repopulating aquatic species are cost-effective means to protect essential natural resources from environmental degradation. The people of the FSM have long depended on coral reefs for coastal protection as well as food as reef fish have long served as regularly available sources of protein. Establishment of Marine Protected Areas (MPAs) is an example of a strategy that has been and can continue to contribute to the sustainability of fish and shellfish populations, fostering greater biodiversity and ecosystem health while generating income through ecotourism and sustainable fishing. If managed appropriately it also provides means to protect from the over-exploitation of local resources from large export markets.

Supporting Sustainable, Local Food System Development

Supporting local food system production and development is an adaptive strategy that reduces several vulnerabilities now facing the people of the FSM including health, nutrition, economic and capacity-building vulnerabilities. The FSM's sustainable local food production efforts provide myriad climate change adaptation measures that are most cost effective. Implementation of community-based holistic food systems that build upon local and traditional agriculture, agroforestry and marine production support economic and cultural sustainability and climate change adaptation. The recognition and promotion of traditional farming, fishing and agroforestry systems that have sustainably supported subsistence livelihoods, community obligations, and food security over generations can improve household food security and economic resilience.

Supporting the FSM's farmers:

The majority of agricultural production in the FSM is for domestic and family consumption. Most of the land used for agriculture and agroforestry is freehold land or held with customary titles. Just over 90% of households recorded in the 2016 Federated States of Micronesia Integrated Agriculture Census had access to land they used for their specific agriculture needs.

In 2015, FSM's Second National Communication included Food System Technological options that are understood to support community adaption to climate change, specifically:

Introduction of salt-tolerant species to prepare for anticipated increase in soil salinity due to salt water intrusion from rising sea levels and increased storm surges. Salt-tolerant varieties of current harvested and cultivated crops (swamp taro, breadfruit and banana) could be sourced and/or new salt-tolerant crops should be made available to FSM farming families.

Crop research and introduction of heat tolerant crops to reduce local dependence on introduced European cool vegetables such as cabbages, tomatoes, potatoes, etc. With the expected temperature increases as part of climate change, there is a need to support the local production of heat-tolerant vegetable crops both for domestic consumption and for potential export. In addition, crop research is needed to assess the most productive, most nutrient dense, most climate resilience and most desired food crops for local consumption.

Improved pest and disease management to prepare for anticipated increase in pests and food crop diseases that threaten the local food systems and biodiversity. Such management plans should include development of climate and disease resilience local food crops and training in ecologically sensitive pest management strategies that do not introduce harmful toxins into FSM's vulnerable ecosystems.

Restoration of degraded lands to support local agriculture. Sea level rise will result in land degradation and thus there is a continued need to uphold land restoration policy to ensure lands are available for agricultural purposes.

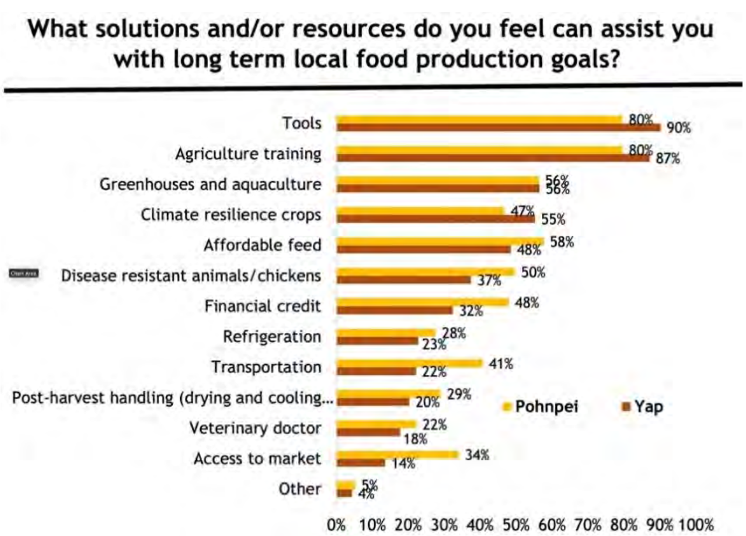
Farm relocation for coastal farmlands impacted by sea level rise. Climate change–induced sea level rise will result in flooding and inundation of some coastal farmlands and such affected farms should be relocated to locations still fit for farming.

Agricultural diversification plans have been suggested for vulnerable area including potential non-agricultural developments better fitted to the anticipated climate conditions in the vulnerable areas.

Promotion of traditional agroforestry as essential to support local food system development within FSM's limited land resources. Many of FSM's current farming system problems are related to unsustainable and foreign cultivation methods introduced to FSM. Promoting traditional agroforestry supports protection of local biodiversity and ecosystems when combined with sustainable harvest practices.

Results from the 2022–2023 Green Climate Fund Baseline Food Security Survey indicate that only 40% of the FSM's households have made adaptive adjustments to overcome or face climate change, largely by planting trees, changing crops types and varieties, implementing soil conservation techniques and other approaches; the other 60% have not made any changes. When asked why no adjustments were made, households report that they do not see a need to change because they do not know what will help, that there is a lack of information and guidance as to what to do, there is a lack of money/credit to finance any change, and there is a current labor and land limitation.

As an illustrative example, when comparing survey respondents from Yap and Pohnpei, the number one resource that farming families said they needed to adapt to climate changes is tools, as per 80% Pohnpeians and 90% Yapese responding. A close second adaptation need was agricultural training, according to 87% of Yapese and 80% of Pohnpeian farming families. Other significant and immediate needs according to farming families surveyed in Yap and Pohnpei in 2022 were greenhouse and aquaculture infrastructure, climate and disease resistant food crops and affordable feed for livestock and poultry followed by disease resistant animals including chickens**.**



Based on farmers' expressed need for tools, new low-cost climate smart green technologies such as greenhouses, solar dryers, cold storage, and sustainable aquaculture can be made available with associated training. Newly introduced appropriate technologies should be used to support local knowledge of best sustainable agricultural practices.

Cost-effective adaptation measures should be sensitive and consider those activities that are place-based, culturally relevant and resonate with the community for longer-term engagement and adoption. There are two broad approaches to such environmental preservation approaches: those activities that are led and maintained by communities on their land; and activities on lands/waters where the state and national government have a vested interest. Examples of the latter could include expansion of mangrove forests, ecological restoration of coral reefs, creating productive new habitats for shellfish, river cleanup from livestock and/or other contaminants and planting of perennial nitrogen-fixing trees, all of which can complement efforts at the individual and community levels.

Vulnerability Reduction through Environmental Conservation

Good stewardship of the available land is necessary to maintain agricultural productivity, ensure economic growth, protect biological and cultural diversity, maintain the watersheds that provide clean water and meet the increasing food demands of a growing population. Restorative ecological actions that preserve and rehabilitate the coral reefs, beaches and ocean fronts foster preservation and protection from environmental degradation while providing opportunities to enhance reseeding and repopulating aquatic species support local adaption to climate change. Establishment of Marine Protected Areas (MPAs) is an example of a strategy that has been and can continue to contribute to the sustainability of fish and shellfish populations, foster greater biodiversity and ecosystem health and generate income through ecotourism and sustainable fishing. If managed appropriately it also provides means to protect from the over-exploitation of local resources from large export markets.

Improved Forecasting for Disaster Preparedness and Prevention

Proactive approaches are required to develop resilient management strategies that protect and conserve marine and terrestrial habitats from the impacts of climate change. Forecasting seasonal shifts in habitats and species will inform adoption of management strategies to sustain farming, fishing and aquaculture operations as well as to identify suitable future food production opportunities. Over the long-term, rising sea levels will impact the island atolls and shoreline, however "living" shorelines have been demonstrated to have beneficial impacts to minimize shoreline erosion. Site surveys exist that provide good characterizations of local habitat and should be used to inform MPA establishment, management and sustainability, and the potential establishment of zones specifically delineated for aquaculture.

As the FSM's economy and environmental well-being is tied to the health of the nation's ocean ecosystem, ocean observation and ocean monitoring capacity building should be considered. The development of environmental monitoring strategies can be informed by global and regional forecasts. Working with the international community, improved forecast skills could be achieved by densifying the atmosphere and ocean observation to inform regional forecasts models. Beyond the climate forecast implications, these efforts have the potential for shorter term weather forecasting, storm surge modeling and potential flooding. These efforts could be facilitated by ensuring the FSM helps steer the development of western Pacific Global Ocean Observing System (https://www.goosocean.org/). These assets combined with international partnerships can be used to assist in the development of the FSM preparedness plans.

Reducing health and nutrition vulnerabilities through access to local, healthy foods

Nutritional security is provided through consumption diets that comprise safe, healthy foods rich in micronutrients. At present, almost half of all women and over one-third of all men in the FSM are classified as obese (WFP Regional Food Security Atlas of the Pacific), which has been associated with an increased risk for nutrition-related chronic diseases, such as type 2 diabetes, hypertension, cardiac disease, increased absenteeism, and early mortality (FAO 2021). The cluster of disease and consequences of consuming a highly processed diet extends to decreased economic opportunities, increased health care costs, and a stress on the economy that is unnecessary and preventable.

Increasing access to local, healthy foods is a cost-effective way to increase the health of the FSM population while supporting sustainable economic growth through the development of local agriculture. The 2022–2023 data from the

Green Climate Fund food security baseline survey for farming households showed high interest in consuming local foods in place of imported foods if made available. The majority of those surveyed in Yap and Pohnpei said they would prefer to consume locally produced vegetables, fruits, meats and fish. The survey also revealed an interest in substituting specific imported foods now consumed with locally produced replacements. More than 70% of those surveyed in Pohnpei and Yap indicated interest in replacing imported rice with local, nutrient-rich starch crops such as taro and breadfruit. A majority of respondents in Yap and Pohnpei also expressed interest in replacing cow's milk with locally produced coconut milk if made affordable and available:

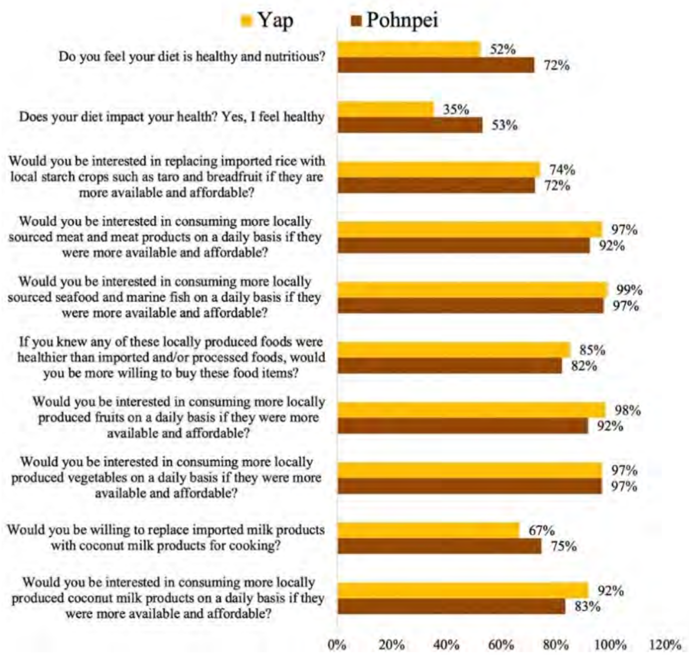


Figure 28. Respondents' perception of their diet, health and food preferences relative to local and imported foods from 2022–23 preliminary data from Green Climate Fund food security for farming families baseline survey.

Price policies can also support consumption of local, healthy foods. The people of FSM have become dependent on imported, highly processed unhealthy foods that are directly related to high incidents of heart disease, diabetes, obesity and other food-related diseases, including a variety of cancers. At the same time, the people of FSM are spending an increasingly significant portion of their salary on food. The FSM National Government controls taxation of imported foods into the country. The 2014 FAO funded Policy Measures to Increase Local Food Supply in the Federated States of Micronesia argues for a tax reform program to disincentivize the purchase of unhealthy imported food and increase purchase of locally produced, healthy foods. Price policy mechanisms can be used to ensure remunerative prices to growers for their produce in order to encourage higher investment in local production while making local food available at affordable prices.

Establishing an Inventory of Local Famine and Emergency foods

Historically, local farmers in the FSM have relied on a wide array of "emergency" or "famine foods" that are resistant to climate disasters such as hurricanes, droughts or plant pathogens. A survey carried out in the 2000s (Balick 2009) listed a handful of the potentially edible famine/emergency foods, and further investigation into this area is warranted. Ethnobotanical surveys include interviewing knowledgeable people about native or introduced species that can be eaten in times of famine, if and when conventional crops and imports are not sufficient to feed the community. The intention would be to identify species widely found in the FSM that can supplement caloric needs, rather than taking over for the more conventional foods. One species that can be used as a caloric supplement is *Tacca leontopetaloides*, which is not widely cultivated, but is easy to grow. Species such as *Adenanthera pavonina* (edible seeds and leaves when processed correctly), *Bambusa vulgaris* (young shoots are eaten), *Asplenium nidus* (young dark green leaves containing high levels of provitamin A, lutein and zeaxanthin) and *Cordia subcordata* (ripe fruits are edible) are just a few of the many species that could help supplement caloric and/or nutritional needs. This information would then be made widely available to the community.

Improved Pest management

Climate change is altering the movement and prevalence of many insects, arthropods and microbes, pests that impact humans, animals, marine organisms and plants. Since temperature is the most important environmental factor affecting insect population dynamics (Schneider et al. 2022), global climate warming could trigger an expansion of their geographic range, increased overwintering survival, increased number of generations, increased risk of invasive insect species and insect-transmitted plant diseases, as well as changes in their interaction with host plants and natural enemies (Skendzic et al. 2021) and alterations to forest insect dynamics (Liebhold and Bentz, 2011). Some of these insect and pests also carry infectious and noninfectious diseases that can be transmitted to humans and agricultural and marine food species, and others can result in significant crop and forest loss. In combatting this, scientists are using strategies that mitigate such risk. These include improving the plants genetic resistance to biotic (fungal, bacterial, insect) and/or abiotic stress (e.g., salt water, drought/heat) to developing an integrated pest management approach that combines using the best germplasm with environmentally sustainable management to provide a guide on ways forward.

Improved pest and disease management is essential to prepare for anticipated increase in pests and food crop diseases that are now or can threaten the local food systems and biodiversity. Such management plans should include development of climate and disease resilient local food crops, training in ecologically sensitive pest management strategies that do not introduce harmful toxins into FSM's vulnerable ecosystems, and the elimination of invasive species. The introduction of legally approved pesticides and herbicides need to be approached with caution as the short-term benefit for their particular application(s) needs to be balanced with certainty that the users (applicators) are duly trained, and the processes associated with their use including safe and clean area for calibrating the spray equipment, cleaning the spray equipment, the proper storage, disposal of such toxic products can be handled safely, and the assurance the chemicals do not end up in the water supply and/or into the community households. Ongoing training programs relative to handling and safety, available options are needed at the community and state level. Monitoring insects and pests locally and sharing the information widely would be beneficial to communities, allowing them the opportunity to respond proactively.

Protecting Biodiversity through Climate-Smart Agriculture and Agroforestry

The FSM's traditional agriculture systems are based on biotic diversity and the practice of polyculture (e.g., such as agroforestry) rather than larger-scale monoculture. Properly managed, these home garden / agroforestry systems can be highly productive while also contributing important environmental services such as soil stabilization, carbon sequestration, clean water and air. Traditional agriculture and agroforestry land-use systems integrate agriculture with tree forest harvesting and livestock within the same land for environmental, economic and social benefits. The FSM agroforestry systems evolved over hundreds of years under different physical, cultural and socio-economic conditions.

Current climate-smart, climate-resilient agroforestry efforts build upon traditional practices while exploring and integrated new approaches and training for Soil Management; Water Management; Crop Management; Tree & shrub Management; Livestock Management; Climate Change and Disaster Management; Tools and Equipment; Agroforestry

Communities; Agroforestry for Enhancing Biodiversity; Agroforestry for Economic Development; and Agroforestry Research.

Climate-smart conservation agriculture approaches, designed to helps farmers to maintain and boost yields and increase profits while reversing land degradation protecting the environment in the midst of climate change, are based on the interrelated principles of (1) minimal mechanical soil disturbance, (2) permanent plant-based soil cover, (3) crop diversification through rotation or intercropping (Tuivavalagi, 2022).

Case Study 1. Vulnerability assessment: example from the outer islands of Yap[257]

In 2017, the Government of the FSM financed the project "*Building Resilience to Disaster and Climate Risks,"* implemented by DECEM in consultation with the Disaster Coordinating Officers for the States of Yap, Chuuk, Pohnpei and Kosrae. The project was initiated with a pilot conducted in Yap State and involved 1,958 men and 1,520 women across 625 households located in 16 outlying islands. The goal was to strengthen the capacity of the most vulnerable communities that are located in the outlying atoll islands of the FSM to address existing and emerging challenges with regard to the risks posed by natural hazards, climate change and related disasters. Remote communities in the FSM's outlying islands are the most affected from natural disasters and the project assessed their current resilience practices and needs, as well as strengthen the capacity of these communities to address existing and emerging challenges regarding the risks posed by natural hazards, climate change and related disasters. The assessment focused on agriculture assets, public infrastructures (i.e., health facilities, schools), individual water catchments and early warning communication systems available for the islands. The team utilized the Initial Damage Assessment Forms (IDA) potential disaster points on the islands. The IDA form was fully implemented in 16 out of the 19 outer islands of Yap. In addition to implementing the form, the team was able to identify all the disaster focal points on each island. At all sites, schools and dispensaries were key infrastructures and were then designated shelters for typhoons and other natural catastrophic disasters. The assessment highlighted the need to improve the early warning communication systems for 11 of the assessed islands.

Chapter 7
Gender

Photo credit: Nick Hall, The Nature Conservancy

Empowered lives.
Resilient nations.

7.1 Introduction

The Federated States of Micronesia (FSM) comprises over 600 islands, spread across an area of 702 km^2 or one million square ocean miles. The island nation's remoteness kept it isolated and allowed its environmental systems to produce unique endemic species and fabricated distinctive cultures and traditions that thrived on these unique biodiverse systems. As globalization takes root, social and economic changes are redefining the role of the traditional extended family and of the household, particularly those of women.

The FSM's remoteness, wide geographic dispersal and limited amount of land, make the country extremely vulnerable to climate hazards. The FSM increasingly face severe climate impacts including sea-level rise, changing temperature and rainfall patterns. Degradation of islands ecosystems through pollution, overfishing, and unsustainable development is exacerbating country's vulnerability to climate hazards. Extensive studies have now made it clear that these impacts affect men and women differently, which highlights the substantial need for gender responsive plans that identify the most vulnerable members of the communities and integrate differential gender needs into plans for climate change resilience.

Communities responses to climate change are being scaled up through policies that reinforce the critical role that nature plays in climate adaptation. A global collective response has shown governments taking action through legislative and regulatory initiatives to curtail destructive habits. Additionally, communities who are at the frontlines are proactively taking measures to assure their resilient capacity by adopting natural resource management plans and employing ecosystem-based adaptation measures. Often*,* women are leading these climate change adaptation efforts, particularly those that focus on food and water security. These efforts contribute to local development priorities and create co-benefits for multiple sustainable development goals (SDGs).

The FSM is acutely aware that food production, food and water security, and the integrity of culture, are all reliant on maintaining healthy, stable and resilient natural systems. As such, the FSM has already taking measures to ensure it is meeting its obligations to its people while also meeting its global commitments under the United Nations Framework Convention on Climate Change (UNFCCC).

The UNFCCC has taken several steps to ensure women's equal participation in the UNFCCC process (see Table 3), gender responsiveness of climate change policies and gender integration in the implementation of the UNFCCC, including in the countries National Adaptation Plans (NAPs), National Communications (NCs), Biennial Update Reports (BURs) and NDCs. In 2014, The Lima Work Programme (COP 20) called for the development of a Gender Action Plan (GAP) that was adopted three years later at COP 23 (2017). This first GAP defined five (5) priority areas which are deemed to be critical for the achievement of gender responsiveness and integration: (1) Capacity building, knowledge sharing and communication; (2) Gender balance, participation and women's leadership; (3) Coherence consistent implementation of gender-related mandates and activities; (4) Gender-responsive implementation and means of implementation; and (5) Monitoring and reporting. As a consequence of the Lima Work Programme, gender became an integral part of the 2015 Paris Agreement (PA), which mandates gender responsive adaptation actions and capacity building activities: "Parties (including the FSM) acknowledge that adaptation action should be guided by respect for human rights, gender equality and the empowerment of women and follow a country-driven, gender-responsive, participatory and fully transparent approach … with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions." Through the PA, gender equality was formally recognized as a pillar of climate change policies (Maarawi 2019).

Demographics

As stated in earlier chapters, the FSM population structure and distribution has not changed significantly in the years between 2010 and 2016, with the ratio between men and women remaining similar (Fig. 1). The FSM is characterized by a young population, with the majority of the population below 29 years old (Fig. 1).

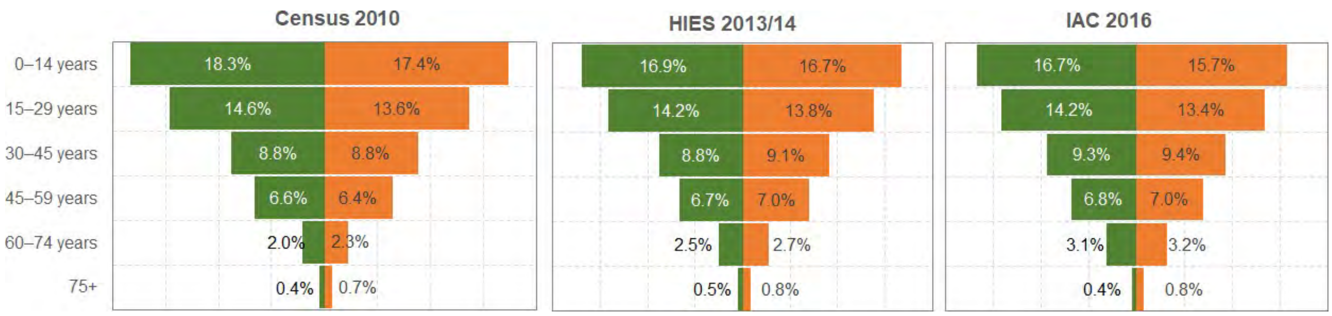


Figure 1. Changes in male (blue) and female (green) FSM population structure between 2010 and 2016. (Census 2010; HIES 2013/14; IAC 2016).

At state level, Chuuk remains the state with the largest population (n = 48,703), followed by Pohnpei (n = 36,948), while Yap (n = 11,995) and Kosrae (n = 5,748) have considerably lower populations (HIES 2013/14). Between 2007 and 2014, the population of the FSM has decreased by 1.8% due to out-migration to Guam, Hawaii and mainland USA (SPC 2019). The Household Income and Expenditure Survey (HIES) 2013/14 indicated that in each state, the difference in numbers between male and female is negligible (Fig. 2). Across the FSM male-headed households are the majority (80%), although Yap has the highest proportion of female-headed households, 26% (Fig. 3; Integrated Agriculture Census 2016).

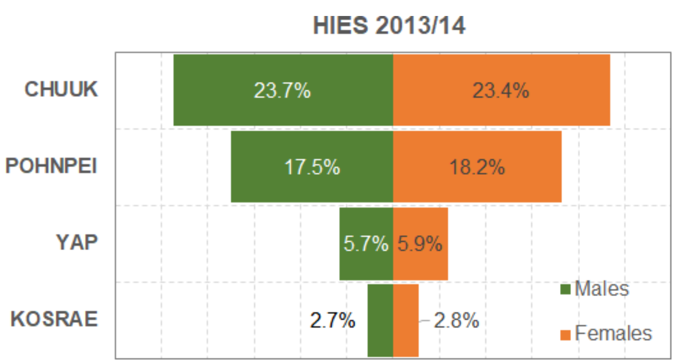


Figure 2. Male/Female distribution in the FSM states, computed based on total population (n = 103,384) recorded from the HIES 2013/14.

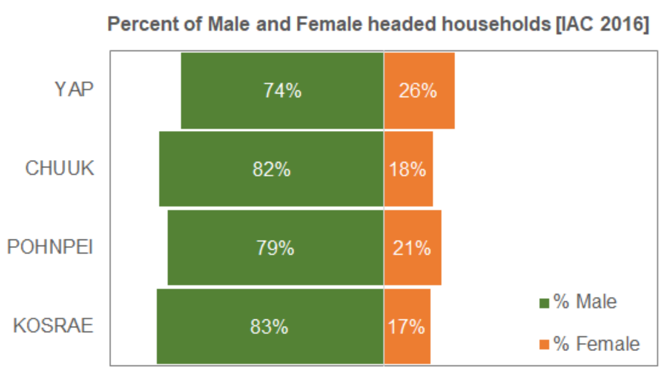


Figure 3. Proportion of male and female headed households in the FSM by state (IAC 2016).

Households headed by males earn on average 9% more than female-headed households and 11% more based on cash income. However, on average they also tend to spend 12% more than female headed households, which save 9% more than male headed households (HIES 2013/14). The income imbalance between male and female householders is highest in Chuuk, where households headed by males earned 42% more than female headed households. Chuuk is also the state with fewest female householders (16.7% out of the total state households), compared to Yap where female householders are more than a quarter (HIES 2013/14).

Poverty Incidence

Poverty incidence in the nation is considerably high (41%) and a similar trend is observed across the four States with higher poverty incidence in female headed households (51%) than in male headed households (39%). Poverty and hardship reflect on children growing in these households, indicating that children living in female headed households are more likely to grow up in a poor household. About one-fifth of the FSM population lives in female-headed households, which, with the exception of Yap, tend to be both larger and have more children (FSM and World Bank, 2017). In the country, the proportion of households that earn less than US$ 5,000 annual is the same for both male and female household heads (HIES 2013/14), but female headed households tend to be less represented among those households that earn more than US$ 30,000 (6.7% females vs 10.2% males). Approximately 40% of all households in FSM receive remittances from family members abroad; with households in Kosrae receiving the most (SPC 2019). In 2013, 46% of female headed households received remittances against the 40% of male headed households (HIES 2013/14). It is important to note that poor households are more vulnerable to climate change impacts, due to their limited ability to recover after a disaster, which in the long term is likely to increase their reliance on external assistance. Understanding the gender dynamics at household level is central to increasing the resilience of those who are the most vulnerable to climate change impacts.

Education

Education is central to accelerate climate change adaptation and mitigation. It plays an important role in empowering, informing and motivating the social changes that are required for integrating traditional knowledge and innovative techniques into climate change adaptation. Therefore, increasing educational opportunities for youth and women can help them to better prepare for the effects of climate change.

It is important to recognize that in Pacific islands, including the FSM, traditional embedded knowledge has shown to be essential for communities' sustainable use of resources and, to a large extent, also to climate change adaptation. However, the rapid changes in climate and environment are unveiling the limitations of implementing only traditional techniques. This evidence highlights the need for a combination of both traditional and scientific knowledge of climate change impacts and natural climate patterns such as El Niño and La Niña (Mc Leod 2018). In the face of these realities, education on climate change and natural climate patterns, can empower women, who have shown to be powerful agents of change in 'adapting' traditional techniques and embrace innovation (Mc Leod 2018). Additional benefits reside in the role that women play in transferring knowledge to their children from early ages.

In the FSM, on average 73% of the entire population has graduated from elementary school, and 36% have graduated from high school with larger gaps between males and females observed in Yap and Kosrae (Fig. 4, Census 2010).

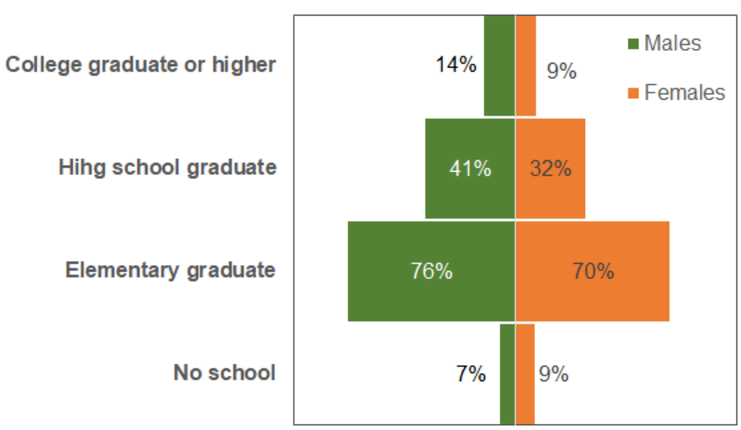


Figure 4. Proportion of male and females that attained school degrees in the FSM and by state (Census 2010).

In the FSM, on average, men have slightly higher levels of education than women. At the post-secondary level 12.6% of men vs. 9% of women have graduated from tertiary/vocational institutions (HIES 2013/14), although at the college level there are considerable differences between the most populated state of Chuuk (8.8% of males) and the other states (Fig. 5, Census 2010).

In general, a larger number of females completed elementary school, but the percent of females attaining a high school or college degree decreases considerably (Fig. 5). In addition, the percent of females with no education is higher than that of males, with the exception of Pohnpei (Fig. 5).

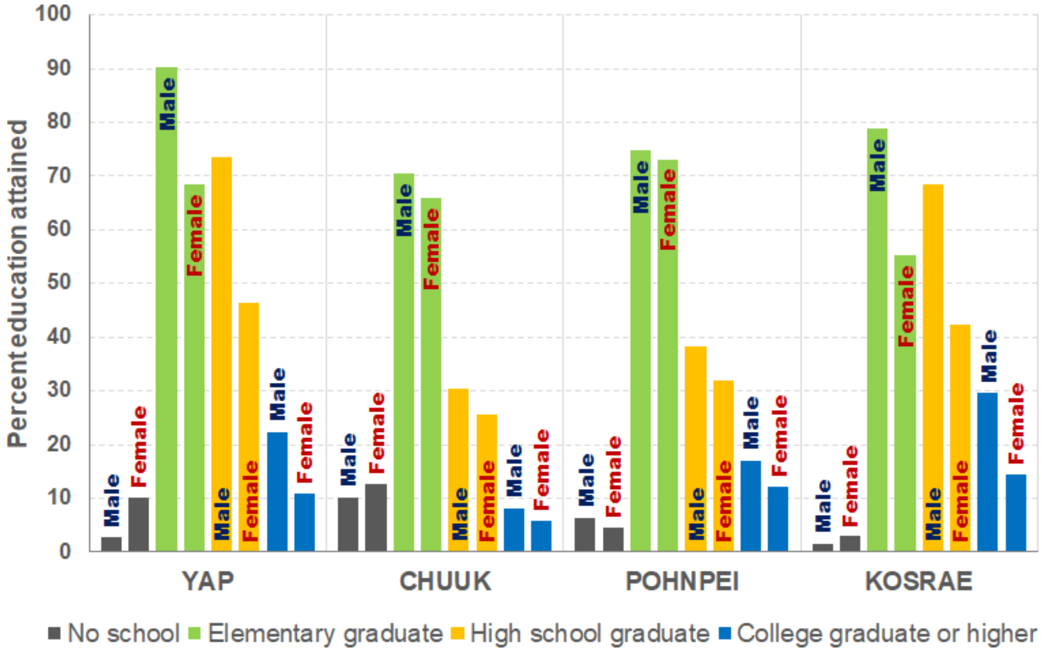


Figure 5. Proportion of school attainment for females and males in the four FSM states (Census 2010).

Recent data on education are available from the Integrated Agriculture Census (IAC 2016), but this report only includes population of people 15 years and older, specifically, within households that have land used for agriculture purposes. Although this data is not representative of the entire country's population, it still provides a good proxy of male and female participation in education within the country. Students represent 11% of the population aged 15 and older in households with land used for agriculture (IAC 2016). At state level, the number of males and females that completed education show minor variations. However, estimates from IAC 2016 indicate that after high school, the population living in households with land used for agriculture tends to be less involved in higher education (Fig. 6). In particular, for both male and female students, there is a substantial decrease in the number of those who have completed bachelor's degrees and other higher degrees (e.g., Masters and PhD), although there are no substantial differences between gender and among states (Fig. 6).

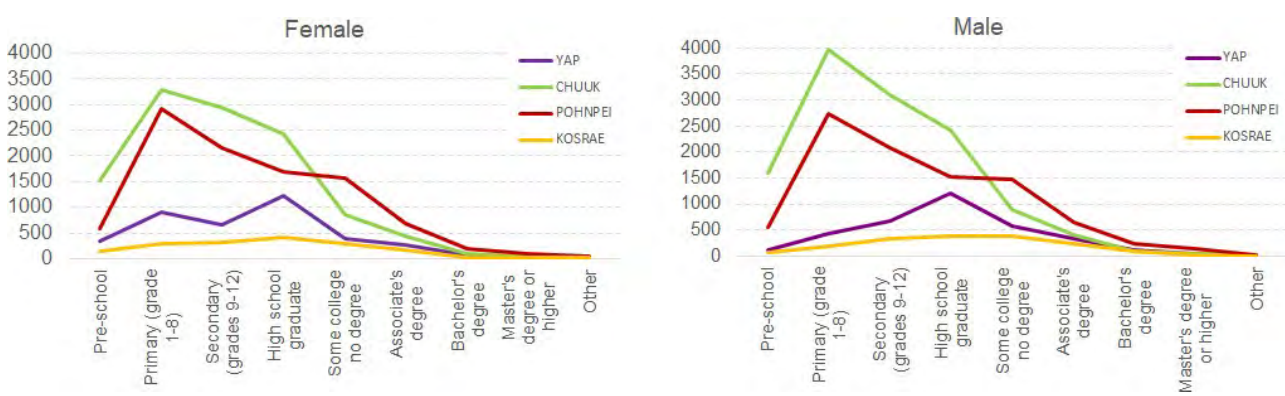


Figure 6. Population of 15 years and over by highest grade of education and sex. This data reflect only population that has land for agriculture (IAC 2016).

Key messages

> Across the FSM, male headed households are the majority, and with higher income than female headed households.

> Poverty incidence is higher for women headed households where children are more likely to be disadvantaged in accessing higher education. Collection of data on the gender dynamics at household level, including data disaggregated by age and location, can help have a better understanding of those most vulnerable to climate change.

> On average, in the FSM, men have slightly higher levels of education than women. The proportion of women accessing education tend to decrease for higher education (i.e., high school and college degrees).

Employment and income

Based on the FSM's Census (2010) 48% of the population of 15 years of age and older was engaged in formal jobs (employed full-time or part-time), while 25% was involved in subsistence activities and 9% was unemployed (Fig. 7).

Participation in the market economy has distorted the strict demarcation of gender roles associated with subsistence production. Across the FSM, 41% of females 15 years of age and older participate in the labor force compared to 59% of males (Census 2010). Among the employed workers men were the most represented gender in Chuuk, Pohnpei and Kosrae, while in Yap women were the most represented with 51% of women engaged in part-time or full-time jobs (Fig. 7). Men were also the highest proportion of the unemployed population across the four states, although in Pohnpei the proportion of unemployed population was the same for men and women (50%, Fig. 7). The proportion of male wage and salary earners (67%) was more than double that of females (33%; Braun 2012). In addition, 68% of the men that are head of a household are part of the labor force (HIES 2013/14), supporting the findings that fewer women than men participate in the labor market. Therefore, fewer women than men receive income from salaried jobs.

Regarding the source of income, in 2007 men employed in the private sector were 62% vs. 38% of women, a similar trend was observed for the public sector with 71% of men employed vs 29% of women (Braun 2012). Statistics on labor force participation rate, for both men and women, tend to include subsistence work, artificially inflating participation rates especially for women. Data from the IAC (2016) revealed that of the total workers employed (n = 33,354) in paid (41%) and unpaid jobs (59%), males make up the majority (paid: 25% and unpaid: 33%). When data are considered for a specific gender, of the total female employed (n = 13,866; IAC 2016), a large number is in unpaid jobs (67%), while this proportion decrease to 57% for the total number of males employed (n = 19,488; IAC 2016). Generally, women are less likely to receive income from unpaid jobs. For example, only 23% of women living in households with land for agriculture are receiving income from agriculture, compared with 77% of men in the same condition (IAC 2016). Similarly, in the fisheries sector most of the paid labor force is male (HIES 2013/2014).

Photo Credit: College of Micronesia

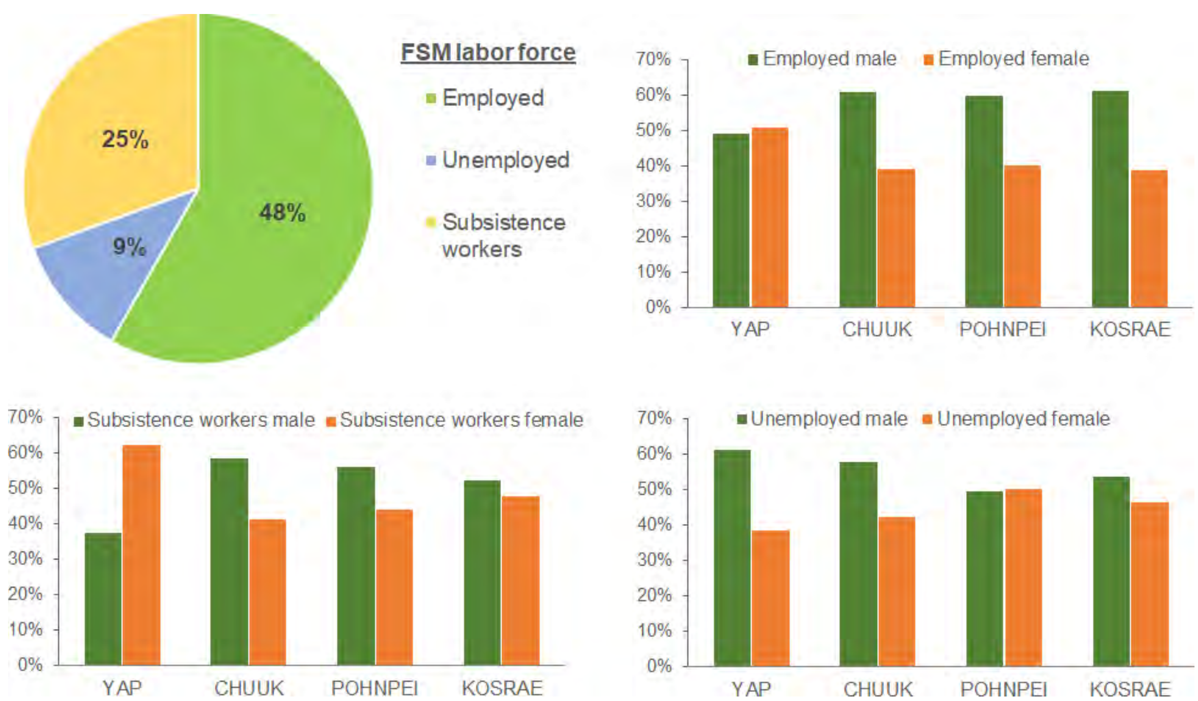


Figure 7. Labor force distribution (population of 15 years and over) for the FSM. Proportion of female and male population (15 years and over) that were employed full-time or part-time in a formal job (with or without pay) by State. Proportion of

female and male population (15 years and over) that were unemployed, representing the proportion of the labor force who were not employed or engaged at a formal job or subsistence activities. Proportion of female and male population (15 years and over) engaged in subsistence activities mainly for own consumption, and sometimes for selling. (Census 2010).

> Women's economic empowerment is impacted also by factors that particularly affect Micronesia islands, including:
>
> i) Climate change, which has a significant effect on subsistence activities (i.e. agriculture and fishing).
> ii) The effects of globalization on economies that are small and highly dependent on imports, which are more sensitive to the volatility of fuel and food prices.
> iii) Increased out-migration, which increases women's burden of unpaid work and changes the make-up of households, villages and communities.
> iv) Some social norms that may exacerbate women exclusion from decision-making and governance mechanisms, relegating them to specific roles and activities.
>
> (SPC 2017)

Men also still hold higher status jobs in the government, while women are concentrated at the lower levels of the employment hierarchy with consequently lower pay (Braun 2012). Generally, women that are economically active (in part-time or full-time salaried jobs) experience an unequal burden of work, with continuing responsibilities at home, with their families and also their communities. The persistent lower engagement and salary of women in the FSM's labor force, and low representation among the subsistence workers, indicates that the different statistics fail to take into account the burden of unpaid work to which women are subjected. Social and economic norms pose women as principally responsible for unpaid care work (for children, elders and the disabled) and domestic work, including cooking, cleaning and collecting water and biomass fuel. The combination of work in low-income jobs, family responsibilities and customary responsibilities can further delay women's economic empowerment. Indeed, women's additional workload, associated with unpaid care and domestic work, may become a disadvantage that promotes inequalities when it comes to women's participation in the formal economy, planning and decision-making. However, data indicates that the civil society arena is where many women are able to affect positive change and to support government sectors across society (FSM Department of Resources and Development 2020). Importantly, in the civil society arena, women are considered equal to men and on average earn more, earning US$ 9,078 versus the US$ 7,200 of their male counterparts (FSM Department of Resources and Development 2020).

Highlights

- Although women's participation in the market economy has changed traditional gender roles associated with subsistence production, fewer women than men participate in the labor force, and generally tend to receive lower income from salaried jobs.
- Both in the public and private sector, women are less represented than men and they are generally found at the lower levels of the employment hierarchy.
- The burden of work between women and men can be unequal. Particularly, unpaid caretaking work (e.g., women are responsible to taking care of children, elders and disabled), family and customary responsibilities can limit women's ability to participate in the formal economy.
- The burden from unpaid work can be exacerbated by climate change, and its effect on islands economy. For instance, climate change has been associated with out-migration, which affects social settings by changing the make-up of households, villages and communities, with direct implications on women's workload.

7.2 Subsistence Economy and Access to Resources

Modification in Gender Roles Due to the Shift from Subsistence to Monetized Economy

In the FSM, gender is generally the organizing principle in the division of labor among those who participate in subsistence economy. Particularly in rural areas, the traditional division of labor remains relatively unchanged today. Women are primarily responsible for domestic chores such as cooking, laundry, and collecting water and biomass fuel (i.e. wood). They are the primary child-care providers and are also responsible to harvest subsistence produce, tend livestock, glean shellfish and fish inshore. Men engage in the heavy labor associated with subsistence agroforestry, conduct fishing activities beyond the reef and work as carpenters and builders. This complementarity in labor roles represents a traditional safety net that has supported communities in times of hardship (e.g. after disasters).

Although traditional roles still persist in present-day, the traditional pattern of matrilineal land tenure on the main islands (with the exception of Yap Proper that have a traditional patrilineal system) has been impacted by colonial rule, which initiated a slow, but persistent evolution of the islands' social systems. Throughout the twentieth century, changes in the economic landscape, with an important shift from a subsistence to a monetized economy, have contributed in diminishing women's traditional economic roles (FSM Department of Health and Social Affairs 2014). For instance, the increased utilization of imported food has replaced food crops altering traditional social roles and increasing dependence on modern currency. The shift from subsistence to a monetized economy has resulted in fewer women than men involved in the formal economy with a consequent devaluation of women's contribution to the social setting. Most importantly, these socio-economic changes were not accompanied by any significant improvement in access to higher education, well-paid jobs, or other economic activities for women. As a result of these modifications in the socio-economic system, women and men are still struggling to establish a new form of complementarity.

Gender Roles and Access to Resources

Although in the FSM gender roles are shaped by cultural norms and practices, these can greatly differ across the four states. Even further, there can be substantial differences in gender roles among the states and within the states and their outer islands population (Table 1).

For instance, in Yap Proper, women are very involved in agroforestry; they tend taro patches leading all aspects of operation and maintenance while fishing is considered a man's activity, and has traditionally been surrounded by obligations and beliefs; men are also responsible for heavy work, boat making, and betelnut and coconut harvesting.

In modern Kosrae, women are still responsible for the household chores, but more women are becoming engaged in agricultural activities by cultivating home gardens that produce vegetables for their families and offer an alternative income. Agroforestry, fishing the outer reef with boats and spearfishing all remain solely male activities. Men are also responsible to pound and prepare customary food.

The FSM's islands have seen a recent shift in segregation of roles, and women's associations are taking on projects that are sensitive to, or starting to challenge, gender norms. For example, The Nature Conservancy (TNC) is financing a local NGO, the Women in Farming in Kosrae, to build portable dry-litter piggeries, which would then be used for the production of compost utilized by women and men to improve the soil quality of their home-gardens. The project aims to support better agriculture yield and enhance the provision of alternative income, while mitigating the impact of pig effluents to the environment.

In Pohnpei, agroforestry and fishing are considered a man's duty, which also includes the preparation and preservation of breadfruit. However, now women of the family also participate in gardening and food preservation. For instance, Island Food (NGO) launched a program for processing breadfruit into flour that is designed to build the capacity of both women and men of the family while remaining respectful of the complementarity of their roles.[226] Fishing is considered a male and female activity, however, men are responsible for fishing on the outer reef and spearfishing, while women focus on reef gleaning nearshore and tend to dedicate less time than men in this activity (IASI 2018). In Pohnpei, women are still considered responsible for household chores and caring for children, while growing ceremonial yams and sakau (kava) still remain men's domain, as it is associated with their prestige in society. In the outer islands of Pohnpei, agriculture was almost entirely women's work, while men were responsible for fishing outside the reef.

In Chuuk, women were traditionally responsible for housekeeping chores, caring for the children, cooking, weaving and sewing, and this is still unchanged today. Women are also responsible for gleaning on the inshore reef flats and selling firewood at the market. Men are responsible for the heavier work, including house construction, boat-making and fishing offshore, tend to agroforestry activities and also pick, pound and prepare breadfruit and taro (Oneisom 1994). Interestingly, in Chuuk, some traditional fishing activities were conducted by both men and women. For instance, spiny lobsters are speared or caught by hand by both men and women at night, during the full moon at low tide (Lambeth and Santiago 2001). Similarly, trochus may be collected by both men and women. Though, octopus are harvested by both men and women, there is variation in the location of collection. Men catch octopus when spearfishing in deep seawaters, while women and children catch octopus on the reef flat (Lambeth and Santiago 2001).

Photo Credit: Monica Jain for National Geographic.

[226] This type of projects falls in the spectrum of the gender sensitive projects, which are designed to mainstream existing gender dynamics and roles (labor roles and norms) in pursuit of the project goal.

Table 1. Role of women and men in using natural resources for household subsistence and income by state.

State	Activity	Male Roles	Female Roles
Yap	*Agriculture*	Generally responsible for gathering betelnut and coconuts. They assist women in heavy labour work in gardening (clearing of areas, cutting down trees, planting of trees)	Lead the process for planting agroforestry and agriculture, because traditionally they have this knowledge.
	Fishing	Fishing is seen as a male activity, surrounded by rituals and obligations.	Fishing activity for women in the main islands of Yap is very specific. Except for their occasional participation in community fishing, women and children's role are restricted to less prestigious fishing activities, which traditionally are not seen as 'fishing' (e.g., reef gleaning, clamming). They are also involved in in some food processing and marketing (Lambeth 2001). As in other states, women are primarily tasked with invertebrate fisheries, although in some areas, women participate in finfish fisheries (IASI 2018).
	Handicraft	Some men from Yap Proper and outer islands of Yap creates wooden artifacts which are valued and requested by locals and tourists.	Women from the Yap Proper and outer islands, are well known for their handicrafts which they sell to locals and tourists on Yap Proper.
Chuuk	*Agriculture*	Tend agroforestry, as well as preparing breadfruit and taro.	Nowadays women are working their home gardens, for accessing healthier food for the household and livelihood.
	Fishing	Responsible for catching fish in the deep slope areas around the islands, on sea mounts and outer banks. They are those conducting spearfishing (inshore fishing) and trolling and any of those activities that are considered more dangerous. They are responsible also to caught octopus and lobsters when diving in deep waters.	In Chuuk lagoon a significant part of the inshore fishing is done by women. Women are responsible for reef gleaning, harvesting octopus, lobsters and clam fish from the reef flat and inshore reef. They harvest and process the sea cucumber for subsistence use and some local sale. Women are responsible for the primary (e.g. gutting, scaling) and secondary processing of fish and seafood products for home use and sale in the markets.
State	**Activity**	**Male Roles**	**Female Roles**
Pohnpei	*Agriculture*	Agroforestry is primarily a men responsibility. As a result, men are generally more involved in training and capacity building for this sector.	Nowadays women are working their home gardens, for accessing healthier food for the household and livelihood.
	Fishing	Fishing is often seen as a male activity. Men are responsible for offshore fishing (e.g. tuna) and outer reef fishing as well as dive and spearfishing.	Women are responsible for collecting invertebrates and the preparation and sale of fish, shellfish and other seafood products. For example, the internal organs of the sea cucumber are collected and processed by women. The intestines are believed to be particularly good for pregnant women and new mothers.
	Handicraft	Men from Kapingamarangi creates wooden artifacts which are highly valued and requested by locals and tourists.	Pohnpei's skirts are highly requested and sewing skirts can be an important source of income for many households. Women from the outer island of Kapingamarangi, residing in Pohnpei, are well known for their handicrafts which they sell to locals and tourists.
Kosrae	*Agriculture*	Agroforest is the sole responsibility of men, which transfer their knowledge to the male children in the family.	Nowadays women are working their home gardens, for accessing healthier food for the household and for alternative income. Since home gardening is a new

State	Activity	Male Roles	Female Roles
			mean for incomes, they are experimenting new techniques for improving their productivity.
	Fishing	"Men traditionally fish outside of the reef for pelagic finfish species utilizing trolling and, in some case, drop stoning on the outer reef slope, the also target finfish and invertebrates (e.g., clams, gastropods) using a wide range of fishing techniques and gear (e.g., hand lining, rod and reel, spearfishing, hand collection). In more recent times men are increasingly becoming involved in inshore fishing activities targeting finfish and commercial invertebrates (e.g., sea cucumbers), again utilizing a wide range of fishing gear and techniques (e.g. gills net fishing on reefs)." (Source: IASI 2018)	"Women fish in the inshore reef waters, between the outer reef and the shoreline including rivers and mangrove areas utilizing a wide range of fishing techniques and fishing gear (e.g., reef gleaning, handling/rod and reel, gill and cast nests) targeting a wide range of finfish and vertebrates. A specific women's fishery is associated with the collection of sea cucumber (*Stichopus naso*) for the consumption of their intestines" (Source: IASI 2018)

Subsistence economies in the FSM involve men and women in different ways. In the country, a larger proportion of males earn income from subsistence activity (55%) than women (45%). Indeed, the produce from women's subsistence activities are generally used within their households or shared with other members of the family.

Gender Use and Access to Agriculture and Forestry

In the FSM, 63% of households conduct some form of agriculture (e.g., agroforestry, home gardens), with 40% of households conducting agricultural activities for subsistence (HIES 2013/14). The proportion of the population engaged in subsistence agriculture is as high as 89%, with subsistence production varying greatly among the states (Table 2).

State	Households engaged in agriculture	Households engaged in agriculture for income	Households engaged in agriculture for subsistence
Yap	90%	28%	62%
Chuuk	69%	36%	33%
Pohnpei	50%	12%	38%
Kosrae	59%	20%	39%

Table 2. Proportion of the FSM's households engaging in agriculture for income and subsistence (HIES 2013/14).

In the state of Pohnpei, sakau (kava), and in the state of Yap, betelnut, are important crops for sale, consumption and cultural exchange. In 2013, in Pohnpei, sakau represented 57% of the income from sales of agricultural produced. In Yap, betelnut represented 84% of all crop sales (HIES 2013/14), and 81% of households that have land for agriculture reported growing them (IAC 2016). Both sakau and betelnut are used in ceremonial settings and they are considered extremely important for customary obligations. The identity and culture of the population of these two states are profoundly woven with these crops, increasing their value for the people (cultural value). Traditionally, both crops are men's domain as they are responsible for their production and collection, and in the case of sakau, its preparation.

Climate change has been of great concern for island agriculture, and the economic loss associated with climate change drought and disasters (storms, typhoons), have impacted several households over the years. For instance, there were severe impacts on betelnut production from the 2015/16 El Niño-related drought, which produced a spike of price for this product. Similarly, typhoon Maysak in 2015 and typhoon Wutip in 2019 had significant impacts on the agricultural production of the islands that experienced these storms, reducing access to subsistence assets (food and potable water).

In the 2016 Integrated Agriculture Census (IAC 2016), in Chuuk, Pohnpei and Kosrae the proportion of men engaged in crop production was considerably higher than that of women, reflecting the traditional role that men play in island agroforestry and the differential access and management of land and agricultural resources. A different trend was observed for Yap proper with 62% of women engaged in crop production vs. 38% of men (Fig. 8). This considerable high number of women in agriculture reflects Yap's traditional labor roles, characterized by a demarcated division of labor between women (land: agriculture) and men (sea: fishing). The IAC (2016) reported that among the men and women in households with land used with agriculture, most of the income was received by men (81%).

A large proportion of men engaged in agriculture are aged between 15 and 54 years old, and women between 25 and 54 years old are more engaged in crop production (Fig. 8). The reported greater proportion of men involved in crop production translates to a larger involvement of men in technical capacity building and in Farmer Associations, although across the states there are active women associations that promote capacity building for their female associates on crop production and vegetable gardens. In the government, at state level, the head of the divisions of agriculture in all 4 states are male, and so are the majority of their staff.

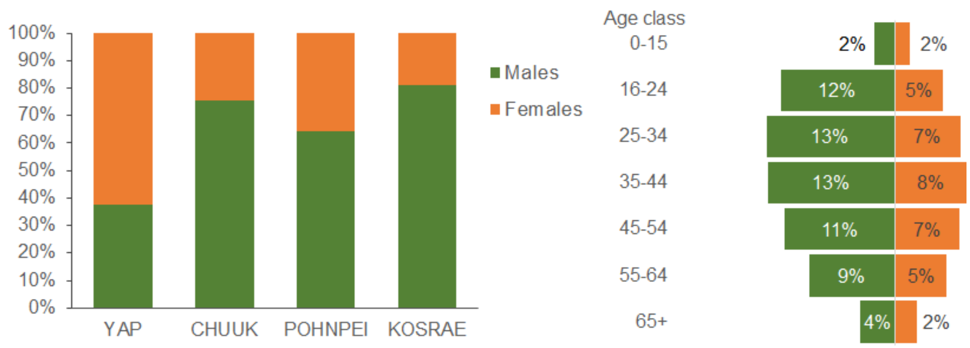


Figure 8. Proportion of male and female population engaged in crop production activities by state and age (data source: IAC 2016).

In the FSM, management of soil and enhancement of soil fertility is key for food security of high volcanic and low coral islands. For instance, on low-lying islands, abandoned fields are more prone to water infiltration and soil "build-up" through mulching and composting is the process that help reduce this threat. Taro patches play an important cultural and social role, and oftentimes, women are the guardians of these resources by tending to the patches to ensure appropriate drainage and soil quality. In other islands where agroforestry is culturally executed by men, women play an important role in managing home gardens that provide vegetables to the household or local markets. Many times, these gardens require women to practices with active soil management by adding compost or seaweeds to maintain or re-establish soil nutrients.

Households across the FSM are also engaged in livestock activities, although once again, there are considerable differences among the states (IAC 2016). Pigs are largely used for social and customary obligations (Pohnpei and Kosrae), particularly in Pohnpei owning pigs is considered a social status for men and 49% of the pigs were reportedly used to meet 'male' customary obligations. Men are responsible to maintain and slaughter the animals, but in some of the states, women may take care of the piglets, which are often sold or consumed at home. Although pigs represent an important source of protein in many households, only 42% of households reported consuming them at home (IAC 2016), suggesting that a large number of pigs or piglets are sold or used to attain social obligations.

Barriers for women's empowerment in the agriculture sector have to do with the social norms that confine them to certain agriculture activities. As a result, women (i) tend to have lower participation to agriculture trainings and capacity buildings, (ii) are unaware of options for alternative livelihoods and access to markets; (iii) tend to be less represented in islands' Farmer Associations, which traditionally have a strong focus on agroforestry. However, this is not always the case and promising changes are occurring. For instance:

- In Chuuk, the Chuuk Women's Council (CWC) with assistance from the Department of Agriculture and the College of Micronesia Cooperative and Research Extension (COM-CRE), has implemented a project to introduce women to home gardens techniques. To ensure women's economic empowerment, CWC promoted a weekly market where women can sell their fresh products, and to ensure the sustainability of the project CWC established a plant nursery to distribute and sell seedling for home-gardens.

- In Yap, the Tamil Women Association (TWA), in collaboration with TRCT, took a leading role in promoting food security through the planting of local crops and the promotion of a program that focused on providing elementary school children with regular meals.

- In Pohnpei the COM-CRE launched a program that aimed to improve farmer's knowledge on climate change dynamics and techniques for improving traditional crop resilience. The several workshops and training sessions were designed to target both men and women.

These are examples of effective bottom-up approaches that can be scaled-up to reach the larger public.

Importantly, incoming funds from Global Environmental Finance (GEF), Green Climate Fund, Adaptation Fund and others, have all built-in components that promote and facilitate gender mainstreaming in the agriculture sector. These resources can help promote the scaling up of lessons learned and good practices from the local examples, thus ensuring that top-down projects are also inclusive of local traditions and specific metrics that are sensitive to the FSM's women' and men's needs.

The FSM forests and mangroves are particularly important to subsistence economies. They provide a series of services such as firewood, building material and other wood products that are used for handicrafts, carving and making canoes. While resources and activities in the forest are generally accessed and managed by man, mangrove areas are equally used by men and women for fishing, firewood and recreational activities. Forest types in the FMS vary among states, depending on climate, soil type and topography (SOE 2019). This ecosystem is becoming endangered by human activities that are promoting deforestation and the spread of invasive species (SOE 2019). Across the FSM, 29% of males and 13% of females aged 20 and over were reported to be involved in forestry activities (IAC 2016; Fig. 9). Among the states, women in Yap lead forestry activities (48% females vs 52% males; Fig. 9).

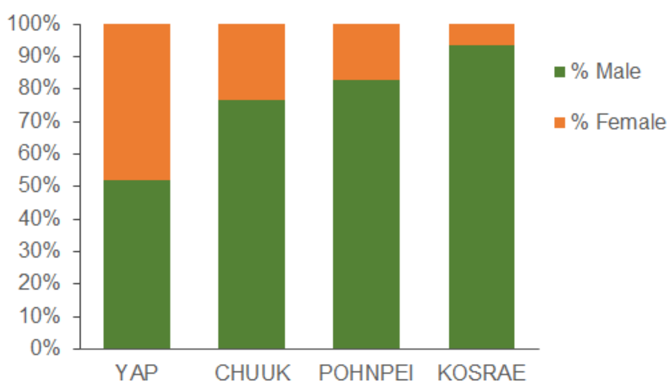


Figure 9. Proportion of male and female population engaged in forestry activities by state (data source: IAC 2016).

Forests are essential for island life and for maintaining island biodiversity. In recognition of the important role that women can play in protecting forests, the FSM Ridge-to-Reef (R2R) project, has implemented, through UNDP-GEF funds, grass-roots projects within communities and women's associations to help reduce the gender gap. For instance, in Chuuk, the R2R project collaborated with community members (men, women and the youth) to take necessary actions to safeguard their key natural resources by establishing and maintaining plant nurseries for the project's sites where forest was rehabilitated. The inclusion and participation of women in the forest and mangrove rehabilitation project, has allowed them to influence decisions that affect their lives, promoting partnership between women and men and thus women's social empowerment. This approach also had the advantage of increasing awareness on forest and biodiversity conservation for all.

Gender Use and Access to Marine Resources

Results from the HIES 2013/14 showed that, for all households in Kosrae, Chuuk and Yap States, fishing was the highest income earner, while in Pohnpei State fishing ranked only fourth. In 2013, in the FSM, 47% of the households engaged in fisheries activities, and of these, 60 to 90% used their catch for subsistence (HIES 2013/14). These results indicate the important role that fisheries play in communities' well-being, by providing an important source of protein for household. These results are also supported by the findings of the 2018 Coastal Fishery Situation Analysis Report (IASI 2018). Across the FSM, both men and women are involved in various aspects of fishing with specific roles undertaken based on traditional and cultural norms of the different states and communities (IASI 2018). However, fishing is often seen as a male activity. This idea is reinforced by the higher employment of men in the fisheries labor market (92%; IASI 2018).

Modernization and loss of women's traditional fishing knowledge

"In Kosrae, fishing in the shallow waters of the lagoon was the domain of women that use to utilize different nets designed for specific fishing techniques, marine habitat, tide, and number of people fishing. Up until the early 1970s over ten different net fishing techniques were in use on Kosrae. By the early 1990s these varied techniques and specialized gear had been replaced almost entirely by the use of monofilament gillnets."

In Pohnpei "*in the past, women would catch clownfish (Amphiprion sp.) and unicorn fish (Naso sp.) by breaking coral into a naik, a basket woven from leaves. The fish would then be scared into taking refuge in the coral in the basket. The fish were eaten and the bones put into oil for use as a 'perfume' for use in the drinking of sakau (kava). The naik would also be used to scoop fish when they were plentiful but this method is no longer used.*"

Lambeth and Abrahm (2001), Lambeth (2000).

Traditionally, many different words exist for different types of fishing. Among the FSM islands, there may be words for the different types of fishing usually performed by men and separate words for women's harvesting activities (e.g., collecting clams or sea cucumbers; Lambeth 2000). As highlighted by Lambeth and Santiago (2001), "*the English term 'fishing' is often translated and understood as a term covering the various types of men's fishing activities. Collecting invertebrates, as well as the preparation and sale of fish and shellfish still tends to be overlooked as fisheries activities, by the women themselves as well as many of the government and non- government agencies that assist fishing activities*". This represents a major barrier for women access to the fisheries sector, since resource management and assistance tend to target a specific gender.

At the subsistence level, among the FSM's states, men and women are involved in the fisheries sector to different extents. These differences were reflected in the IAC 2016 results, with the largest proportion being men between 16 and 54 years old (Fig. 10). The proportion of women engaged in fisheries activities in Yap was the lowest among the four states (5%; Fig. 10). Similar results were reported by the HIES 2013/14, with 85% men engaged in fishing and women in Pohnpei and Kosrae being the most involved in this activity (20% and 16% respectively). The state of Yap has the lowest proportion of women participating in household fishing activities (9%; HIES 2013/14). Generally, the catch from women who engage in fishing activities tends to be used for home consumption or given away when the catch is abundant (IASI 2018). The Coastal Fishery Situation Analysis Report (2018) reported that "i*n Micronesia as a whole, fisherwomen's contribution to subsistence catch was around 20% of the total, while the proportional contribution to total annual catch was less than 10%*" (IASI 2018).

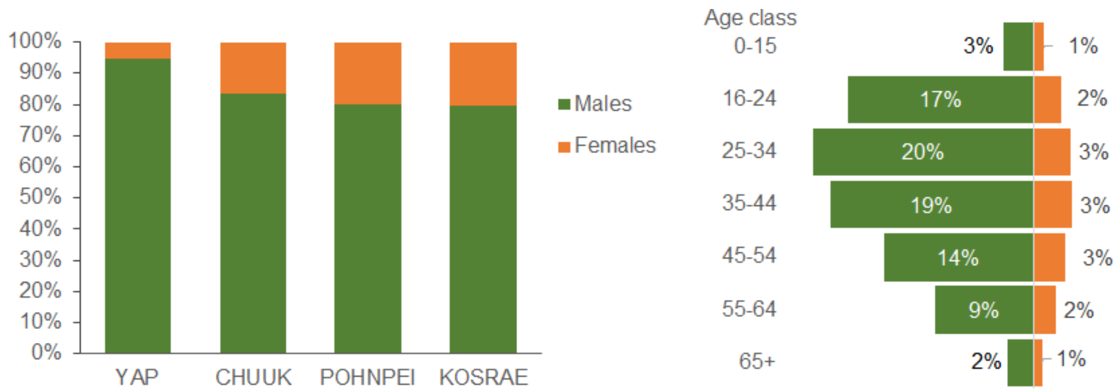


Figure 10. Proportion of male (n = 9,349) and female (n = 1,730) population engaged in fisheries activities by state and age (data source: IAC 2016).

Within traditional Micronesian society, fishing was seen as the capture of fish and solely within the domain of men. The collection of seafood from the reefs and mangroves by women and children, along with the preparation and sale of fish by women, were not considered "fishing". This strong distinction is still unchanged today and has been the driver for targeting men for participation in planning and decision-making related to fishing management. Women's participation in this sector can be overlooked, affecting the way the fisheries sector is socially and economically supported, and the manner in which the management and sustainable development of marine resources is approached (Lambeth 2000). For instance, Lambeth and Santiago (2001) reported that in Chuuk despite women's involvement in harvesting, processing and marketing of marine resources, they have had little or no training in these areas since most training and assistance to the fisheries sector has sought to increase local involvement in commercial fishing through mainly targeting men.

Barriers to women's participation in this sector are not limited to social norms, but also include (i) limited access to information on training, equipment or credit; (ii) lack of knowledge or trust on their abilities on how to access available support; (iii) poor dissemination of information on training and opportunities to women; (iv) difficulties in accessing technical information and support due to feeling that they are not able or do not have the capacity (also in terms of time) to participate. However, there are localized projects that are promoting this shift, for instance:

- The pilot project conducted in Pohnpei for sustainable fish value chains with extended fish-life products promoted gender inclusion by advancing the government's agenda of building capacities around higher value-added fish products geared towards women and youth producers. During the project the Department of Health and Social Affairs "*advised on the active participation of women, youth and other vulnerable groups, which in turn facilitated participatory consultations with local governments, farmers associations and coastal community leadership. This ensured that all trainings and workshops responded to gender-specific limitations, such as unpaid work and care burdens among women*" (FAO 2020). The processing technique used was a less labor-intensive preservation method, which reduced the burden of manual labor, especially for women (FAO 2020).

Some of the inshore species targeted by both men and women are already overharvested, but they still play an important part in the subsistence economy. Therefore, gender inclusive participation can be a driver for the sustainable management of these resources and their habitat, with added benefits through their maintenance of a form of traditional subsistence (Lambeth 2000). As highlighted by previous studies, ignoring the role of women, and continuing to exclude them from fisheries development and management activities will not prevent the problems of overharvesting and habitat degradation (Lambeth 2000). Indeed, the management of coastal fisheries at community level may provide an entry point for stronger engagement and visibility of women's groups in each state (SPC 2019).

To date most of the organizations involved in the fisheries sector lack a formal mechanism for gender mainstreaming and most of them fail to collect sex-disaggregated data (SPC 2019). Addressing this gap can prevent the exclusion of women in the management of resources as well as promote their economic empowerment. Better involvement of women in coastal marine fisheries specifically, could help improve the potential to understand coastal fisheries needs and improve capacity needs for marine resource agencies (IASI 2018). In the face of climate change, inclusion of women in this sector is crucial to enhance the benefits from subsistence fisheries activities for the FSM's households.

The Coastal Fishery Situation Analysis Report (2018) highlighted that in Pohnpei "fishing effort by women is far less than men (average = 9.5 mo yr^{-1}) and spend less time fishing (3 hr $trip^{-1}$), with most fishing done seasonally in sheltered coastal areas (60%)". In some ways, this is expected since women are also leading and managing other household activities, and therefore they tend to have less time available to dedicate to fishing. Nevertheless, their contribution to marine resources harvesting and the role that their catch plays in feeding the family needs to be acknowledged and acted upon, through formal recognition in resource management. Women are beginning to take leading roles in the management and administration of Conservation Areas and Marine Protected Areas (IASI 2018). This puts women at the forefront of conservation initiatives where they are contributing to planning and decision-making.

Energy

The FSM has endorsed a National Energy Policy (2012) that aims to lessen the country's dependency on imported fossil fuels "*by implementing energy efficiency and conservation measurements and including more environmentally sound renewable energy sources that are locally available*". The policy identifies, among the community level initiatives, the need for engaging women in policy implementation and integrated planning. However, there is space to include specifications for promoting gender inclusion through women's direct involvement in capacity building such as "energy-related training opportunities at all educational and professional levels" and "technical capacity for all aspects of energy sector planning and development."

In 2018, the Energy Master Plans (EMP) for the FSM was prepared for the National Department of Resources and Development, Energy Division. The EMP identified social needs and areas for improvement in support to women's health and empowerment (Castalia 2018). The EMP highlighted that electricity may be less affordable for female headed households relative to male headed households in Chuuk, Pohnpei, and Yap. This is due to the income gap discrepancy between male and female headed households, with female-headed households having significantly lower income. This result has important implications for both men and women, who may have different priorities when it comes to electricity needs in rural areas with no electrification. When populations from the outer islands of Udot (Chuuk) and Ulithi (Yap) were consulted to gather information on their electricity needs and priorities, men prioritized refrigerators and freezers. Women, in comparison, valued street lights due to the safety benefits and expressed the desire for washing machines to help them save time so they could participate in other domestic initiatives, such as weaving or making handcrafts (Castalia 2018). Electricity was set as priority by both men and women for household lighting and for charging of appliances, such as cellphones. Household lighting is beneficial for the entire family's productivity since it allows for activities such as, household chores and studying to happen in the evening, freeing time in the day to dedicate to other priorities.

Cleaner and more efficient energy for cooking may represent another important benefit associated with extensive electrification of the country. Particularly in rural areas of the FSM, wood fuel is still the predominant cooking fuel used by women, which impacts their time available for other activities and their health. The adverse impacts of traditional fuels, measured in terms of the opportunity cost of time spent and the health risks is well known and particularly affects poor, rural women more than any other group (UNDP 2007). Exposure to smoke from cooking over an open fire can have negative health impacts, particularly if the fire is in an enclosed space and not well ventilated. Women and children exposed for long hours to wood-smoke from cooking are liable to suffer from respiratory infections and eye diseases far more than average. For infants this has been associated with infants' debility and mortality (UNDP 2007).

Traditional biomass-based cooking is still largely used in rural areas of the FSM. For example, cooking in the outer islands of FSM is usually done over an open fire and is mostly done by women (Castalia 2018). The use of electricity for cooking can help reduce the adverse health impacts from cooking over an open fire. However, data has shown that electricity to cook can be accessed only by those who have a regular household income, potentially limiting the access from women-headed households and in general, poor households. Indeed, the EMP reported that in Weno, Pohnpei Proper, and Yap Proper, where grid electricity is available, 30 to 40% of households still use open fires. Therefore, electricity costs, which may not be affordable to all, can increase exposure of the most vulnerable segments of society to wood-smoke related diseases.

Renewable energy can become a sustainable option to reduce costs of electricity and national dependence on fuel for electricity production. For instance, many of the outer islands of Yap already have access to electricity through mini-grids and solar home systems. The electricity produced is largely used for refrigerators to store fishing catch, but the use of electricity for other appliances (televisions and DVD players) is lower when compared to Yap Proper (Castalia 2018).

The EMP highlighted the importance of renewable energy, specifically stand-alone solar systems, for gender-inclusive access and management of electricity. In the past, FSM women have received technical training on solar panel maintenance and management through the Solar Mamas project with the Barefoot College in India (Castalia 2018). In 2016, through the Solar Mamas project, funded through MCT, eight (8) mature women from Pohnpei (Parem, Lenger, Mwahnd, Depehk and Takaiou Islands), Kosrae (Walung Village) and Chuuk (Parem Island) were trained to become certified solar engineers and operate solar energy systems. This project revealed the potential of upscaling projects on renewable energy systems that promote access to technical knowledge and improve local capacity to enhance benefits of renewable energies to the larger community.

Renewable energies have benefits in terms of costs of energy production and health. However, it is important to identify mechanisms for the maintenance of the systems and processes for managing and disposing the waste produced from the dismissed material (e.g. solar panels, batteries for micro-grids). Waste management of these systems can become a further step for building capacity of women and men in the energy sector.

Land tenure

This section on land tenure is extracted from the FSM State of the Environment (SOE) endorsed in 2019 (SPREP 2019). The extract identifies the different land tenure systems among the four FSM's states and describes the existing inclusion of modern and traditional systems. Examples of traditional systems are presented in Annex 3.

"The land tenure system varies across the four states. All have adopted the Torrens land registration system, which places the authority of registration of titles and recording of liens, leases, and other land transactions with each state government. Certificates of title are issued by each state land authority, and land transactions pertaining to the parcel are also annotated on the certificate.

In Yap, approximately 98% of land is privately owned by family and clan groups, with most of the state's owned land located in the capital of Colonia, in the municipalities of Rull and Weloy. In Yap, both land and the reef system are privately owned. Non-citizens cannot own land in Yap, but they can lease land for a maximum of 99 years, including options to renew. Leasing of land, or making landowners partners or shareholders of projects, is viewed as the most appropriate arrangement. Almost all land in Yap and aquatic areas are owned or managed by individual estates and usage is subject to traditional control. Most property is held as family trusts and land use rights are passed down from generation to generation within the extended family system. The Yap Land Resources Office is responsible for registration, surveying and recording of titles and land transactions.

In Chuuk, there is very little public land owned by the state. All lands are privately owned either by the individuals, an entire family, a clan or lineage, or heirs of deceased owners. Western land registration procedures and land tenure practices are increasingly adopted, but customary land tenure systems still strongly influence most lands in Chuuk. The state's role in the land tenure system through the Chuuk Land Commission is primarily registration of titles, record keeping and to adjudicate in land disputes. Land and nearshore marine areas are owned by families, and customary rights of ownership, use, inheritance, and transfer are still followed. Disputes over titles and land registration seriously complicate the efficient application of land tenure practices, development and use of land.

In Pohnpei 60% of the total land area of the main island has been declared 'public land'. The Constitution of Pohnpei limits acquisition of permanent interest in land to Pohnpei citizens (pwilidak). However, non-citizen individuals and business can obtain land on long-term leases. Pohnpei is unique in that the sale of real property is forbidden except as authorized by law, however, land transfers by gift are allowed. In Pohnpei, while land can be privately owned, the reef system is public. There is a Public Lands Board of Trustees that administers and manages the distribution of land parcels within the public lands in Pohnpei. A Court of Land Tenure presides over all land matters, including registration of titles and recording of liens, leases, and other land transactions.

In Kosrae, most of the land mass consists of steep mountains reducing their potential for agriculture and settlement. As a result, Kosrae has a relatively small amount of inhabitable land. This coupled with a small population in Kosrae lends itself to a less rigid land tenure system with fewer rules and regulations, and fewer difficulties of ownership conflict and dispute settlement. Also, in Kosrae, land can be privately owned, but the reef system is public. The Kosrae Constitution limits acquisition of title to land to citizens of Kosraean descent. The Kosrae Land Court presides over all land matters and is responsible for registration and recording duties."

Land Access

According to FAO (2011), if women in rural areas had the same access to land, technology, financial services, education and markets as men, global agriculture production could be significantly increased, which would considerably reduce global hunger (FAO 2011).

The 2016 Integrated Agriculture Census reports on the proportion of male to female householders that own land used for agriculture. The proportion of male householders with access to land used for agriculture was 72%, which is considerably higher than female householders (12%). At the same time, 7% of male and 2% of female householders were reported to have no land to use for agriculture. Among those reported with land used for agriculture, the states of Chuuk and Pohnpei have the highest proportion of male (34% Chuuk, 30% Pohnpei) and female (Chuuk 7%, Pohnpei 8%) householders.

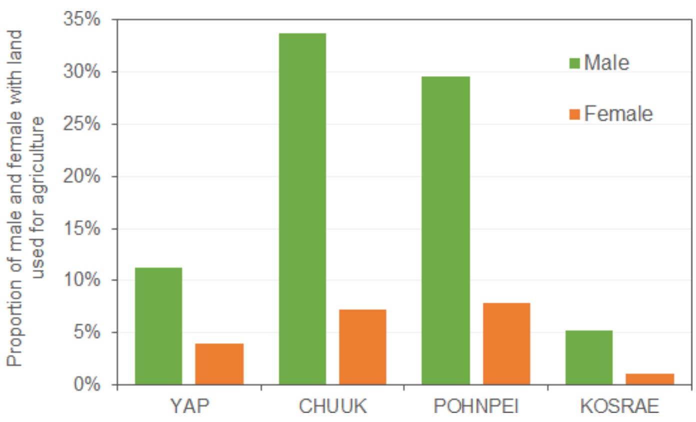


Figure 11. Proportion of householders by land used for agriculture by state (IAC 2016).

Highlights

> Although in rural areas the traditional division of labor remains relatively unchanged, the shift from a subsistence to a monetized economy, and the limited access of women to the formal economy, have contributed to reduce women's participation to the social settings.

> A larger proportion of men than women earn income from subsistence activities. The role of women in managing natural assets is key, but their knowledge on the management of natural resources is underestimated and to some extent fail to be incorporated in environmental and conservation planning and decision making.

> Inclusion and participation of women in conservation and natural resources management and rehabilitation have proved to enhance partnership between women and men, promoting an inclusive environment for sustainable management of natural assets.

> Resources are generally directed to build the capacity and skills of men working in the fisheries, forestry and agriculture sectors, although also women have proved to be important agents of change for climate change adaptation and food security.

> In the face of climate change the inclusion of women in the agriculture, forestry and fisheries sectors would be crucial to increase food security, and therefore enhance benefits from subsistence activities.

> Electricity may be less affordable for female headed households relative to men headed households. However, electricity is a priority for both men and women.

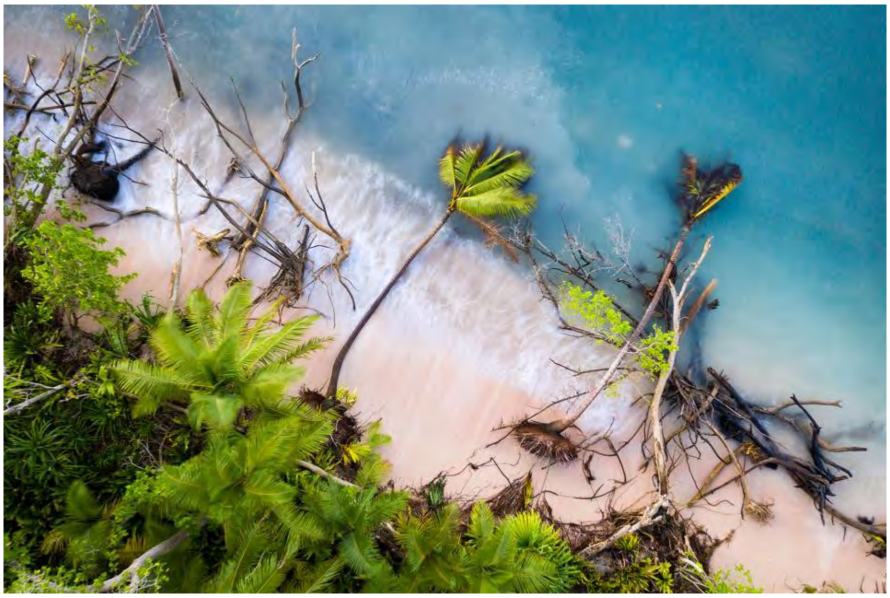


Photo Credit: Sean Gallegher

Empowerment and Participation to Decision Making

> "*The Pacific Women Roadmap, […], shows that countries with improved gender equality have better social and economic development outcomes due to the involvement of more people with diverse views, skills and experiences in decision-making, economic activity and maintenance of positive social relations. Further, children and adolescents who witness men and women sharing care-giving tasks and decision-making are more likely to carry values of equality into their own adult lives. This in turn has a positive influence on belief systems, attitudes and behaviors*"
>
> Assessment of EVAW Services and Gaps in Services Section 1 – FSM National Report (2017)

Historically, Micronesian societies have emphasized matrilineal descent through which women could exercise considerable influence over the conduct of domestic affairs, and the allocation of the use rights to land. Men typically controlled the political and economic affairs in the public sphere and had ultimate authority over domestic decisions, but the complementarity of tasks provided all people with valued roles in society. Although this had provided women with a level of status that was not found in more patriarchal societies, the shift towards a market-oriented economy and the widespread western influence has unsettled traditional gender relations. These societal changes have impacted the matrilineal inheritance practices. These social shifts have narrowed the complementarity of tasks between males and females. The customary law in the FSM is still largely practiced and recognized. However, the introduction of a formal form of legislation has generated a system in which customary gender roles are lessened, producing some level of separation between modernization and tradition.

The FSM National Constitution (Article IV, Section 4), guarantees fundamental rights and freedoms to all FSM citizens, regardless of sex, race, ancestry, national origin, language religion, or social status. However, the constitution also gives legal status to customary law and community practices that can be discriminatory against women (CEDAW 2015).

FSM ratified the Convention on the Elimination of All Forms of Discrimination against Women in 2004 and is also committed to the 2012 Pacific Leaders' Gender Equality Declaration. In 2018, the FSM government endorsed the National Gender Policy that builds on the strategic goals for gender equality under the FSM Strategic Development Plan 2004–2023 and held consultations with the women of FSM during the National Women's Conference in 2016 (SPC 2019).

The FSM's representation of women in decision making and leadership roles remains limited. Women are still largely under represented at the legislative and executive levels of the government (Braun 2012). As of 2022, only 2 of the 14 seats of the FSM National Congress have been filled by a woman. At the same time, there are three (3) women in national cabinet. There are three (3) in Pohnpei State Legislature, one (1) woman at State Legislature in Chuuk and one (1) in Yap State Legislature. In 2017, at state Congress there was one (1) woman elected in Pohnpei and one (1) in Chuuk. In 2017, two out of seven Secretaries (department heads) in the national government were women and the Public Defender and Post Master General were women. Of the five overseas diplomatic missions, only one has been headed by a woman (United Nations, NY). One of three Associate Justices is a woman and out of five Assistant Attorney General positions one is filled by a woman (AUS AID 2017).

In general, with the exception of Yap, the leads of environmental agencies at national and state levels, including local environmental NGOs, are male, although women are well represented in managerial positions at national level (Assistant Secretaries and Project Managers). As reported by the 2020 First Voluntary National Review Report on the implementation of the 2030 Agenda for SDG, women are well represented in the civil society arena, but most of these organizations focus their work on women’s empowerment and social equity, although there has been a constant increase in women’s lead NGOs working on environmental and climate change issues.

Although there have been some attempts to ensure women’s participation in the National Congress (FSM Bill No 16-10), recognition of traditional women leadership roles, particularly at state level, may have greater impact and acceptance. At state level, the states can promulgate their own laws, and with regards to gender Pohnpei passed a *Domestic Violence Act* in 2017 and Kosrae passed the state *Family Protection Act* in 2014. States also have power in the implementation of their budgetary policies, which represent an essential entry point to allocating budgets for gender mainstreaming (SPC 2019b). In addition, the states of Pohnpei and Yap have gender officers within their government administration to provide strategic guidance to the state on gender issues and coordinate activities with women. Chuuk State makes use of the Chuuk Women’s Council, which, as an umbrella organization for more than 40 women’s groups, coordinates women activities. In Kosrae, the Kosrae Women’s Association, an umbrella organization that represents the women of Kosrae, is supported by the state. The extent to which these entities are involved beyond traditional “women’s domains” may vary (SPC 2019b).

In many cases at the local level, women are also under-represented. High status positions in traditional political hierarchies are primarily held by men and there is a general recognition, appreciation, and value in the separation of roles in traditional settings (Mc Leod 2018).

It is crucial to recognize that many Micronesian women value traditional forms of leadership as part of their identity. Therefore, recognizing the diversity of perspectives on women’s empowerment and engagement in the FSM can pave the way for inclusion and participation in decision-making. Long-lasting changes in decision-making norms can be achieved by enhancing and strengthening the roles of the women within Micronesia culture rather than through the application of external metrics of empowerment that can devalue women’s traditional and cultural roles (Mc Leod 2018). Recognition of traditional women’s leadership roles can be beneficial in supporting gender mainstreaming into policy mechanisms at state and local level.

At the local level women can be very influential through their traditional roles and while significant, their influence may be behind the scenes (Mc Leod 2018). Women are also central in the transfer of traditional knowledge and information to new generations. Participation of women across age groups, through all-female settings, provide them with a cultural and social environment to speak freely, allowing for the intergenerational flow of gendered information. This is especially true for young women that, by culture, are restrained from speaking in village and community settings in front of elders or chiefs. The all-female setting approach is becoming increasingly used by local NGOs, due to the recognition that it helps create a comfortable space for women to share knowledge and experiences, which improves their participation in planning and decision-making (Mc Leod et al 2018).

Although the FSM has policies for inclusive gender approaches, gender departments are often under-resourced and have limited capacity. Therefore, to tackle climate change issues from a gender perspective, there is a need to raise the profile of these institutions and promote collaboration with national development office and women associations. Doing this will ensure harmony between climate and gender policies from local to global levels (e.g., integrating climate consideration in the national gender policy, and gender equity into the national adaptation plan and nationally determined contribution). The empowerment of women can greatly increase the climate change resilience of the country. Indeed, despite policy commitment, institutional responsibilities, and gender responsive project design, gender equality and empowerment of women often is not achieved (Mc Leod 2018). To address this gender gap, governmental institutions that address climate change (e.g., DECEM at national level) will benefit by integrating national gender mechanisms- e.g., through appointing gender focal points in relevant ministries and governmental bodies; developing a gender and climate change mainstreaming strategy or action plan to guide governmental action; integrating gender equality into policy mechanisms through gender budgeting.

Highlights

> Gender institutions are often under-resourced and with limited capacities. States budgets represent a key entry point to support gender agencies.

> Raising the profile of gender institutions can help harmonize climate and gender policies from local to international level.

> Long-lasting changes in decision-making norms can be achieved by enhancing and strengthening the roles of the women within Micronesia culture rather than through the application of external metrics of empowerment that can devalue women's traditional and cultural roles.

> Governmental institutions that address climate change (e.g., DECEM at national level) will benefit by integrating gender-responsive mechanisms.

Climate change and vulnerabilities

The Pacific region is greatly exposed and extremely vulnerable to the impacts of climate change. Climate change tends to amplify both the strengths and weaknesses of a social system which, in most cases, increases gender inequality. A person's gender, age, education, social status and disability, all impact one's roles, skills and vulnerability when it comes to disaster and climate change. Location and economic opportunities are also significant factors (SPC 2019b).

It is well documented that in the Pacific women and girls are disproportionately affected by climate change impacts due to underlying gender inequality and socio-economic disadvantages. Climate change related disasters can increase women's additional unpaid work because they will be required to restore their homes and gardens, fetch water, and take care of children due to school closure. For women actively engaged in full-time and part-time jobs, this can translate to losing some of their earnings. Where sex-disaggregated data were available, they have shown that women's mortality rate in major disasters is much higher than of men. In the Solomon Islands, 90% of the deaths from the 2014 flash flood were women and children (World Bank, 2013). Thought disproportionately impacted, women are important agents of change thereby improved capacity, can concretely help tackle climate change issues.

In the FSM women are already contributing to climate change adaptation by adapting traditional knowledge and designing new technology to meet their needs. For example, in Chuuk, women are relying on traditional practices for managing drought including drying and fermenting breadfruit to support food security. Increased heat stress on plants is leading women to revitalize traditional gardening practices, such as in Kosrae, laying palm leaves over the soil to keep it cool, and in Yap, covering young taro plants, transferring young shoots to shady areas, and mulching around taro patches. During droughts in Pohnpei, women's knowledge of the location of traditional wells enabled them to find potable water and build new shallow wells (Mc Leod 2018). Also, in Yap women are planting palms in flooded taro patches to provide material for weaving and home building, and to offer protection from coastal flooding. They are also developing a nursery of native plants to provide seeds for food and medicine and to help repopulate areas damaged by flooding.

Although women and youth are directly contributing to production of crops, playing a key role for households' climate change adaptation, they are generally not directly involved in land management decisions, which commonly involve adult men of the family or clan. However, increasing recognition of the importance of soil management for households' gardens and agroforestry is leading to a greater engagement of women groups and youths in trainings for food security that includes aspects of soil and crop management. Women groups and women led NGOs are active in implementing projects or providing training to women, men and youths for best practices for reducing soil erosion and sustainable soil management. Several projects that are now focusing on the utilization of ecosystem-based adaptation practices (e.g., restoration of traditional taro patches, buffer strips, contour bunds, rain gardens, etc.) and production of compost for soil amendment, are targeting both women and men, with the aim to increase food security for all.

Women can gain the tools and knowledge necessary to respond to climate change through efforts to build their capacity, enhance their involvement in sustainable land and ecosystem management, and provide access to recovery services and products such as micro-insurance and early warning systems. This process should also focus on improving women's access to climate funding, as well as support to meet the funding requirements of climate grants (e.g., requirements for a gender policy and gender action plan).

Among the direct and indirect impacts from climate change, there are problems of forced relocation and increases in gender-based violence. The linkages between climate change and gender-based violence are rarely addressed in mainstream climate discourse, yet during the last drought (2015/16) in some states there were reported increases in the number of cases of violence against women, including the increases in the risk for young girls to become victims of assault specifically when fetching water in wells located far from their houses (Mc Leod 2018). In addition to this, climate change has been known to exacerbate economic abuse[227] by intimate partners. In 2014 economic abuse by an intimate partner was experienced by 25% of women in Chuuk and Kosrae and 8% of women in Pohnpei and Yap (SPC 2017). Gender-based violence may also be exacerbated by the displacement that affects many people after disasters. For instance, in Chuuk after typhoon Maysak some couples lost their homes and had to move back to live with their families. Men are seen responsible to provide for their family, so living in someone else's home and land comes with a great emotional burden due to increased obligations to the family, which can increase stress. In general, those that have to relocate become more vulnerable since they may find themselves in new cultural settings and they may lose ownership of their land. Highlighting the potential for climate change to exacerbate gender-based violence is therefore necessary to ensure that policies designed to protect women are reinforced and can be effectively implemented. Addressing these linkages is particularly important in the Pacific where most gender departments are under resourced, have limited capacity, and are not well integrated into the government agencies responsible for environment and climate change issues.

The FSM has several examples of climate change gendered projects implemented by the government, international organizations (e.g. IOM, TNC, CRS) and local NGOs (e.g. Chuuk Women Council, Pohnpei Conservation Society, Tamil Resources Conservation Trust, Women in Farming in Kosrae). The country has increasingly embraced gender mainstreaming into climate change and environmental projects.

An online survey conducted in September 2020, among NGOs, government agencies and international organizations (n=13 participants) on climate change projects implemented in the FSM, revealed that:

- Over 60% of the participants were implementing more than 3 climate change gender-inclusive projects, with 92% responding that their organization has promoted equal opportunities and benefits for women and men in the projects implemented.
- Over 60% of the organizations that participated to the survey have, or collaborate with, a gender expert, or do both.
- Approximately 70% of the organizations that participated to the survey have identified barriers to participation in climate change project activities for women and men. Among the most relevant were:
    - Cultural barrier:

[227] Economic abuse refers to any act or behaviour which causes economic harm to an individual. The data reported here measured two forms of economic abuse: (1) the intimate partners took women earnings and/or savings against their will; (2) intimate partners refused to provide money for household expenses, regardless of money being available for other things. This data was collected for the FSM Family Health and Safety Study conducted through focus groups and interviews. It is important to note that the trained field interviewers were surprised to learn that these economic abuses (1 &2) are considered form of violence against women (FSM-DOH 2014).

    - difficulties to have women to attend planning sessions due to cultural norms;
    - men and women both play different roles within the society. Women have come a long away from being silent to becoming advocates for their rights, however, it's the cultural roles – i.e. men make the decisions while women tend to the needs at home –that continue to prevent/discourage women from speaking up.
  - Time management and lack of a gender expertise to guide and lead;
  - Men and women have difficulties in participating because they tend to feel overwhelmed by the issue/reality of climate change;
  - Most of the government counterparts are men, especially in high-ranking positions, and it is therefore difficult to ensure a gender-balance during decision making and planning activities;
  - Both women and men leaders/decision makers in the communities around Micronesia are juggling multiple responsibilities, including work, education and health for their children, and their well-being. And so, this limits their time to participate in climate change project activities.

- Most of the organizations that participated in the survey reported that both men and women were equally involved in consultations relative to the projects (92%) and that the projects were designed to ensure benefits to both men and women (85%). However, gender mainstreaming in the project components (e.g., objectives of the project, project activities, project indicators, etc.) may vary:
  - Over 75% of the participants have mainstreamed gender in their climate change projects objectives, activities and outcomes, making sure to design the project in such a way that could respond to the different needs of men and women, by (i) equally involving men and women in trainings (77% of respondents), (ii) ensure full participation and gender roles were recognized during the division of labor within the communities (77% of respondents).
  - Approximately 70% of participants took in consideration the impact that the project workload could have on women and men, while equally involving both men and women in project implementation
  - Over 60% of participants have designed specific indicators for tracking project benefits to men and women and make sure that these indicators helped to capture unexpected impacts on men and women.

Highlights

- A person's gender, age, education, social status and disability, all impact one's roles, skills and vulnerability when it comes to disaster and climate change.
- Post-disaster relocation can increase vulnerability of both women and men, but in different ways.
- To accelerate climate change adaptation, education and training of women, youth and men need to be considered central.
- Gender mainstreaming in climate change projects is becoming a general practice, but capacity need to be built further.
- Social norms and constructs can exacerbate the impact of climate change on women and children.

7.3 Policies, Laws, Frameworks and Plans Review

International commitments

The importance of gender mainstreaming in environmental and poverty eradication policies has been recognized in a wide range of global agreements and forums, including chapter 24 of Agenda 21 (United Nations Conference on Environment and Development, 1992); the 1995 Beijing Declaration and Platform for Action (IV World Conference on Women); the 1996 Leipzig Declaration and the Global Action Plan for the Conservation and Sustainable Utilization of Genetic Resources; the Johannesburg Plan of Implementation of the 2002 World Summit on Sustainable Development; the 2000 Millennium Declaration; the 2015 Paris Agreement of the UN Framework Convention on Climate Change; the Agenda 20130 for the Sustainable Development Goals, among others.

The FSM ratified two United Nations environmental conventions that are relevant to rural women – the Convention on Biological Diversity (CBD) and the United Nations Framework Convention on Climate Change (UNFCCC). These conventions–in combination with the Sustainable Development Goals (SDGs) – can provide rationales and guidance for increased investments in gender analysis and gender-responsive program planning and design.

Photo Credit: Chiara Franco

Table 3. Conventions ratified by FSM and that support gender equality (adapted from FAO and SPC, 2019)

Convention	Relevance to gender equality
UN Framework on Climate change- UNFCCC	UNFCCC mandated that national adaptation programmes of action should be guided by gender equality (COP 7, Marrakech Morocco) and adopted a decision to promote the goal of gender balance in bodies of (and delegations to) the UNFCCC, and to include gender and climate change as a standing item on the COP agenda (COP 18, Doha, Qatar, 2012). However, only in 2014, at COP 20 in Lima, UNFCCC, through the Lima Work Programme on Gender called for develop an action plan on gender. As consequence of this process, the 2015 Paris Agreement (PA) mandates gender responsive adaptation actions and capacity-building activities. In article 7.5 of the PA, "*Parties* (including the FSM) *acknowledge that adaptation action should be guided by respect for human rights, gender equality and the empowerment of women and follow a country-driven, **gender-responsive**, participatory and fully transparent approach … with a view to integrating adaptation into relevant socioeconomic and environmental policies and actions*". Article 11.2 states that "…*Capacity-building should be guided by lessons learned … and should be an effective, iterative process that is participatory, cross-cutting and **gender-responsive***". The first Gender Action Plan (GAP), developed under the Lima work programme on gender, was adopted at COP 23, in 2017. This recognized that for increasing the effectiveness of relevant targets and goals under the Convention, there is a need for women to be represented in all aspects of the UNFCCC process, including gender mainstreaming through all activities of the Convention. The GAP defined five (5) priority areas that are critical to achieving gender objectives: (i) Capacity building, knowledge sharing and communication; (ii) Gender balance, participation and women's leadership; (iii) Coherence consistent implementation of gender-related mandates and activities; (iv) Gender-responsive implementation and means of implementation; and (v) Monitoring and reporting.
UN Convention on Biological Diversity -CBD	The Convention of Biological Diversity recognizes that women "suffer disproportionately from inaction and inappropriate policies" because they are more vulnerable than men to the negative consequences of the loss of biodiversity and ecosystem services and to natural and human induced disasters. Therefore, the thirteenth preambular paragraph of the Convention recognizes the vital role that women play in the conservation and sustainable use of biological diversity and affirms the need for the full participation of women at all levels of policy-making and implementation for biological diversity conservation. This in recognition of the important role played by women as agent of change for conservation and sustainable use of biodiversity. CBD adopted a Gender Plan of Action at COP 9 in 2008 (Boon, Germany). The following year, at COP 10 (Nagoya, Japan) was passed Decision X/19 inviting Parties to consider gender as a core cross-cutting issue in the implementation of the Convention, and urging them to mainstream gender considerations in the development, revision and implementation of their national biodiversity strategies and action plans. Decision X/2 on the adoption of the Strategic Plan for Biodiversity also requests Parties to mainstream a gender perspective into the implementation of the Convention, and to promote gender equality. COP 14 (2018, Sharm el-Sheikh, Egypt) "Emphasizes the need to address gender considerations, through a to enable a gender-responsive[228] and gender-balanced process, in the development of the post-2020 biodiversity framework."

[228] CBD/COP/ 14/INF/15 [https://www.cbd.int/doc/c/5ab6/13f3/3cff0c5b52c856db19b279ec/cop-14-inf-15-en.pdf].

Convention	Relevance to gender equality
Sustainable Development Goals 2015-2030 (SDGs)	The Agenda is "*a plan of action for people, planet and prosperity*". To enhance women capacity to play an active role in climate change adaptation, disaster risk reduction management, conservation and sustainable development of society, there is a need to ensure gender equality and women's empowerment which is reflected in the SDGs goals and actions that aim to improve equal access to resources and opportunities for women. Informed participation to decision-making and planning is critical to ensure that women's knowledge, values, experiences, needs and priorities are reflected in policies and programmes. SDGs recognize how gender equality and women's empowerment can serve as catalyst for transformational change for improved food security, poverty reduction, conservation and management of land and marine resources, protection of biodiversity, sustainable development, climate change adaptation and mitigation.
UN Convention on the Elimination of all forms of Discrimination Against Women – CEDAW (Ratified in 2004)	CEDAW address gender equality and non-discrimination in areas such as education, employment, marriage, health, finances and decision making. CEDAW establishes internationally endorsed norms and standards for women's human rights. The National Gender Policy is the key mechanism of the Government of FSM to guide the implementation of CEDAW. Implementation is supported through the National Gender Policy endorsed in 2018.
Convention on the Rights of the Child	The Convention addresses gender equality by recognizing that girls are often discriminated with respect to boys. It sets norms and standards against harmful practices such as denial of girls' rights to education, early marriage, and female genital mutilation. The Department of Health and Social Affairs is responsible for implementing the Convention and reporting on progress
Convention on the Rights of Persons with Disabilities	The Convention preamble and seven articles specify attention to non-discrimination for women and girls. It recognizes that women and girls are subject to multiple forms of discrimination, including in health, education, access to services and mobility. The Department of Health and Social Affairs is responsible for implementing the Convention and reporting on progress.
SAMOA Pathway	The SAMOA Pathway makes recommendations to states for the elimination of all forms of discrimination against women and girls, the strengthening of women's economic empowerment, the ending of all forms of violence against women, the ensuring of women's full, equal and effective participation at all levels of decision making, and the promotion and protection of the human rights of women, including reproductive rights (United National General Assembly, 2014)
Beijing Platform for Action (1995) -BPA	The Fourth World Conference for Women led to the adoption of the Beijing Platform for Action (BPA). BPA is a comprehensive and transformative framework that support the principle of shared power and responsibility between women and men at home, in the workplace and in the wider national and international communities, as a prerequisite for development, social justice and peace.

Regional commitments

The FSM endorsed several regional agreements that identify priorities for the region and provide guidance to countries in developing their own national gender policies.

Since the Pacific Platform for Action (1994) and Beijing Platform for Action (1995) were adopted, Pacific Island countries and territories have used them to guide national and regional action and international cooperation to empower women in achieving political, legal, social, and cultural rights.

Table 4. Regional agreement adopted by FSM for gender equality

Agreement	Relevance to gender equality
Pacific Leaders Gender Equality Declaration, 2012	Through the PLGED Pacific Leaders committed to implement specific national policy actions to progress gender equality in the areas of gender responsive government programs and policies, decision making, economic empowerment, ending violence against women, and health and education. The PLGED recognizes the lack of information on gender specific data and supports the production and use of sex disaggregated data and gender analysis to inform government policies and programs. PLGED also highlighted the need to "increase financial and technical support to gender equality and women's empowerment programs".
Pacific Platform for Action (PPA) on Advancement of Women and Gender Equality (1994, 2004, 2017)	The PPA, endorsed in 1994, promoted a set of principles and plan of action to advance gender equality in the region. The Platform was then revised in 2004 at the 9th Triennial Conference of Pacific Women and Second Pacific Ministers Meeting on Women in Fiji. The Revised PPA (RPPA) called for (1) stronger institutional mechanisms for action through the promotion of mechanisms for the advancement of women; (2) improved legal and human rights through the participation of women in political and public decision-making and elimination of violence against women; (3) improved access to health and education services; and (4) opportunities for economic empowerment for poverty alleviation and sustainable development. [*https://pacificwomen.org/wp-content/uploads/2017/09/web-RPPA-for-CSW1.pdf*] In 2015 the RPPA was reviewed and renamed **Pacific Platform for Action on Gender Equality and Women's Human Rights 2018–2030**. This document focuses on gender mainstreaming, partnerships and accountability in order to accelerate gender equality support the commitments by the Pacific governments through the PLGED and the SDGs. [*https://www.spc.int/sites/default/files/wordpresscontent/wp-content/uploads/2017/09/PPA-2018-Part-I-EN2.pdf*]

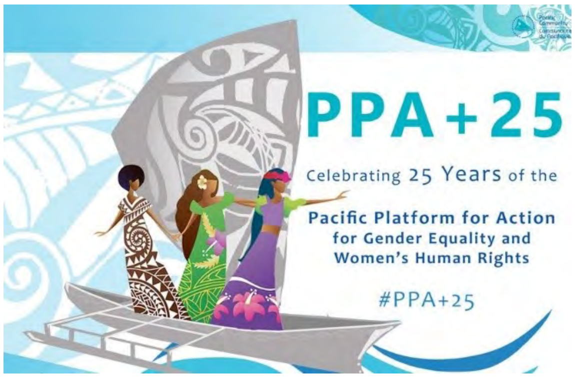
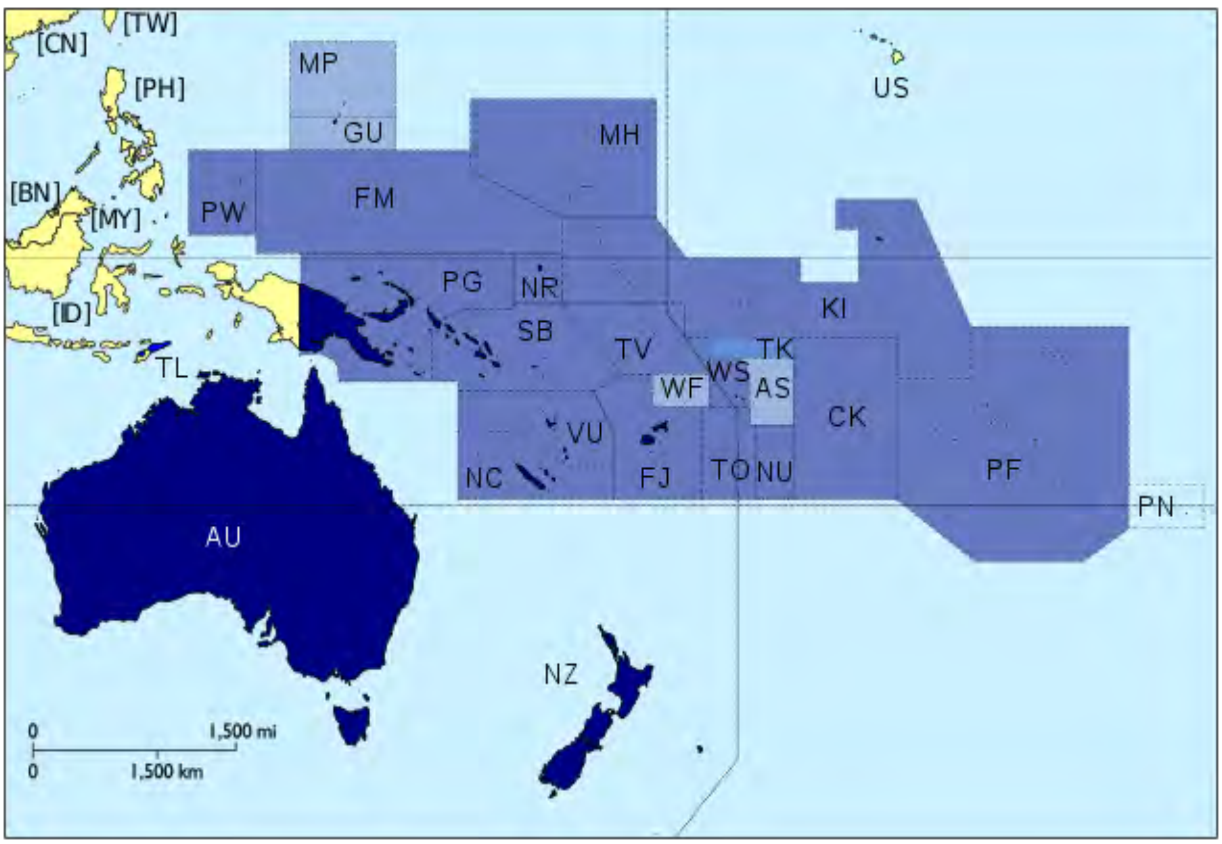


Table 4. Regional agreement adopted by FSM for gender equality [*Continued*]

Agreement	Relevance to gender equality
Pacific Island Forum (PIF) commitment	PIF committed to increase the representation of women in legislatures and decision making, and eradicate sexual and gender-based violence.

1) Boe Declaration (2018) 2) Kainaki II Declaration for Urgent Climate change Action Now (2019)	1) The Boe Declaration recalled the vision and values under the Framework for Pacific Regionalism for '*social inclusion and prosperity for all the Pacific people so that they can lead free, healthy and productive lives*.' 2) At the 50th Pacific Island Forum (PIF) in Tuvalu (2019), Leaders issued the Kainiki II Declaration. This declaration "*is the first time the Pacific Islands Forum has agreed and declared that there is a 'climate change crisis' facing the Pacific Island Nations* [Dame Meg Taylor, Secretary General, PIF]". This set a new bar for the International community, since 'crisis' is not currently agreed language in the PA or in the UNFCCC process. The 50th PIF Communiqué, acknowledged the need for urgent, immediate actions on the threats and challenges of climate change, which require a long-term vision, a carefully considered regionalism strategy, and most importantly a collective commitment. In this context, "*promoting the fundamental principle of inclusivity and equality, particularly the role of women, ensuring increased representation at all levels, and of youth*", is key for advancing regionalism (50th Pacific Island Forum, Funafuti, Tuvalu; 13-16 August 2019. Forum Communiqué).
Framework for Resilient Development in the Pacific (FRDP; 2017)	The FRDP "*provides guidance and support for building resilience to climate change and disasters in the Pacific Island region and a framework for the Pacific Resilience Partnership*". The FRDP advocates for equitable participation of men and women in planning and implementation of resilience building activities, recognizing the critical role of integrating gender considerations through priority actions such as: (i) inclusive gender analysis to strengthen capacities at all level of government, (ii) effective delivery of development initiatives through responsive decision-making systems and human rights-based approaches; (iii) selection of cost-effective resilient development interventions that are gender responsive and inclusive; (iv) development of gender-responsive and inclusive disaster risk management and climate change adaptation strategies at regional and national levels through facilitation and trainings; (v) ensuring that all initiatives related to low carbon
	development are gender responsive; (vi) ensuring that fast and effective humanitarian action, disaster response and recovery through inclusive gender-responsive decision-making systems and human rights-based approaches; (vii) disaster preparedness and response arrangements and plans for communities are gender-sensitive and address specific needs of vulnerable groups.



Pacific Island Forum

Forum members: PW: Palau; FM: Federated States of Micronesia; PG: Papua New Guinea; MH: Marshall Islands; NR: Nauru; KI: Kiribati; SB: Solomon Islands; TV: Tuvalu; NC: New Caledonia; VU: Vanuatu; FJ: Fiji; TO: Tonga; NU: Niue; WS: Samoa; CK: Cook Islands; PF: French Polynesia; NZ: New Zealand; AU: Australia.

Associate members- TK: Tokelau

Observers: MP: Northern Mariana Islands, GU: Guam; WF: Wallis and Futuna; AS: American Samoa; TL: Timor-Leste

Source: https://commons.wikimedia.org/w/index.php?title=File:Members_of_Pacific_Island_Forum.svg&oldid=485406562 (accessed November 2020).

National commitments

The FSM National Strategic Development Plan 2004–2023, sets ambitious goals within the gender matrix for women's advancement, gender mainstreaming, strengthened women's programing, strengthened youth organizations, programming and leadership, establishing social protection and social services for the elderly, and addressing the economic, political, social, and legal needs of people with disabilities and those with special needs. FSM has also committed to gender responsive policies and programs and endorsed its National Gender Policy in 2018.

Table 5. FSM's National policies and plans

Policy & Plans	Relevance to gender equality
FSM Gender Policy	The National Gender Policy aims to ensure that "*all women and men, and girls and boys in FSM states are respected and can reach their potential*". The policy, endorsed at the FSM Women's Conference in 2016 and by the FSM's President in 2018, focuses on six goals: (1) elimination of gender-based violence; (2) better women's representation in decision-making; (3) improved education outcomes; (4) addressing barriers faced by women in the workforce; (5) better healthcare and choices over fertility; and (6) mainstreaming gender across government. Up to now, this policy has led to significant progress in government and civil society to address family protection issues.
FSM Elimination of Violence against Women (EVAW) Policy	This policy focuses on improving policies and services for violence against women. The FSM National Government has led the development of the EVAW Policy, and National and State Action Plans, to support implementation. The policy articulates the need for: (1) a survivor-centred approach; (2) a rights-based approach; (3) a community-based approach; (4) and 'do not harm' approaches.
FSM Nationwide Integrated Disaster Risk Management and Climate Change Policy (2013)	Among its guiding principles this policy recognizes the need to place special attention to gender issues and the needs of marginalized groups, such as small atoll communities, the disabled and the elderly. However, it fails to explicitly mainstream gender into the stated objectives.
Climate Change Act (2013)	The Climate change Act furtherance of the provisions on climate change of the FSM's Nationwide Integrated Disaster and Climate Change Policy. The Act was intended to provide the overarching framework for further detailed legislation on climate change, thus requiring National departments and agencies to prepare plans and policies on climate change consistent with the provisions of the FSM Nationwide Integrated Disaster Risk Management and Climate Change Policy. This act represents an opportunity for mainstreaming gender into climate change plans and policies supported by the requirements for annual reporting and funding since 2015 to Congress on the implementation of the FSM's Nationwide Integrated Disaster and Climate Change Policy.

Policy & Plans	Relevance to gender equality
FSM National Energy Policy (2012, Volume I) and National and States Energy Action Plans (2012, Volume II)	The FSM has endorsed a National Energy Policy (2012) that aims to lessen the dependency of the country on imported fossil fuels "*by implementing energy efficiency and conservation measurements and including more environmentally sound renewable energy sources that are locally available*". The policy identifies the need for engaging women in policy implementation and integrated planning. However, it does not have clear specifications for promoting gender inclusion trough women's direct involvement in capacity building such as "*energy-related training opportunities at all educational and professional levels*" and "*technical capacity for all aspects of energy sector planning and development*". Similarly, the national and states action plans lack to make explicit provision or requirements for equitable gender-inclusion in capacity building programs.
FSM Agriculture Policy	The FSM Agriculture Policy has 7 guiding principles that promote food security and enhancement of agriculture yield in the country. This policy recognizes social and gender equity with the goal of improving farm incomes and livelihoods, placing a particular focus on gender and vulnerable groups. Hence, to ensure gender inclusion the policy identifies, among its strategies and indicators, the need for (i) sex-disaggregated socio-economic data on farm households, (ii) gender balance in recruitment of training staff and enrolment of students on training courses, (iii) gender responsive extension programs.
FSM National Biodiversity Strategic Action Plan 2018-2023	The NBSAP recognizes the vital need to consider gender in order to fully understand the importance and experience of biodiversity across society in the FSM. The Plan highlights how the different experiences of men and women on biodiversity, and changes in biodiversity over time, provides unique insights into FSM's biodiversity, agrobiodiversity and perceptions of changes in biodiversity. This is done by recognizing the different role played by men and women in using and accessing natural resources.
FSM National Strategic Development Plan 2004-2023 (SDP)	The SDP recognizes as prerequisite for economic equity and economic justice the need for women's active participation in the economic development of the country. The Plan highlights the key role that women play in bringing into the economic development process their knowledge and skills, which will likely ensure an equitable social justice for all. Most importantly the SDP recognizes that exclusion of women from the decision-making process can significantly limit the capacity of the FSM *"to successfully achieve its stated macro-economic policies adopted at the 2nd FSM Economic Summit."*
FSM National Disaster Response Plan 2016	The FSM National Disaster Response plan provides for the establishment of national institutional arrangements for preparedness, monitoring for potential events and response to emergency and disaster events within the country. The plan aims to "*promote arrangements in disaster response management that are gender and child specific, which address the needs of marginalised and vulnerable groups and provide for the involvement of women*", recognizing that the involvement of women at all levels, including operational processes and decision-making, is essential for an effective disaster management. To encourage this inclusion, the President of National Council of Women is a member of the National Disaster Coordination (NDC), which has the function to (i) advise the President on strategic institutional, policy and funding issues necessary to provide for effective disaster preparedness and response in FSM, (ii) review and monitoring the state of the Disaster Response plan and (iii) provide management direction in the event of a disaster.

Identified data gaps and needs

Data gaps were identified during the review of existing documents, data and policies, and consultations with stakeholders.

Climate change sex-disaggregated data gaps were relative to:

- Households affected by droughts, floods and typhoons;
- Costs of climate change related damages per household;

> Women and men leading community-based climate change adaptation projects;
> Participation to the climate change regional and international arena;
> Post-disaster relocation and out-migration;
> Access to recovery services and products;
> Access to early warning systems;
> Access to climate funding (e.g., adaptation fund, Green Climate Fund, GEF Small Grant Programme).

In addition, presented below are some suggestions on the type of data that can be collected to inform specific data gaps. Some of these data may already exists, but they were not readily accessible for consultation, or they were not disaggregated by sex. It is highly recommended to identify, through a participatory process with the FSM states and national governments, those data that can be repeatedly collected, and to put in place a framework for systemization of collection, upload, ownership and access of these information.

Table 6. Suggestions for data for collection based on the identified data gaps by sector.

Sector	Data to consider for collection
Agriculture	Consider collecting sex-disaggregated data on: ▪ Climate change and climate smart-agriculture trainings and workshops, including access to trainings, participation, application of learned skills. ▪ Distribution of post-disaster funds in affected communities. ▪ Access to loans or grants to implement climate-smart agriculture. ▪ Impact of drought, or any other climate change related disaster on agriculture assets.
Forestry	Consider collecting sex-disaggregated data on: ▪ Fuel wood.
Biodiversity	Consider collecting sex-disaggregated data on: ▪ Participation to protected areas management. ▪ Men and women involved in technical positions. ▪ Use of resources and implications to loss of biodiversity. ▪ Emerging threats and challenges.
Sector	Data to consider for collection
Fisheries	Promote collection of sex-disaggregated data in organizations involved in the fisheries sector, with focus on food security.
Energy	Consider collecting sex-disaggregated data on: ▪ Households with electricity. ▪ Households with alternative energies (renewable energy, biogas). ▪ Households appliances type and use. ▪ Households accessing grants for implementing renewable energies.
Transport	Consider collecting sex-disaggregated data on: ▪ Car owners. ▪ Boat owners.
Water	Consider collecting sex-disaggregated data on: ▪ Households with water catchment systems and impact of extreme events on these systems. ▪ Households connected to the water grid system and impact of extreme events on these systems. ▪ Households with flush toilets. ▪ Households accessing water from community tanks. ▪ Households accessing water from wells, use of this water and land tenure. Impact of saltwater intrusion and floods on these systems.

Sector	Data to consider for collection
	▪ Leadership and technical positions in this sector. ▪ Access to trainings on water management and storm-water management.

Challenges and Identified Needs

Table 7. Challenges for gender mainstreaming and identified needs

Challenge	Identified needs
Social and cultural norms can be a barrier to gender equality	- Increase investments on awareness (e.g., women as agents of change on climate change action). - Increase opportunities for women to access technical trainings and information. - Equally involve men and women in trainings by involving women facilitators and creating a safe space for knowledge sharing. - Be sensitive to gender roles when working with communities, but still make sure to equally divide labor during projects implementation.
Gender is not always seen as a priority	- Increase investments on gender-responsive program planning and design. - Identify gender focal points in relevant departments and organizations (e.g., National Council of Women) for appointment. - Consider to develop a gender and climate change mainstreaming strategy or action plan to guide governmental actions.
Lack of gender experts and capacity	- Build in-country capacity by raising the profile of gender agencies- national and states gender offices. - Increase investments to build the capacity of the gender focal points.
Lack of time and human resources	- Ensure that consultations are designed to accommodate women's and men's time constraints. - Identify focal points in the non-governmental organizations that sustain climate change actions in the country.
Gender mainstreaming in climate policies is mentioned but infrequently implemented	- Support the recognition of traditional women's leadership roles to enhance gender mainstreaming into policy mechanisms at state and local level. - Implement gender mainstreaming through gender budgeting.
Limited budget dedicated to gender mainstreaming in climate change policies	- Increase investments on gender-responsive program planning and design. - Integrate gender equality into policy mechanisms through gender budgeting. - Access international climate change funds (e.g., GCF, GEF-SGP) with the specific aim of building and/or strengthening institutional capacity and legislative framework for gender mainstreaming.
Lack of data on climate change and gender	- Establish a regulatory framework for data collection and sharing. - Identify climate change data that are relevant to states needs and capacity - Identify specific criteria and indicators that are sensitive to FSM women' and men's needs.
Limited local capacity for climate change adaptation	- Consider collaborate with /contribute to trainings from international organizations (e.g., PREL, SPC) on climate change and natural climate patterns (e.g., El Niño-La Niña, etc.) for rural women and men, teachers and youths. - Increase educational opportunities for youth and women to better understand the role they can play for preparing and respond to the effects of climate change by collaborating with local institutions (College of Micronesia, schools) and NGOs. - Involve, and build the capacity of women associations and groups to support the collection of sex-disaggregated data and assists in consultations.

7.4 Recommendations

Mainstream gender:

> Ensure that the National Communications, BURs, updated NDC and future National Adaptation plans are built upon international frameworks and guidance (e.g., UNFCCC GAP, UNDP Gender National Communications toolkit, the NAP Global Network & UNFCCC Toolkit for a gender-responsive process to formulate and implement National Adaptation Plans).

> Ensure that the NCs, BURs, updated NDC and NAPs include aspects related to women's vulnerabilities, women's participation, women and men roles in each sector, women and men use and access to natural resources, capacity building gaps and needs, and monitoring and evaluation of specific gender-responsive indicators.

> Ensure equitable participation during the development of NC, BUR, NDC and NAPS by balancing the participation of men and women in the working groups, including women from rural areas to ensure that their knowledge is brought into the policy and decision-making arena.

> Ensure that NC, BUR, NDC and NAPS consultations are designed to accommodate women's and men's time constraints and work around social barriers to ensure women's full participations. Be sensitive in addressing cultural barriers and social norms thus to highlight the vital contribution that women's knowledge can play in climate change.

> Identify approve and establish, through States participation, gender-responsive indicators by sector.

Improve sex-disaggregated data system:

> Build on existing FSM Departments methodology for climate change data collection to ensure that gender is mainstreamed in the data collection tools (e.g., VA conducted by the Division of Emergency Management, Census data collection, etc.).

> Raise awareness on the importance of climate change data collection, particularly sex-disaggregated data, not limited to the NC and BUR reporting. Highlight the benefits of collecting this type of data (e.g., data on climate change, including implications on ecosystems and society, can be used to update Joint State Action Plans, states Biodiversity Strategy Action Plans, etc.) and clarify the type of participation required, in terms of time, human resources and budget for collecting climate change data.

> Identify, through a participatory approach, climate change sex-disaggregated data that are relevant for the FSM's states, considering current capacities in terms of human resources, time and budget.

> Establish a framework for systemization of collection of sex-disaggregated data in collaboration with the FSM national and states Statistics Offices. This needs also to include baseline information on gender balance in decision-making by sector, e.g., in energy, coastal management, forestry.

> Create enabling conditions to establish a regulatory framework that clearly defines managing options and guidelines (e.g., Standard Operating Procedures) for climate change data collection, safeguard and ownership.

> Improve and support coordination of climate change data collection, by sector, with the FSM national and states Statistics Offices.

> Build stakeholders capacities regarding the identification, collection and analysis of data disaggregated by sex and age.

Capacity building for climate change action:

> Assess the existence / or assist the development of indicators with the FSM National Gender Office to monitor the level of women's participation in climate change sectoral policies and planning.

> Collaborate and coordinate with the FSM National Gender Office and the States counterparts to support the building of women's leadership.

> Collaborate with the National Gender Office and the States counterparts to strengthen climate change and gender capacities.

> Ensure to systematically involve women in climate change mitigation and adaptation planning and decision-making, particularly in rural areas and outer islands.

> Involve women-led and community-based organizations in climate change planning, trainings, seminars, workshops and events.

> Build awareness on the importance of women's knowledge for climate change adaptation and disaster risk reduction and actively promote women's participation to climate change planning by ensuring meaningful participation (i.e., account for gender roles and needs during consultations).

Establish or reinforce gender focal points network:

> Assist the FSM National Gender Office in advocating, where needed, for the identification of gender focal points within FSM national departments or divisions or offices (e.g., DECEM, R&D, FSM National Statistics Office, etc.).

> Build and/or reinforce network and collaboration between the identified gender focal points with states gender offices (e.g., Yap GSO) or recognized organizations (e.g., CWC).

> Collaborate with the FSM National Gender Office, the states gender offices and the gender focal points to identify training needs for gender and climate change.

> Ensure participation and contribution of the focal points to the working groups for the NCs, BURs, NDCs and NAPs.

> Identify budget for national and states gender focal points meetings and learning exchange.

Strengthen public institutions' capacities to mainstream gender:

> Strengthen participation of women and men to gender and climate change trainings with the intent to inform key stakeholders (e.g., national government, state agencies, local NGOs, community-based organizations, etc.) on the differential impact of climate change on men and women, climate change vulnerability by gender and sex-disaggregated data.

> Reinforce partnership with international organizations working on gender and climate change (e.g., SPC, IOM, MCT, TNC, etc.) to enhance capacities to mainstream gender into climate change action.

United Nations Organizations:

The **UN Women** is the organization dedicated to gender equality and women's empowerment that was established to accelerate progress on meeting women needs. The UN Women operates in the FSM in assisting the country in advancing gender justice, ending gender violence and increasing community resilience through empowerment of women. The Programmes implemented by UN Women in the FSM were sourced from the UN Women website (https://asiapacific.unwomen.org/en/countries/fiji/co/federated-states-of-micronesia):

- **Advancing Gender Justice in the Pacific (AGJP) Programme**: UN Women continues to build capacity with its government and civil society partners for CEDAW implementation and reporting, particularly when it comes to adopting a harmonized human right reporting and implementation approach. In terms of women's political participation, UN Women is undertaking advocacy initiatives through its Empowerment Series events.
- **Ending Violence against Women (EVAW) Programme**: This programme provides stakeholders with access to virtual knowledge platforms, tools and evidence-based resources in order to better equip them with the knowledge and evidence to advocate for strengthened EVAW legislation, improved policies and services for violence against women survivors. Social media tools are also made available to support community mobilization aimed at ending violence against women and girls, through campaigns such as the United Nations Secretary General's UNiTE to EVAW and Say NO-UNitE.
- **Women's Economic Empowerment (WEE) Programme**: As part of this programme, UN Women is providing technical support to the national and local governments in producing knowledge products that give decision-makers improved and comparable evidence on the economic situation for women in FSM.
- **Increasing Community Resilience through Empowerment of Women to Address Climate Change and Natural Hazards (IREACH) Programme**: UN Women supports the incorporation of gender dimensions in strategic documents for disaster risk management and climate change through provision of knowledge products and tools on the gendered implications of climate change and disasters.

Gender Action Plan

Introduction

On 12 June 1992, the Federated States of Micronesia (FSM) signed the United Nations Framework Convention on Climate Change (UNFCCC). On the 18th of November 1993, the FSM Congress ratified the initiative and on the 21st of March 1994, the UNFCCC entered into force. As party to the UNFCCC, the FSM has made every effort to comply with its obligations, including reporting back on the country's efforts for addressing climate change mitigation and adaptation.

As part of the FSM reporting commitments to the UNFCCC, the nation submitted its Second National Communication (SNC) in November 2015. The SNC instituted the FSM baseline documenting the country's vulnerability to climate change (CC) and established the reference point for its greenhouse gas (GHG) emissions, since submitting its Initial National Communication (INC), in October 1999. It described the effort the FSM was making to reduce GHG emissions and establish a set of actions to curtail the impacts of climate change. In addition, the SNC laid out the country's requirements for improved information, the need to strengthen capacity and develop policies to reduce the impacts of climate change.

The FSM has been diligent in its efforts to preserve their natural heritage. For over a decade it has documented the challenges they are facing due to climate change. The people and government of the FSM believe that their wealth is tied to their natural resources and they have taken great efforts to conserve their valuable resources as well as create the enabling conditions to ensure the continued health and resilience of the people and the nation.

Thereby, to reduce climate risks, minimize the impacts of natural disasters, and ensure the nation's and its people's resilience, the FSM put great energy in creating policies and strategic plans to ensure that National and State agencies have the mandate to implement climate action plans. This was also realized through regional multilateral environmental agreements (MEA), such as the Micronesia Challenge (MC).

As the country prepares itself to deliver its Third National Communication (TNC) and its First Biennial Update Report (FBUR), it will use this exercise to fully explore the real security risks – current and future – imposed by climate to the nation, its states and communities. The TNC-FBUR would assist the collection of data that will ascertain the countries vulnerabilities, describe challenges and analyze threats, all to support the development of appropriate adaptation measures that are implementable at all levels of society and across all sectors of development. The assessments should support a wide and comprehensive suite of policies and strategic plans that assure that the nation and its people are able maintain the resources in which their communities, cultures and private sectors depend upon. Such strategic measures would assure basic human needs, societal wellbeing, and provide living wages by ensuring natures provisions are intact to support food security and access to clean water. Furthermore, the TNC-FBUR will provide critical information to support the FSM's efforts in climate stability and mitigation. The assessments will support the government to establish appropriate social and environmental targets and incorporate measures to track their progress that benefits the country and socioeconomic wellbeing of the people.

Through this process, the FSM will collect and report on eight (8) key areas:

- National circumstances and institutional arrangements;
- Assess progress towards mainstreaming climate change consideration into key development strategies and sector-based policy frameworks;
- Identify constraints and gaps including assessment of financial, technological and capacity building needs and provision of recommendations for addressing those needs;
- Consolidate other information relevant for the preparation of the NC and the BUR;
- Update the GHG Inventory up to the year 2014 and improve the GHG reporting mechanism;
- Provide a key in-depth vulnerability assessment, including recommendation for adaptation measures for key sectors for socioeconomic development and natural environment, risks of climate change, climate variability and extreme weather events;
- Assess sectors and interventions contributing to GHG emissions reduction at the national level, using best practices and latest NDC;
- Support the establishment of a domestic Measurement, Reporting and Verification (MRV) system.

The National Communication (NC) and FBUR will also incorporate a guide to guarantee gender is integrated into the data collection process and that strategic plans are developed that includes equal and equitable access to trainings, technical capacity building. This gender-responsive approach guarantees that men and women are represented in the development and implementation stages of the NC and FBUR. Thereby, it is crucial that sex disaggregated data is collected and analyzed, and that the data collection process is considerate of culture as well as sensitive to all participants, stakeholders and partners.

Adding a gender dimension to the TNC-FBUR process will provide vital information about the way different gender interact with available resources and provides context for the roles that the genders play, which are influenced by socioeconomic and cultural conditions. The gender dimension creates enabling conditions that promotes community resilience and supports full participation in the implementation of climate action. Including gender into strategic plans and establishing clear monitoring protocols, it will embed gender actions into sustainable, mitigation and adaptation practices and decision-making processes. Further, it ensures that all genders are represented at all stages – design, planning, decision-making and implementation.

It should be noted, that in 2015, a decision was made in line with the Climate Change Act and the Climate

Change Policy (2013) that (a) each year, a report card on ways climate change issues have been mainstreamed into public sector (8 Departments including FSM National Government's Department of Health and Social Affairs (latter housing gender, ending violence against women disability, youth, sports, social inclusion will be tabled to Congress); (b) FSM committed, as outlined in the National Disaster Management Plan (2016), to "promote arrangements in disaster response management, which are gender and child specific, which address the needs of marginalised and vulnerable groups and provide for the involvement of women" and; (c) Several Joint Action Plans on addressing climate change have been developed between the FSM National Government and States such as Yap, Kosrae and Pohnpei. Therefore, it is important that the GAP ensures that the aforementioned policies and plans take into account commitments in the National Disaster Management Plan and the contexts and capacities in each State in terms of data collection including equal and equitable access to trainings, technical capacity building.

Furthermore, it is imperative that the GAP supports the ideas that capacity building, knowledge sharing, and communication are part of each of the components that are covered within the TNC-FBUR, and that they resonate with the accompanying Gender Analysis Report. The TNC-FBUR should also ensure that the ideas of capacity development follow the five priority areas in UNFCCC's Gender Action Plan out of COP 23 (2017). Other priority areas (b) Gender balance, participation and women's leadership (c) Coherence (d) Gender- responsive implementation and means of implementation and (e) Monitoring and reporting.

Purpose

The Gender Action Plan (GAP) was created to guide the data collection process for the reporting areas of the TNC-FBUR:

- Greenhouse Gas Inventory Update
- Climate Change Mitigation Update
- Vulnerability Assessment and Adaptation to Climate Change
- Domestic Measurement, Reporting and Verification (MRV)

It is intended to collect gender data to ascertain where key informational gaps exist and to develop structures that supports mainstreaming gender through the implantation of existing gender policies, to develop policies that ensure equality and equity where needed, and to ensure significant and meaningful participation of all genders. It should also be made clear that the GAP is not a national gender action plan, rather it is a guidance document for the collection gender included data and statistics; to ensure that trainings and capacity building activities are gender inclusive, balanced, gender coherent; and that climate adaptation and mitigation plans are not only gender sensitive, but that the needs are accurately reflected as a result of gender inclusivity in all processes.

Chapter 8

Opportunities, Barriers and Paths Forward

Photo credit: Micah Seidel, Rutgers University

UNDP

Empowered lives.
Resilient nations.

8.1 Sustainable Development Opportunities

From the 2023 GCF baseline survey of 600 farming families and local food producers across all four FSM states, key stakeholder aspirations and initiatives were reported that suggest opportunities for community led sustainable development (Rutgers University, 2023). Essential to the mission of this GCF food security baseline survey conducted with each of the FSM state governments and collaborating organizations is giving the nation's subsistence farmers and aspiring commercial farmers the opportunity to express their needs, goals and market challenges for future agriculture, aquaculture, and sustainable food production within a changing climate. The core criteria for selection of the communities from which farming families were interviewed was done in consultation with the state governments and local NGOs to ensure (i) geospatial distribution across each of the states to ensure representation across each of the townships/districts and (ii) inclusion of communities living on the coastal areas; (iii) inclusion of communities that had been impacted by prior environmental/weather/storms; (iv) inclusion of communities that participated in prior national surveys as a result of their vulnerability.

The GCF baseline survey results show a consistent desire by farming families and local commercial farmers to increase local food production with requests for additional capacity building through training and access to new tools and technologies including improved varieties of climate resilient crops (e.g. salt tolerant, disease resistant). Farming families and focus groups interviewed offered a series of potential community-led and often culturally-based opportunities for sustainable growth and job creation.

The role of Traditional Knowledge in Sustainable Food System Development

The FSM's local communities apply traditional knowledge in day-to-day social, economic and environmental decision-making, and therefore traditional knowledge can play an important role in the FSM's sustainable development planning and implementation.

In the FSM, traditional knowledge (TK) systems are understood to be living cultural traditions that evolved over centuries as the result of local people interacting with their natural surroundings. Traditional knowledge includes community governance, social and family institutions, language, naming and classification systems, natural resource use and conservation practices, rituals, spirituality and world views.

Traditional knowledge systems have been, and are, empirically tested, applied, and validated by indigenous peoples and local communities, and are continually evolving through contemporary problems-solving.

Opportunities Related to Local Food System Development

A long-term commitment to environmental conservation and preservation coupled with increased production of local food to reduce importation of fresh and processed foods can lead to a stronger local circular economy. Traditional agricultural systems can be made more efficient for food production and sustainable development strategies could enhance sustainable agricultural production for both food and cash earnings.

There are many new opportunities related to the sustainable development of local foods, including the establishment of aggregation centers, incubator centers for food processing and preservation, and related training and capacity building. In addition, introduction of the commercialization of aquaculture, protected cultivation (greenhouses), and clean drinking water that incorporate green energies such as solar power will create new jobs and new markets.

Challenges:
In order to cope and adapt, IPLCs rely on essential elements of traditional knowledge, cultural values and customary institutions, households, extended families and clans for relief and support. These indigenous customs often operate outside government institutions.

Opportunities for Aquaculture:
On small islands and low atolls, marine food sources are often the principal means of survival and production since agriculture and freshwater resources are limited. High islands, such as the main island of Pohnpei State, are fortunate in having a wider range of aquaculture options since fresh water, brackish and marine environments provide potential sites for aquaculture. Pohnpei has a well-developed barrier reef surrounding a narrow lagoon with an area of about 181 km^2. Off-shore aquaculture may also be a possibility.

The FSM is perfectly situated to develop marine aquaculture, with some of the highest tropical marine biodiversity in the world and clean ocean waters that provide a unique opportunity for growing native marine species with an integrated aquaculture strategy. The FSM Aquaculture Management and Development Plan 2019–2023, produced by the FSM Department of Resources and Development, provides a list of priority Yap State marine commodities developed through consultations with a range of stakeholders and resource personnel. Planning workshops at the national and state level were conducted involving key individuals from state and national agencies, non-governmental organizations (NGOs) and private sector companies; participants from each state developed strategic actions for specific aquaculture commodities and addressed key challenges or constraints to aquaculture development. The marine commodities listed were scored based on their aquaculture feasibility and impact. Feasibility was defined by how appropriate the technology was for Yap and how well the marine commodity might be grown and marketed. Impact was defined by the potential benefits of that marine commodity and how the commodity would affect local culture, society and the environment. In both categories—feasibility and impact—the giant clam received the highest priority ranking.

Challenges: Marine aquaculture success requires development of effective methods to maintain proper local conditions combined with effective management to minimize environmental degradation. Proactive approaches are required to develop resilient aquaculture management strategies that protect and conserve marine and terrestrial habitats from the impacts of climate change. Forecasting seasonal shifts in habitats and species will inform adoption of management strategies to sustain farming, fishing and aquaculture operations as well as to identify suitable future food production opportunities. Over the long-term, rising sea levels will impact the island atolls and shoreline, however, "living" shorelines have been demonstrated to have beneficial impacts in minimizing shoreline erosion. Site surveys exist that provide good characterizations of local habitat and should be used to inform MPA establishment, management and sustainability and the potential establishment of zones specifically delineated for aquaculture. Ultimately, the challenges to successful aquaculture development for Pohnpei State includes lack of Technical Capacity Building, lack of marketing and lack of infrastructure (Federated States of Micronesia Aquaculture Management and Development Plan 2019–2023). There is also a weak private sector investment infrastructure and an under-developed orientation to move from pilot development projects, research & development projects into either public/private sector partnerships or commercialization enterprises.

Opportunities for Processing Clean Drinking Water:
The FSM's remote islands are vulnerable to fresh water shortages and access to clean and reliable drinking water sources is an urgent priority that also provides opportunities for infrastructure development, capacity building and job creation. Pohnpei Island, for instance, is one of the wettest places on earth, yet the majority of bottled drinking water is imported into Pohnpei State. Strategies to ensure reliable, clean drinking water is available to everyone is a priority for the people of Pohnpei (Pohnpei State Department of Resources and Development Food Security Strategy 2023). There are currently nascent water processing operations in Pohnpei that can be developed and further commercialized while protecting this precious natural resource.

Public policies coupled with capital investment can support the development of local water collection and transport methods that do not increase plastic pollution. Local water production on the atolls could also consider solar-powered desalination units with proper training and maintenance protocols to provide reliable drinking water for outer island communities. Water collection systems can assist and used during dry periods for household consumption and food production (animal and plants).

Challenge: A multipronged approach to the processing of local drinking water must include the voices of all stakeholders to ensure protection and sustainable development of this critical resource. The solar-powered desalination units can become damaged and there is not sufficient local expertise to repair them and maintenance has been challenging to provide reliable drinking water for outer island communities.

Opportunities for Traditional Cropping and Agroforestry

Intercropping and agroforestry systems have been leveraged throughout the Pacific to optimize dietary diversity and resilience with limited land and have been proposed as climate adaptive strategies (Burgess et al. 2022). Agroforestry systems are designed to balance production considerations with ecosystem services, many of which (e.g., water filtration, shade, habitat for natural enemies of pests) are important for coping with climate change stressors. Additionally, like intercropping, these mixed systems allow farmers to maximize the chance that at least some crops will be successful, as the varied species planted often have a range of stress tolerances. Additionally, mixing ecologically complementary species can create synergistic systems, in some cases with land equivalence ratios capable of superseding net yields in monocultures of the component species to a substantial degree. Agroforestry is the traditional cultivation method for many of the food crops on Pohnpei, and while a great deal of local research has been done on this topic, much more could be accomplished, perhaps through a partnership with the Department of Agriculture. This potential should be investigated as part of the food security strategy. The GCF baseline survey revealed a wide variety of activities farming families practiced, including tree planting, to protect their land's biodiversity (Rutgers University, 2023). Those household communities that did not alter their practices in face of climate change, reported that they did not because they lacked information and/or lacked skills or resources.

The FSM has sophisticated agroforestry systems and traditional knowledge for the sustainable harvesting of forest crops that can be combined as part of a sustainable harvest strategy for both subsistence needs and market sales. The main cash crops of the FSM of bananas (Kosrae, Pohnpei), citrus (Kosrae, Yap), pepper (Pohnpei), sakau (Pohnpei) and betel nut (Yap) are all well suited to production within a multitiered agroforestry production system.

Challenges: The lack of commercial-oriented growers and marketing associations; limited financial, research and development investments; lack of postharvest refrigeration, drying, processing and packaging facilities; and the high costs of imports relative to agricultural equipment and supplies all are challenges to locally based and economically competitive commercial agriculture.

Opportunities for Culturally Based Agritourism and Ecotourism:

Ecotourism is one of the fastest growing sectors in the global economy. Ecotourism tends to attract tourists of financial means seeking authentic traditional and environmental experiences. Visitors from the United States dominate tourist arrivals to the FSM, and the 2014 FSM National Tourism Sector Development Framework included ecotourism with linkages to local agriculture. The FSM National Tourism Policy 2015–2019 includes the objective of promoting local traditional knowledge, expressions of culture including production and preparation of local foods and traditional livelihood skills as part of a national tourism development strategy. In addition, the FSM 2023 Action Plan describes sustainable tourism as a driver for economic growth. Agritourism can include opportunities for visitors to pay to learn traditional agroforestry and ethnobotanical practices, visit local farms and farmers markers and learn to cook traditional meals. The FAO has been supporting agritourism in the Micronesian region as part of sustainable tourism initiatives that include local food cultivation traditions intended to empower women, increase local nutrition and reduce dependence on imported foods (FAO, 2023). The FSM has the potential to be a global destination for high-end specialty cultural ecotourism by attracting a targeted market of educated, ecologically minded travelers that prefer to enjoy lands with rich cultural heritages and traditional local foods.

Community stakeholders are intricately involved in the development of these FSM tourism policies. For example, the Pohnpei State Strategic Development Plan includes opportunities for tourism-based private sector development. This plan's development approach relies on public participation and cross-sector engagement throughout a five-stage process: Preparation to Plan, Training and Capacity-building, Public Education and Engagement, Analysis and Strategic Plan Development, and Plan Approval. Major components include cooperating with traditional, elected and community leaders; involving existing community, NGO and other organizations already working in Pohnpei; and developing a public education program to facilitate citizen engagement.

A successful ecotourism development requires that traditional resource owners and communities must be fully involved in the protection, conservation, preservation and sustainable use of the state's biodiversity for the development of ecotourism. FSM's local resource owners and communities need to be empowered to promote conservation and thus be included in the design of ecotourism strategies.

Examples: Yap State is home to some of the most complex, indigenous Pacific Ocean stewardship knowledge still practiced today and Yap's stone money is referenced in international economic curriculum. Yap is home to the world-famous master navigator Pius Mau Piailug, who helped revive the practice of non-instrument navigation throughout the Pacific. Yap has also shown a capacity for eco-education and eco-research industries such as One People, One Reef, which is already attracting many scientists to Yap State each year. One locally based capacity building initiative that could support culturally based ecotourism, is the College of Micronesia year-long traditional navigation program that provides participants with skills in traditional Micronesian non-instrument seafaring and navigation. This course offered at COM's Yap campus was created due to increased local interest in traditional navigational knowledge that includes applied use of ethnomathematics and a holistic understanding of ocean ecosystems, weather and marine life.

Challenges: Currently, there are no legally protected areas in the Yap Islands; all land is privately owned. The use of natural resources has been regulated by customary management but, as populations grow, this is becoming more problematic in Yap as it is elsewhere in the Pacific. A successful culturally based ecotourism development requires that traditional resource owners and communities must be fully involved in the protection, conservation, preservation and sustainable use of the state's biodiversity for the development of ecotourism. The FSM's local resource owners and communities need to be empowered to promote conservation and thus be included in the design of ecotourism strategies.

Opportunities for In-Country Capacity Building and Technical Training:

Unemployment is high in the FSM, particularly among young people, and many Micronesians leave the country in search of training and job opportunities abroad. The country's working-age population is shrinking, and much of the labor demand is met by workers from abroad (IOM, 2016). A lack of access to technical and vocational training is a considerable obstacle to improving this situation. The FSM Skills and Employability Enhancement Project (SEE), funded by a $17,700,000 investment from the World Bank, will partially address this need by establishing the FSM Skills Academy housed in the refurbished Pohnpei Agricultural and Trade School ("PATS"). The SEE Project will also be used to upgrade and purchase relevant equipment and materials to strengthen hands-on learning opportunities for high schools in all four states.

To increase professional offerings with the FSM, the College of Micronesia just expanded their curriculum to include two new 4-year Bachelor's degree programs. The first is a Bachelor's Degree of Science in Business

Administration with an Emphasis in Accounting (BSBAA) and the second is a 4-year Bachelor's degree program in elementary education.

Challenges: A young adult population is needed to drive demand for increased professional educational offerings within FSM. At the same time, patterns of out migration reduce the very young adult population that in-country training programs seek to serve.

8.2 Barriers, Gaps and Constraints

Since the Second National Communication, the FSM has taken a number of initiatives that ensure climate change is mainstreamed into national development planning, setting the basis for climate change adaptation and mitigation activities. Many initiatives have been done, including, among others, the formulation of the Joint State Action Plans (2015) for disaster risk management and climate change adaptation, the Disaster Preparedness/Response Plans (2017), the development of the Country Program for the Green Climate Fund (2017), and the current update of the FSM Nationally Determined Contribution (NDC) in 2022. However, some barriers, constraints and gaps related to data availability, collection, storage and coordination still persist. These constraints are associated with a clear need for technical capacity building, in terms of data management, financial and human resources.

The third NC was structured by utilizing data from different sectors, including information on policies, strategies, plans and projects planned, completed or under implementation. A description of the type of data used for informing the third NC is provided in the table in Appendix 2.

The data available to inform the National Communications are part of institutionalized frameworks at country level, however, limited resources and capacity restricts the utilization of this information. At present the national institutional arrangements for data sharing across departments and agencies for climate change reporting are not clearly outlined. Nevertheless, the FSM Climate Change Act (2013) provides a starting point for data/information sharing, by which climate change mainstreaming across FSM government departments is defined.

At national level, the Division of Statistics has the mandate for periodic data collection on population, international arrivals, housing and households, economic and environment (e.g., climate characteristics), but some dataset are incomplete or inconsistent. The FSM national statistical system requires improvements to respond to data needs for banking, remittances, private enterprises, services trade, tourist receipts and export data. Some of this information is key to better understanding the potential impact of climate change on social settings (e.g., migration) and key sectors (e.g., tourism sector). Some key data on climate change projects are available through the Office of Overseas Development Assistance (ODA), which is required to facilitate and identify priorities for the country, also in terms of climate change adaptation and mitigation. ODA collects, monitors and evaluates data on grant agreements, donors, project implementing agencies, sectors expenditure per year, including grants for climate change and mitigation projects.

The most relevant data collection frameworks in the FSM are presented in Table 1.

Table 1. Existing data collection processes in the FSM and responsible agencies.

Program	Data type	Responsible agency
FSM National Census	Provides sex- and age-disaggregated data collected on demographic, education, migration, income, employment (formal and informal economy), as well as data on households' access to electricity, drinking water and sanitation	FSM Division of Statistics under the FSM Department of Resources and Development.
Household Income and Expenditure Survey (HIES)	Provides a demographic profile with information on household expenditures, housing characteristics, tenure expenditure, utilities and communication expenditure, land and home expenditure, household goods and assets expenditures, vehicles and accessories expenditures, provisions of financial support (loans), health and communication expenditures. Information on income from wages and salary, non subsistence business (agriculture and forestry activities), from handicraft and home processed food activities, from livestock, fishing, hunting and aquaculture activities, from property income, remittances and other cash gifts, is also included.	FSM Division of Statistics under the FSM Department of Resources and Development.
Agriculture Integrated Census (IAC)	Provides sex- and age-disaggregated data on households that have access to land for agriculture, in particular arable land cover, land tenure, crops and livestock diversity and density, access to capacity building and equipment for agriculture, households' income from agriculture and livestock, uses of forest and data on fisheries and aquaculture	Division of Agriculture under the FSM Department of Resources and Development
Micronesia Challenge (MC) monitoring data	Provides information on the status of managed conservation marine and forest systems set aside under the Micronesia Challenge initiative. This set of data allows monitoring changes in forest and coral reef cover and progress towards the achievement of the MC targets.	Consortium of regional organizations[229]
Green Climate Fund	- N. of Projects funded under the GCF - Total amount financed since last NC Project based information are also available but dependent on the type of project implemented	National Designated Authority (NDA) for the Green Climate Fund, with the Department of Finance and Administration. The Office of Overseas and Development Assistance (ODA) tracks and provides information on overseas funds.
Adaptation Fund	- N. of Projects funded under the GCF - Total amount financed since last NC Project based information are also available but dependent on the type of project implemented	Department of Foreign Affairs is the national focal point for the Adaptation Fund, with DECEM as executive Agency. ODA and Development Assistance track and provides information on overseas funds
Sustainable Development Goals Targets	- Targets for the FSM SDGs - Baseline data	Division of Statistics under FSM R&D. FSM identified 89 SDG targets, with an

[229] The Micronesia Challenge monitoring data are collected by a consortium of regional organizations: The Micronesia Conservation Trust, the U.S. Forest Service, the University of Guam, College of Micronesia, The Nature Conservancy, Conservation Biology Institute. Data to monitor progress on the MC marine target is collected through the 'Micronesia Coral Reef Monitoring Program' by a consortium of local NGOs, academia, and government agencies. These organizations work together with the common goal of assessing the status of the Micronesia coral reefs for management and conservation purposes. Among these organizations are the University of Guam Marine Laboratory, Yap Department of Marine Resources, Yap Community Action Program (YAPCAP) Marine Division, Chuuk Department of Marine Resources, Chuuk Conservation Society, Pohnpei Office of Fishery and Aquaculture, Conservation Society of Pohnpei, Kosrae Island Resource Management Authority (KIRMA), Kosrae Conservation Safety Organization, CNMI Coastal Resources Management Office, The Nature Conservancy Asia Pacific Program.

	- Progress on targets	accompanying 90 SDG indicators, linked to the FSM Strategic Development Plan, 2004-2023 (SDP). DoS is mandated with tracking progress on country SDGs.
Pelagic Fisheries under the Nauru Agreement	- Tuna stock trends - Variation in GDP from offshore fisheries - Trends of Vessel Day Scheme overtime	National Oceanic Resource Management Authority (NORMA): NORMA has the mandate to manage FSM fisheries within the country EEZ, excluding states territorial waters (12 nautical miles). The agency, in collaboration with SPC, collects and/or has access to pelagic fish stock trends, VDS, number of vessels operating in the FSM EEZ, and other data. These data are collected routinely and overtime.

Each state has a Statistics Office that may collect data at state level, according to their state mandate, and assist in the collection of census and HIES data, making the data available to the Division of Statistics at FSM R&D. Aside from the existing data collection frameworks reported in Table 1, the National and States governments collect a set of data at departmental and agency level, including data collected (i) on annual basis, (ii) sporadically and (iii) periodically (Appendix 3). In some cases, project-based data are also collected from NGOs, academia and International Organizations; however, access to project-based datasets for governmental reporting is not yet streamlined although information on the adaptation projects implemented in the country are particularly relevant for reporting (Appendix 3). Some constraints in using project-based data are associated with the lack of a clear methodological outline for data collection, lack of standardized procedure for data collection, and lack or partial availability of raw data.

The FSM climate reporting will benefit from establishing and operationalizing, at national and state level, a framework for the collection, archiving and processing of data and information required to inform NCs, thus to ensure that reporting requirements are met on a continuous basis. This would assist in reducing the constraints associated with data collection, processing, and reporting and ensure to address the challenge of incomplete or inconsistent datasets for climate change reporting. The establishment and operationalization of a framework for NC shall occur in a sustainable manner by taking into consideration government departmental needs and capacity and by building on the existing data collection processes (Table 1). This would ensure the consistent, transparent, comparable and flexible provision of, while avoiding duplicating data collection, as well as additional financial and capacity needs. Before the development of a national climate change data management system, the responsible agency would benefit by the identification of policies and initiatives (at national and state level) that could address NCs preparation as well as identify gaps that need to be filled to assist in the process. Appendix 4 provides guidance to establish a systemic process for the collection, analysis and storage of data for informing NCs.

A conceptual framework for data collection is proposed in Figure 1. The framework identifies linkages between the data central coordinator agency and other stakeholders. The main stakeholders identified in the proposed conceptual framework are:

- The FSM national data central coordinator agency is responsible for reporting to the UNFCCC, archive data provided by the national data teams or working groups, and for coordinating with the national data teams their available data. The data central coordinator agency would be responsible to identify the extent of climate relevant data to be captured to inform the National Communications and Biennial Update Reports.

- The data teams, located in departments that can provide climate-relevant data, are responsible for compiling the climate information from the data providers and to provide these data to the national data central coordinator agency.
- In the FSM some sector data may be collected from different agencies. The framework identifies potential coordinating agencies, which are responsible for coordinating with key agencies and stakeholders (data providers) on the availability and collection of data for a particular sector.
- The data providers work with the national data teams for providing climate-relevant data collected on the ground.
- The Steering Committee, which oversees the process, advises the stakeholders on overarching challenges (e.g., extent of climate-relevant data), roles and responsibilities for data sharing, and potential data management systems.

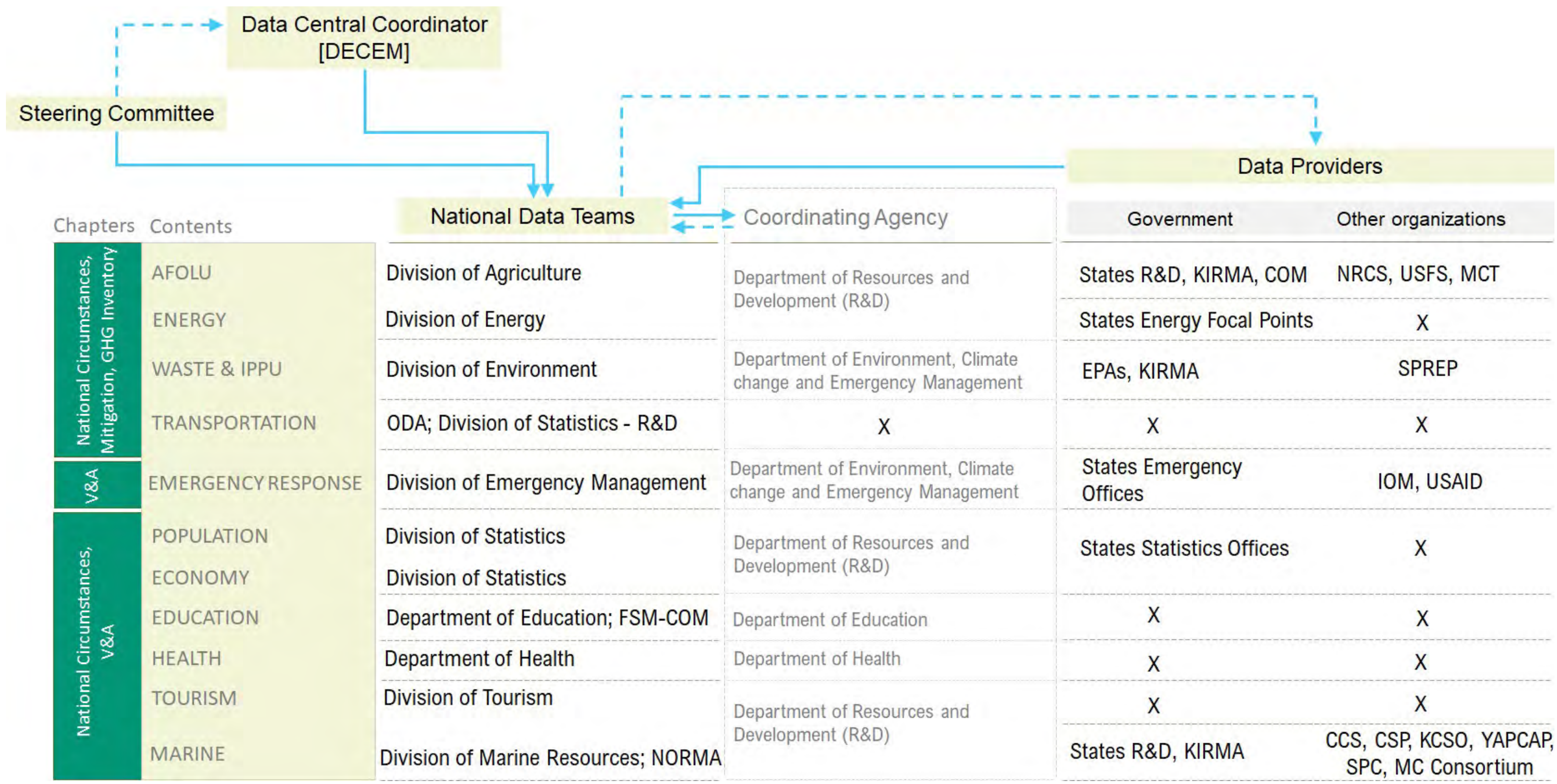


Figure 1. Conceptual framework for data collection. ODA: Office of Overseas Development Assistance, NRCS: Natural Resources Conservation Service, USFS: US Forest Service, MCT: Micronesia Conservation Trust, FSM-COM: FSM College of Micronesia, CCS: Chuuk Conservation Society, CSP: Conservation Society Pohnpei, KCSO: Kosrae Conservation Safety Organization.

8.3 Paths Forward

Policy in Place to Prepare for a Changing Climate

In the FSM, climate change and its impacts present an existential challenge. As a developing island nation, the FSM is highly vulnerable to the impacts of climate change in the form of environmental, social and economic losses. The impacts of climate change already have arrived by way of saltwater intrusion from rising sea levels that inundate taro patches and foul fresh water supplies, as well as through the increase in extreme weather events, such as storm surges.

The FSM is among the first 20 countries in the world to formally ratify the 2015 Paris Agreement. On August 2, 2016, the FSM Congress adopted Congressional Resolution No. CR 19-237,[230] ratifying as a treaty "the Paris Agreement concerning the need for an effective and progressive response to the urgent threat of climate change." Ratification of the Paris Agreement was the culmination of many years of work by the FSM to make addressing climate change a priority for the country.

The FSM has taken steps to "mainstream environmental considerations, including climate change, in national policy and planning as well as in all economic development activities," as outlined in its 2004–2023 Strategic Development Plan. The FSM's four states have enacted Joint State Action Plans (2015) for disaster risk management and climate change adaptation, Biodiversity Strategy and Action Plans for biodiversity and ecosystem conservation (2018), and Disaster Preparedness/Response Plans (2017). The FSM also committed to the Micronesia Challenge, a regional initiative that in 2019 launched new goals for effectively managing 50% of marine resources, including the exclusive economic zone (EEZ), and 30% of terrestrial resources by 2030. The FSM also enacted in 2012 a National Energy Policy and State Action Plans, which outline the country's transition toward renewable energy and have been translated into the FSM Energy masterplan (Castalia, 2018).

The FSM had previously adopted a brief "Nationwide Climate Change Policy 2009" whose focus was to mitigate climate change especially at the international level and adaptation at the national, state and community levels to reduce the FSM's vulnerability to climate change adverse impacts. In this context, FSM reaffirms its social and cultural identity and its people's rights and desire to continue to live sustainably on their islands. In 2013, the FSM adopted a policy for nationwide integrated disaster risk management and climate change. This policy calls for strong horizontal and vertical coordination between sectors and national, state, and community levels, using an "all-of-government," "all-of-country" coordinated approach that emphasizes partnerships between the public and private sectors and civil society. In the same year the FSM Congress passed the FSM Climate Change Act, intended to further the provisions on climate change of the FSM's Nationwide Integrated Disaster and Climate Change Policy (CC Policy) by introducing certain legal obligations for departments and agencies of the national government and to recommend additional legislation where applicable and necessary. The Act and the CC Policy are to provide the overarching framework for further detailed legislation on climate change. Since 2015, the FSM Congress has operated a Special Committee on Climate Change and Environmental Issues to focus on additional climate change legislation.

In 2017, the Department of Environment Climate Emergency Management (DECEM) was established to stand as the national coordinating agency for all government activities, including the implementation of the national emergency response framework.[231] DECEM is responsible for developing and mainstreaming climate change adaptation and disaster management policies. This department is the focal point for the Vienna Convention on Ozone Layer Protection and Montreal Protocol and the Global Environment Facilities. The Department of Foreign Affairs is the national focal point for the Adaptation Fund, with DECEM as executive agency and the Secretariat of the Pacific Regional Environment Programme (SPREP) as implementing agency. In March 2018

[230] C. Res. 19-237, 19th FSM Cong. (2016).
[231] The National Office for Environment and Emergency Management (OEEM), under the Department of Resources and Development, on the 29 September 2017, became the Department of Environment, Climate Change and Emergency Management (DECEM)

the FSM launched its first Adaptation Fund project "Enhancing climate change resilience of vulnerable island communities in FSM," executed by DECEM on behalf of the Government of FSM and implemented by SPREP as Accredited Entity to the Adaptation Fund. This $9 million USD project aims to build the resilience of FSM's island communities to climate change, reducing their vulnerabilities to extreme drought, sea level rise and other climate risks through water resource management, coastal resources and development planning through the National Designated Authority (NDA) for the Green Climate Fund, with the Department of Finance and Administration (DoFA). The FSM secured its first GCF Readiness Program, a country-driven initiative, to prepare FSM to access GCF funds effectively and efficiently through the National Designated Authority Office with the Department of Finance and Administration (DoFA) and developed its Country Program[232] (CP) for GCF in 2017. The CP is a living document, currently under update, presenting a portfolio of cross-sectoral priority projects for a resilient and transformative development of the country. FSM is currently implementing two (2) GCF-approved projects for an estimated total of $27.6 million USD.[233] These projects are the "Climate Resilient Food Security for Farming Households across the Federated States of Micronesia" with the Micronesia Conservation Trust, and the FSM on-granting for local authorities US Economic Development Administration (EDA) program with SPC.

Coral Reef Protections

The status of FSM's coral reefs is monitored for management and conservation purposes by a consortium of organizations that collaborate under the aegis of the Micronesia Coral Reef Monitoring Program.[234] The Micronesia Challenge (MC) was launched in 2006, whereby FSM's leadership committed to effectively conserve at least 30% of their nearshore marine resources and 20% of their terrestrial resources by 2020. During the 24th Micronesia Island Forum in 2019, FSM, along with the other countries and territories in MC and its partners, worked to expand the MC's ambitious goals to effectively manage at least 50% of marine resources and 30% of terrestrial resources by 2030.The MC 2030 includes climate change adaptation by reducing the risks from climate impacts for communities within flood zones and on low-lying islands.

Studies based on this long-term data collection have shown that 42% of the major reef habitats exceeded the ecosystem-condition threshold established by the Micronesia Challenge, and fishing pressure is the main driver of coral reef changes.[235] Long-term monitoring data on coral reefs indicate a consistent decline in coral cover at Chuuk, Pohnpei and Kosrae, while an increasing coral cover trend is shown for Yap main island. At some sites the observed decline is associated with extensive bleaching events and with high densities of coral- eating Acanthaster starfish, particularly in Kosrae.[236] Healthy and resilient coral reefs are crucial habitats that sustain FSM coastal fisheries, which for generations have provided for food, recreation, social cohesion, culture, and more recently economic security (SOE, 2019). In recent years, FSM's coastal fisheries has seen a decline in fish stock, linked to unstainable harvesting levels, throughout the country, particularly at high volcanic islands where a large part of the population lives,[274] and exacerbated by global warming and climate change. Despite the high value of large iconic species (i.e., Napoleon Wrasse, Bumphead Parrotfish, and groupers) to culture, tourism and reef ecology, these species are most vulnerable to fishing and have become rare on most FSM coral reefs (Houk et al. 2012; Hernandez-Ortiz et al. 2016; Houk et al. 2017; Cuetos-Bueno et al. 2018).

Implementation of the Micronesia Challenge and climate adaptation plans for forest areas in the Federated States

[232] DoFA (2017). Federated States of Micronesia Country Program. Report prepared by Briones-Johnson, L. under the FSM-GCF Readiness Phase, with SPC. https://www.greenclimate.fund/sites/default/files/document/micronesia-country-programme.pdf (last accessed on October 2021).
[233] https://www.greenclimate.fund/countries/micronesia
[234] Among these organizations are the University of Guam (UOG) Marine Laboratory, Yap Department of Marine Resources, Yap Community Action Program Marine Division (YAPCAP), Chuuk Department of Marine Resources, Chuuk Conservation Society, Pohnpei Office of Fishery and Aquaculture, Conservation Society of Pohnpei, Kosrae Island Resource Management Authority (KIRMA), Kosrae Conservation Safety Organization, CNMI Coastal Resources Management Office, The Nature Conservancy Asia Pacific Program.
[235] Houk, P., Camacho, R., Johnson, S., McLean, M., Maxin, S., Anson, J., et al. (2015) The Micronesia Challenge: Assessing the Relative Contribution of Stressors on Coral Reefs to Facilitate Science-to Management Feedback. PLoS ONE 10(6): e0130823. doi:10.1371.
[236] Houk, P., Yalon, A., Maxin, S., Starsinic, C., Mcinnis, A., Gouezo, M., Yimnang Golbuu, Y., van Woesik, R. (2020). Predicting coral-reef futures from El Niño and Pacific Decadal Oscillation events. Scientific Reports (2020) 10:7735; https://doi.org/10.1038/s41598-020-64411-8.

of Micronesia, funded by the United States Forest Service (2014–2017) include the Yela Conservation Easement in Kosrae State, covering 78 acres of wetland forest, including part of the largest remaining contiguous stand of Ka tree (Terminalia carolinensis) in the world and a portion of the Tafunsak area watershed. Management activities in the site include clearing channels in the watershed, combating invasive species, replanting native species and putting in a network of ecotourism trails.

Protecting At-Risk Species

The FSM has enacted a number of laws and regulations, at the state and national level, to guide the management and development of sustainable fisheries within the offshore, inshore, coastal and aquaculture subsectors. In 2017, the FSM Congress established a closed area for commercial fishing that extends 12 nautical miles seaward of the territorial sea. Fishing and exploitation of natural resources in this area are prohibited. Shark fishing is prohibited by the Marine Resources Act of 2002, amended[237] to prohibit harvesting and commercialization of sharks or parts of the animal. A marine sanctuary for sharks was enacted in 2015,[238] to declare the entirety of the FSM's EEZ a marine sanctuary for sharks, rays, dolphins, and whales. The sanctuary covers more than 2.5 million km^2 in the northwest Pacific and it is part of the wider regional shark sanctuary, which covers 6.5 million km^2 among FSM, Palau, Marshall Islands, Guam, and the Commonwealth of Northern Mariana Islands. Sharks fishing is also regulated through state legislations, all prohibiting harvesting and/or commercialization of sharks. States regulate fish harvesting with the goal of sustainably managing marine resources and eradicating destructive fishing practices. Key legislations include the complete or partial harvesting and/or commercialization of iconic species (Bumphead parrotfish and Napoleon wrasse in Yap and Kosrae), and prohibition of exporting groupers and using dynamite fishing (Chuuk). Additionally, the FSM and state constitutions explicitly recognize customs and traditions relating to fishing rights in certain areas—i.e., nearshore, around submerged reefs and tidelands—are deeply rooted in Micronesian culture.

Mangroves are a marine habitat that provide an array of services to communities, including food, firewood and building material, as well as being an important nursery ground for juvenile fish. They also provide coastal buffering against typhoons and other extreme weather events and regulate coastal water quality. In the FSM mangroves vary across the states with highest cover in Pohnpei (72% of the total mangroves in the country) and the lowest in Chuuk (7% of the total mangroves in the country; SOE, 2019).

The Paris Agreement recognized the role played by mangroves and seagrass meadows as a carbon reservoir (Blue Carbon) and in climate change mitigation. FSM's states have enacted laws and regulations for the protection and conservation of mangroves (i.e., the Pohnpei Watershed Forest Reserve and Mangrove Protection Act of 1987, and the Kosrae Protected Area Act of 2010, which prohibit mangrove harvesting in protected areas). Mangroves are protected and conserved as part of protected areas and biosphere reserves (i.e., Utwe Biosphere Reserve in Kosrae[239]) through States Protected Areas laws and the more recent FSM Protected Areas Network (PAN) National Guiding Policy Framework (see Conservation Areas), enacted in 2018, which aims to extend the network of protected areas in the country. At least 17% of the FSM landmass is in terrestrial protected areas and 27% of it is mangrove forests (SOE, 2019). The nationwide FSM Ridge to Reef Project[240] aims to preserve biodiversity and maintain key ecosystem services such as carbon sequestration. Overall, the project aims to protect and restore ecosystems, including mangroves, to improve the country's biodiversity, sustain livelihoods and increase climate resilience through a ridge-to-reef management approach.

Creating Conservation Areas

The FSM is a country on the front line of climate change, already experiencing its impacts through rising average

[237] 24 FSM Code § 913(2), as amended by P.L. 18-108 (2015).
[238] C.R. No 17-110. Retrieved from: https://cfsm.gov.fm/ifile/17th%20Congress/Resolutions/CR%2017-110.pdf (Accessed August 2021).
[239] https://en.unesco.org/biosphere/aspac/utwe%20(Accessed%20December%202021)
[240] https://www.pacific-r2r.org/partners/member-countries/fsm?pid=103%20(Accessed%20December%202021).

atmospheric temperatures, increasing coral bleaching and changing patterns of precipitation and crop harvest. The FSM recognizes that the protection of ecosystems through the establishment of protected areas is an essential route to building the nation's resilience to climate change. The FSM has a long history of protected areas established through community endorsement and/or recognized by state laws and municipal ordinances. Over the years, communities have been the driving force enabling protection of critical areas for conservation and encouraging development of state laws.[241]

In the FSM, protection and conservation of critical habitats was further guided by the ecoregional plan "A Blueprint for Conserving the Biodiversity of the Federated States of Micronesia,"[242] which assisted the four states to set aside terrestrial, mangrove and coral reef Areas of Biodiversity Significance (ABS) for conservation.

These local efforts have been accompanied by multilateral environmental agreements (MEAs) and regional commitments, as well as the development of a National Protected Areas Policy, the Protected Areas Network National Guiding Policy Framework (PANPF). This nationwide policy for protected areas aggregates and supports state and local protected area mechanisms. In the FSM, protected areas are likely to play a significant role in ecosystems management, conservation, and planning, as they are seen as a crosscutting management tool that directly supports country biodiversity, and adaptive capacity and mitigation to climate change, as well as the implementation and fulfillment of the Sustainable Development Goals (SDGs) 1, 2, 3, 5,6, 13, 14 and 15.[243]

Among the most relevant MEAs, regional agreements and country legislations in support of FSM Protected Areas are:

- The United Nations Convention of Biological Diversity (UNCBD): FSM is signatory to the UNCBD (ratified in 1994) and part of the Programme of Work on Protected Areas *(*PoWPA[244]), which was launched with the purpose of galvanizing countries to take a more concerted effort in establishing, conserving, and managing "ecologically representative networks of protected areas on land and sea."[245] The PoWPA emphasizes the placement of social safeguards, encourages multiple types of management structures and encourages multi-leveled and multi-sectoral governance structures with protected areas.
- The Micronesia Challenge (MC): MC was launched in 2006, whereby FSM's leadership committed to effectively conserve at least 30% of their nearshore marine resources and 20% of their terrestrial resources by 2020. During the 24th Micronesia Island Forum in 2019, FSM, along with the other countries and territories in MC and its partners, worked to expand the MC's ambitious goals to effectively manage at least 50% of marine resources and 30% of terrestrial resources by 2030 and include climate change adaptation by reducing the risks from climate impacts for communities within flood zones and on low-lying islands. MC 2030 provides a platform to regionally connect this locally led action to the UN 2030 Sustainable Development Goals and the CBD Aichi targets. Under the MC, the FSM's communities, national, state and municipal government, as well as local and international NGOs, have worked together to establish numerous Protected Areas across the country.
- In September 2018, the national government of the FSM endorsed the Protected Areas Network National Guiding Policy Framework (PANPF), which "outlines a transparent, fair, and efficient system governing the designation and operation of a nationwide protected areas network, inclusive of state-level protected area networks in Yap, Chuuk, Pohnpei and Kosrae" (NBSAP 2018). The PANPF identifies the need for large conservation areas encompassing more than one ecosystem type, hence supporting the Pacific Ridge to Reef program that has been adopted by the FSM. This ensures conservation reflects the intrinsic links between

---

[241] Franco C., Yatilman R., Nash R. and Bruton-Adams, M. 2022. Strengthening Protected Area Management through effective community participation in the Federated States of Micronesia. FSM Ridge-to-Reef, DECEM, FSM Government, Palikir, FSM.
[242] The Nature Conservancy. 2002. A Blueprint for conserving the biodiversity of the Federated States of Micronesia. Available from: https://www.reefresilience.org/pdf/MicroPg1-47_main_Blueprint_Micronesia.pdf
[243] https://www.iucn.org/sites/dev/files/natural_solutions_-_sdgs_final_2.pdf
[244] Programme of Work on Protected Areas (PoWPA), https://www.cbd.int/protected/pow/learnmore/intro/
[245] The CBD Programme of Work on Protected Areas, Dudley N., Retrieved from: http://www.tbpa.net/page.php?ndx=23

the health of terrestrial and marine ecosystems, supporting protected areas across the FSM landscape, while responding to the need for conservation in cultural heritage sites throughout the nation.

- States PAN laws and/or regulations have the objective to enhance the management of existing conservation areas and establish new areas to achieve a full representation of the FSM's ecosystems, building resilience of ecosystems and communities to climate change.

Relevant plans capturing the interlinkages between protection and sustainable management of natural systems and climate change adaptation and mitigation include the National Biodiversity Strategy and Action Plans (NBSAP, 2018), the FSM Updated Nationally Determined Contributions (NDC, 2022) and the reports to the UNFCCC (e.g., Second National Communications–SNC).

In this context, Nature-based Solutions (NbS[246]) are part of national and state plans as a multi-pronged approach to not only reduce and/or halt biodiversity loss, but to mitigate and adapt to climate change. Ecosystem-based Adaptation (EbA[247]), which is part of the adaptation component under NbS, was recognized by the early FSM Nationwide Climate Change Policy (2009) as an essential adaptation tool for the country and expanded in the FSM Nation Wide Integrated Disaster Risk Management and Climate Change Policy (2013) as holistic, integrated, community and ecosystem-based ridge-to-reef approach to ensure relevant social and ecological adaptation measures.

Blue Prosperity Micronesia: In 2019, His Excellency David W. Panuelo, President of the Federated States of Micronesia (FSM), signed on behalf of the FSM National Government a Memorandum of Understanding (MOU) with the Blue Prosperity Coalition to protect 30% of its ocean by 2030. Announced on the margins of the 74th United Nations General Assembly at the Bloomberg Global Business Forum, the MOU is the beginning of a partnership between the FSM and the Blue Prosperity Coalition working together to ensure the sustainable use of ocean resources for economic growth, improving the livelihoods of communities, and protecting the health of ocean ecosystems. President Panuelo will collaborate and consult with the FSM Congress and relevant stakeholders in FSM to formulate the necessary legislative and regulatory measures to give effect and meaning to this MOU.

Global Methane Pledge: In 2021, FSM endorsed the Global Methane Pledge led by the United States and the European Union. By joining the Pledge, FSM commits to working together with the 111 country participants to collectively reduce methane emissions by at least 30% below 2020 levels by 2030.

Advancing Women's Roles in Decision making: Importantly, FSM's is committed to providing women and girls with quality education, skills training and leadership opportunities while supporting women's inclusion in decision making at all levels of society. FSM recognizes that economic growth will significantly benefit from inclusion of women in the work force. The **Chuuk Women's Council** (CWC) is the umbrella organization for 64 individual women's organizations officially registered by the FSM National Government with a membership of over 1,000 women. CWC's mission is to assist women in becoming more productive and self-sufficient members of our society through comprehensive programs that enhance the social, economic and physical well-being of women and their families in Chuuk.

[246] IUCN Definition of Nature-based Solutions: "NbS are actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits. They are underpinned by benefits that flow from healthy ecosystems and target major challenges like climate change, disaster risk reduction, food and water security, health and are critical to economic development." https://www.iucn.org/theme/nature-based-solutions (Accessed January 2021). NbS encompass approaches of working with nature, such as ecosystem-based adaptation (EbA) and ecosystem-based mitigation (EbM).

[247] Ecosystem-based Adaptation (EbA) is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change

8.4 Conclusion

The FSM contains a rich natural environment that has for centuries sustained and nourished the nation's local communities spread across hundreds of islands within one million square miles of ocean. The FSM's future path forward is well aligned with the 2030 Agenda for Sustainable Development to provides inclusive and sustainable economic growth and decent work for all citizens. The FSM is committed to achieving sustainable development in a balanced and integrated manner that respects local cultures and traditional knowledge, protects human rights and promotes gender equality while sustainably managing precious natural resources to meet the needs of the present and future generations.

Appendixes and Annexes

Appendix 1: Climate Data Source and Methodology

Data on the historical climate trends in the Federated States of Micronesia region is obtained from Australia Bureau of Meteorology and CSIRO and the Pacific Climate Change Data Portal (PCCDP), which provides site-specific historical climate information and trends for the Pacific Islands. The PCCDP was developed through the Pacific Climate Change Science Program (PCCSP, 2009–2011) and Adaptation Planning Programs 2009–2014, with further improvements/updates undertaken during the DFAT funded Climate and Oceans Support Program in the Pacific 2018– 2022 (http://www.bom.gov.au/climate/pccsp/). Additional information and figures were derived from the CSIRO and SPREP (2021) "NextGen" technical report. For consistency with the FSM Second National Communication, information on past and current climate for the FSM are presented based on data from the PCCDP and the Australian Bureau of Meteorology and CSIRO report (2014[258]). This report is a result of a collaborative effort between the National

Weather Service Offices of the FSM and the Pacific Climate Change Science Program. Air temperature records for Yap, Chuuk and Pohnpei are homogeneous and more than 95% is complete, while records for Kosrae present several data gaps and therefore are not presented in this report. Rainfall data for Pohnpei are available from 1949; for Yap, 1951; and for Chuuk, 1949. Air temperature data are available from 1950 for Pohnpei; 1951 for Yap and Chuuk. The data considered for this reporting are from 1951 to 2020 for the states of Yap, Chuuk and Pohnpei.

Data and maps on tropical storms and typhoons for the FSM were obtained from the NOAA National Hurricane Center HURDAT2 and NOAA National Centers for Environmental Information IBTrACS datasets through the interactive mapping tool "Historical Hurricane Track" (https://coast.noaa.gov/hurricanes/#map=4/32/-80).

Sea level data for the FSM were obtained from different data sets and reports. Data and figures on mean monthly sea level for Pohnpei (2001–2020) is obtained from PCCDP, University of Hawaii Sea Level Center, (Lindsey, 2020[259]) and the World Bank Climate Change Knowledge Portal.[260]

Climate projections were derived from the Australian Bureau of Meteorology and CSIRO report[261] (2014) and from the CSIRO and SPREP (2021) "NextGen" technical report. Additional information was obtained from Marra et al. (2021) regional report and the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC, 2021[262]). Sea level projections for the western and eastern FSM were obtained from the Australian Bureau of Meteorology and CSIRO report (2014) as well as Marra et al. (2017, 2021).

Below is a table summarizing the sources of information utilized to develop this climate section.

Table A.1. Data sources and type used for analysis and reporting on FSM current climate and projections.

Data Source	Data type	Link
Pacific Climate Change Data Portal	Raw and homogenized data for the 4 FSM's states on rainfall mean air temperature, maximum air temperature and minimum air temperature	http://www.bom.gov.au/climate/pccsp/
	Sea level, sea water temperature - Pohnpei	http://www.bom.gov.au/pacific/fsm/index.shtml
World Bank Climate Change Knowledge Portal	Rainfall, Air temperature, sea level, droughts occurrence.	https://climateknowledgeportal.worldbank.org/country/federated-states-micronesia
NOAA National Hurricane Center HURDAT2 & National Centers for Environmental Information IBTrACS	Interactive mapping tool to view, analyze, and share track data from NOAA hurricane Center (HURDAT2) and IBTrACS	https://coast.noaa.gov/hurricanes/#map=4/32/-80
University of Hawaii Sea Level Center	Sea level – Pohnpei, Yap, Kapingamarangi (Pohnpei state)	https://uhslc.soest.hawaii.edu/data/?fd
Australian Bureau of Meteorology and CSIRO-2011	Report including data on historical sea level	https://www.pacificclimatechangescience.org/wp-content/uploads/2013/09/Volume-2-country-reports.pdf
Australian Bureau of Meteorology and CSIRO-2014	Report including data on surface air temperature, temperature extremes, rainfall, rainfall extremes, drought, ocean acidification and projections.	https://www.pacificclimatechangescience.org/wp-content/uploads/2014/07/PACCSAP_CountryReports2014_WEB_140710.pdf
CSIRO and SPREP (2021) "Next Gen"	Report including average temperature and rainfall change including historical change, interpretation of climate projections, understanding projections as they relate to "global warming levels," and summary of important new projections information on tropical cyclones, extreme rainfall and sea level rise.	https://www.rccap.org/uploads/files/5e6f50d2-a62e-4412-8984-7cc08f48d461/Federated%20States%20of%20Micronesia%20Country%20Report%20Final.pdf
Marra et al. 2017	Report providing trends and patterns in physical, biological, chemical, and ecological observations under a changing climate	https://coralreefwatch.noaa.gov/satellite/publications/state_of_the_environment_2017_hawaii-usapi_noaa-nesdis-ncei_oct2017.pdf
Marra et al. 2021	Report describing variability and change in Pacific Island climates, drawing on the latest meteorological and oceanographic data, information, and analyses.	https://www.pacificmet.net/sites/default/files/inline-files/documents/PICC%20Monitor_2021_FINALpp_0.pdf

Appendix 2. Type of data used to inform the Second and Third National Communications for the FSM

Section	Type of information	Data type
Geography	Location, dimension, geology, etc.	Description of country and states.
Political and legislative context	Political system, legislations, strategies and plans relative to climate change	Political system (National and states), climate change legislative context, focal points for climate change related funds, plans for climate change adaptation and mitigation.
Climate	Current climate (surface air temperature, rainfall, sea level, sea surface temperature, typhoons), climate projections	Trends and extremes in air temperature and rainfall since 1951, trends in SST and sea level, climate change projections for RCP 6 and 8.5 emission scenarios
Natural resources	FSM biodiversity, terrestrial (forest, wetland, etc.), marine (coral reefs, seagrasses, etc.) and inland water ecosystems- status and changes since SNC	Endemic species in FSM, status of biodiversity, high vs atoll islands biodiversity, changes in forest cover, forest cover vs agriculture land, type of
		forests, coral reef status and changes over time, conservation areas
Population	Demographic, poverty	Changes in population, population structure by sex and age, percent of poverty and hardship – available through census data at the FSM Division of Statistics
Education	Enrollment, # of institutions, allocated budget for education development	Sex- and age- disaggregated enrollment data, number of institutions, annual budget for education
Health	Non communicable diseases, vector and water borne diseases, climate change impacts on health, and Climate Change and Health Action Plan	Expenditure for health sector, sex-disaggregated data on NCD, data on vector- water- borne diseases (since SNC), any upcoming data on mental health relative to climate change disasters [this data will be routinely collected as part of post-disaster assessment]
Economy	Formal and informal economy, commodities, import and export, economic status.	Country GDP, per capita GDP, employment rates, wage rates, imported commodities and trade balance, poverty line, contribution of major sectors to national GDP, COFA status and updates, labor force in formal and informal jobs, contribution of coastal fisheries to national economy
Fisheries	Status of coastal fisheries, policies and regulations for pelagic fisheries, economics of fisheries	Status of coastal and pelagic fisheries, policies, plans and programs (e.g., status of BPM, MC and PROPER since NC3), projects fund to address policies and plans
Agriculture	Status of agriculture, climate change impacts on agriculture, policy, plans, strategies, and projects for food security	Rates of agroforestry, N. of food security projects, policies, plans and strategies for agriculture and food security since NC3.
Waste	Policies, strategies and plans since SNC, programs and projects	Waste collection coverage, volume of waste produced, type of waste disposal and distribution among states, progress on states solid waste management strategies, PacWaste Plus indicators.

Section	Type of information	Data type
Transportation	Marine and terrestrial transportation, projects and plans	Number of register vehicles (if possible, based on GHG inventory, vehicles emission), number vessels from national marine fleet, progress on projects
Tourism	Policy, plans, status of tourism sector	Rates of tourists' arrival overtime, status and updates on tourism policy and plans
Energy	Policy, plans and strategies targets, energy projects progress, electricity production from renewable energy vs fossil fuel (generators), cost of energy production, energy production on national GDP, investments to increase electricity production from RE, NDC targets	Electrification rates vs. targets; energy contribution to emissions (based on NC3 GHG inventory), trends in annual national production of electricity from renewable energy (RE), progress on Energy Master Plans targets, progress on NDC targets for energy, rates of emissions reduction due to RE, policy updates (expected Energy policy 2012 to be soon updated)
Water and wastewater	Policies, plans, information on drinking water access, description on available water resources (high vs. atoll islands), impact of climate change on water resources	% of households accessing drinking water, % of households accessing sanitation, sewage systems, septic tanks, progress of implemented projects, progress of SDG 6 and WASH indicators

Appendix 3. Frequency of Data Collection for Informing Climate Change Reporting and Associated Constraints

Frequency of data collection		Example	Constraints
Annual	Data is collected over-time every year. Data are collected during the year (every month, quarterly or with other frequency) from state departments and/or agencies	- Water quality data - Fish market data - Number of permits released for earth moving	- Some data are retained only for a set time- for example water quality data for drinking water are stored for 5 years. - Data storing is managed by specific agencies but lacks coordination with other governmental departments. - In many cases lack of framework for data management and storing that may impair ability to capture trends. - Dissemination of results does not occur regularly or on an annual basis and unclear path for accessing this information. - Automation of data reports is largely not available
Periodic	Data is not collected on an annual basis but rather every 3, 5, 10 years.	- Data for census, IAC and HIES	- The mandate for the collection of these data is within the states office of statistics that work in collaboration with the national division of statics to implement data collection at state level. - The last National Census was conducted in 2010 and it was supposed to be repeated in 2020, but the Sars-Cov-2 pandemic had delayed data collection.
Sporadic	Data are not collected within a specific timeframe, but are rather collected based on official requests (e.g., request from a municipal government)	- Test water quality for specific community tanks or wells - Land data	- The data are collected upon specific request addressed to government agencies - Also, some programs operated by agencies are activated upon request, therefore data may be available on a sporadic basis (see Appendix 2, Kosrae-DREA).
Project-based	Data are collected for specific climate change adaptation or mitigation projects implemented at state or national level This is a varied source of data on climate change adaptation projects. It also includes results from data collected by local and international non-governmental agencies	Food and water security projects Reforestation/ Rehabilitation projects Climate change adaptation projects Implementation of community-based plans for conservation and adaptation	- This data is generally available through reports, but raw data is more difficult to access. - Methodology on how data has been collected is not always available. - Problem with data storing as organizations are not required to store this information in their system. - There is no standardized procedure neither for collection of this type of data or storing. - Lack of a storing system for this data type in many cases causes the loss or misplacement of the raw data collected for the project.

Appendix 4. Guidance to Establish NCs Data Management System

Below are recommended steps to establish a data collection system for NC reporting

1. Set up for utilizing existing data collection frameworks and reporting on climate change funds for climate change adaptation and mitigation projects implemented in the country, while identifying meaningful indicators relative to the type of data that are collected overtime. There are a number of considerations when considering data availability and requirements: the scale of data, the source, the type of data, frequency of update and time series and quality.

2. Identify relevant stakeholders and set up permanent data teams or working groups - it is desirable that the stakeholders, in particular the providers of key information necessary for the preparation of NCs and BURs, are identified at departmental and agency level.

3. Develop a common understanding of the reporting objectives across all relevant stakeholders which can be then translated into a formal procedure/protocol document.

4. Establish coordination mechanisms between governmental departments by formalizing contents of the procedure (roles, responsibilities and provision of data and information) and developing a clearly defined procedure for the flow of necessary information and data from the data teams/working groups to the Department responsible for reporting to the UNFCCC. This procedure document will establish the foundation for:

    a. what data would be useful to inform NC and BUR,

    b. who is responsible for collection, processing and storing of these data,

    c. who is responsible to provide the data to the Department responsible for reporting to the UNFCCC,

    d. the frequency of data provision (quarterly, annual, etc.)

5. Assess the need for the establishment of formal agreements (e.g., MOU) or legal instruments (policy, regulations) between the coordinating body and other relevant stakeholders involved in the formulation of the NCs and BURs.

6. Plan and provide for data team/working groups capacity building and training

7. Ensure data are archived on a regular basis under the Department responsible for reporting on NC and BUR to the UNFCCC.

8. Document systematically all the assumptions, data and methods used, and report lessons learned from the data team/working groups, thus, to modify and improve the process where needed.

9. Investigate the use of a formal data management system as a tool for data storing and processing.

Annex 1: GHG Inventory Coverage

Categories	Remark
Total National Emissions and Removals	
1 - Energy	Estimated
1.A - Fuel Combustion Activities	Estimated
1.A.1 - Energy Industries	NE
1.A.2 - Manufacturing Industries and Construction	NE
1.A.3 - Transport	NE
1.A.4 - Other Sectors	NE
1.A.5 - Non-Specified	NO
1.B - Fugitive emissions from fuels	NO
1.B.1 - Solid Fuels	NO
1.B.2 - Oil and Natural Gas	NA
1.B.3 - Other emissions from Energy Production	NO
1.C - Carbon dioxide Transport and Storage	
1.C.1 - Transport of CO_2	NO
1.C.2 - Injection and Storage	NO
1.C.3 - Other	NO
2 - Industrial Processes and Product Use	NE
2.A - Mineral Industry	NE
2.A.1 - Cement production	NO
2.A.2 - Lime production	NE
2.A.3 - Glass Production	NO
2.A.4 - Other Process Uses of Carbonates	NO
2.A.5 - Other (please specify)	NO
2.B - Chemical Industry	NO
2.B.1 - Ammonia Production	NO
2.B.2 - Nitric Acid Production	NO
2.B.3 - Adipic Acid Production	NO
2.B.4 - Caprolactam, Glyoxal and Glyoxylic Acid Production	NO
2.B.5 - Carbide Production	NO
2.B.6 - Titanium Dioxide Production	NO

Categories	Remark
2.B.7 - Soda Ash Production	NO
2.B.8 - Petrochemical and Carbon Black Production	NO
2.B.9 - Fluorochemical Production	NO
2.B.10 - Other (Please specify)	NO
2.C - Metal Industry	NO
2.C.1 - Iron and Steel Production	NO
2.C.2 - Ferroalloys Production	NO
2.C.3 - Aluminium production	NO
2.C.4 - Magnesium production	NO
2.C.5 - Lead Production	NO
2.C.6 - Zinc Production	NO
2.C.7 - Other (please specify)	NO
2.D - Non-Energy Products from Fuels and Solvent Use	NE
2.D.1 - Lubricant Use	NE
2.D.2 - Paraffin Wax Use	NE
2.D.3 - Solvent Use	NE
2.D.4 - Other (please specify)	NE
2.E - Electronics Industry	NO
2.E.1 - Integrated Circuit or Semiconductor	NO
2.E.2 - TFT Flat Panel Display	NO
2.E.3 - Photovoltaics	NO
2.E.4 - Heat Transfer Fluid	NO
2.E.5 - Other (please specify)	NO
2.F - Product Uses as Substitutes for Ozone Depleting Substances	NE
2.F.1 - Refrigeration and Air Conditioning	NE
2.F.2 - Foam Blowing Agents	NE
2.F.3 - Fire Protection	NE
2.F.4 - Aerosols	NE
2.F.5 - Solvents	NE
2.F.6 - Other Applications (please specify)	NE
2.G - Other Product Manufacture and Use	NE
2.G.1 - Electrical Equipment	NE

Categories	Remark
2.G.2 - SF6 and PFCs from Other Product Uses	NE
2.G.3 - N2O from Product Uses	NE
2.G.4 - Other (Please specify)	NE
2.H - Other	NE
2.H.1 - Pulp and Paper Industry	NE
2.H.2 - Food and Beverages Industry	NE
2.H.3 - Other (please specify)	NE
3 - Agriculture, Forestry, and Other Land Use	Estimated
3.A - Livestock	Estimated
3.A.1 - Enteric Fermentation	Estimated
3.A.2 - Manure Management	Estimated
3.B - Land	NE
3.B.1 - Forest land	NE
3.B.2 - Cropland	NE
3.B.3 - Grassland	NE
3.B.4 - Wetlands	NE
3.B.5 - Settlements	NE
3.B.6 - Other Land	NE
3.C - Aggregate sources and non-CO2 emissions sources on land	Estimated
3.C.1 - Emissions from biomass burning	NE
3.C.2 - Liming	NO
3.C.3 - Urea application	NE
3.C.4 - Direct N2O Emissions from managed soils	Estimated
3.C.5 - Indirect N2O Emissions from managed soils	Estimated
3.C.6 - Indirect N2O Emissions from manure management	Estimated
3.C.7 - Rice cultivations	NO
3.C.8 - Other (please specify)	NO
3.D - Other	NE
3.D.1 - Harvested Wood Products	NE
3.D.2 - Other (please specify)	NO
4 - Waste	Estimated
4.A - Solid Waste Disposal	Estimated

Categories	Remark
4.B - Biological Treatment of Solid Waste	NO
4.C - Incineration and Open Burning of Waste	NE
4.D - Wastewater Treatment and Discharge	Estimated
4.E - Other (please specify)	NO
5 - Other	NE
5.A - Indirect N2O emissions from the atmospheric deposition of nitrogen in NOx and NH3	NE
5.B - Other (please specify)	NO
Memo Items (5)	
International Bunkers	NE
1.A.3.a.i - International Aviation (International Bunkers)	NE
1.A.3.d.i - International water-borne navigation (International bunkers)	NE
1.A.5.c - Multilateral Operations	NO
Notation Keys: **NE: Not estimated (Emissions and/or removals occur but have not been estimated or reported)** **NO: Not occurring (An activity or process does not exist within a country)**	

Annex 2

Mitigation Action ID: M1					
Title	Federated States of Micronesia: Yap Renewable Energy Development Project				
Objective	Supply an increased amount of clean and renewable energy to Yap				
Description	The Yap Renewable Energy Development Project supports development of the power system, by installing 825 kilowatts (kW) of wind generation and 300 kW of rooftop solar photovoltaic generation in the State of Yap (Yap), Federated States of Micronesia (FSM), in order to reduce dependency on imported diesel through expansion of renewable power generation and improving the supply-side efficiencies of power delivery.				
Action Type	Mitigation	Adaptation priority	-	Mitigation priority	High
Status of implementation	Completed	Start date	June 2013	Full implementation date	October 2018
Sector category	Conventional energy generation -	Institutional responsible [Executing agency]	Yap State Public Service Corporation	Implementing agency	Yap State Public Service Corporation
Activities covered	Renewable energy generation solar & wind	Mitigation Scenario	With existing measures	Type of policy instrument	Project
Action cost	4,680,000	Geographical area included	Yap proper	Methodology and assumption	ADB project document, Completion Report
CO_2 reduction	3,470 tCO2e				
Related SDGs	SDG 7.2, SDG 9, SDG 13.a				
Related NDC target	INDC: By 2025 reduce emissions from 150,000 tons per annum to about 108,000 tCO2eq; NDC[152]: By 2030, reduce carbon dioxide emissions from electricity generation by more than 65% below 2000 levels				
Related national strategy	FSM Strategic Development Plan 2004-2023, Strategic goal 3: reduce energy use and convert to renewable energy sources/ minimize emission of greenhouse gases. / FSM National and States Energy Action plans (2012).				
Impact	Energy security of Yap has improved and reliance on fossil fuel reduced				
Related indicators	GHG emissions mitigated from the energy sector				

Finance							
Funder name	**Status**	**Type of instrument**	**Type of funding**	**Recipient**	**Amount**	**Currency**	**Data Source**
Asian Development Bank	**Completed**	**Loan**	**Ordinary capital resources**	**Yap State Public Service Corporation**	**4,680,000**	**USD**	**https://www.adb.org/projects/44469-013/main**

Mitigation Action ID: M2	
Title	Energy Sector Development Project (ESDP)
Objective	Increase the available generation capacity and efficiency of electricity supply in the state power utilities, and to strengthen the planning and technical capacities of the National Government and the state power utilities in the energy sector

Description	Improve the efficiency and reliability of electricity supply in the four State Utility Companies across the Federated States of Micronesia (FSM). The project supported fuel savings through improved fuel efficiency of power generation and increasing penetration of renewable energy sources, loss reduction, reliability increases, and performance improvement activities and maintenance plans for the four utilities, including key investments in equipment needed to increase revenues and reduce energy losses				
Action Type	Cross-cutting	Adaptation priority	-	Mitigation priority	High
Status of implementation	Completed	Start date	May 2014	Full implementation date	September 2019
Sector category	Energy	Institutional responsible [Executing agency]	Federated States of Micronesia	Implementing agency	Department of Resources and Development
Activities covered	Renewable energy solar, energy supply	Mitigation Scenario	With existing measures	Type of policy instrument	Development project
Action cost	12,480,007 US Dollars	Geographical area included	Nationwide	Methodology and assumption	World bank project document
CO_2 reduction	Unknown				
Related SDGs	SDG 7.2, SDG 11, SDG 13.a				
Related NDC target	INDC: By 2025 reduce emissions from 150,000 tons per annum to about 108,000 tCO2eq; NDC[153]: By 2030, reduce carbon dioxide emissions from electricity generation by more than 65% below 2000 levels				
Related national strategy	FSM Strategic Development Plan 2004-2023, Strategic goal 3: reduce energy use and convert to renewable energy sources/ minimize emission of greenhouse gases. / FSM National and States Energy Action plans (2012)				
Impact	Improve reliability of fuel supply and reduce costs of energy production for the states power utilities.				
Related indicators	Energy Efficiency improved				

Finance

Funder name	Status	Type of instrument	Type of funding	Recipient	Amount	Currency	Data Source
World Bank	**Completed**	**Investment Project Financing**	**-**	**Department of Resources and Development**	**12,480,007**	**USD**	**https://projects.worldbank.org/en/projects-operations/project-detail/P148560**

Mitigation Action ID: M3

Title	Renewable Energy Development Project (REDP)				
Objective	Increased sustainable generation and utilization of renewable energy in Yap, Kosrae, and Pohnpei, bolstering energy security and reducing reliance on fossil fuels for power generation in these states.				
Description	Sustainable generation and utilization of renewable energy in Yap, Kosrae, and Pohnpei increased by: (1) increasing renewable energy generation in Kosrae and Yap, (2) increasing access to electricity in Kosrae with the electrification of Walung Village, and achieving about 30% renewable energy contribution in the first year of the project's operation in the states of Yap and Kosrae.				
Action Type	Mitigation	Adaptation priority	-	Mitigation priority	High
Status of implementation	Under implementation	Start date	November 2019	Full implementation date	August 2024

Sector category	Energy (energy supply and combustion)	Institutional responsible [Executing agency]	Department of Finance and Administration	Implementing agency	Department of Resources and Development
Activities covered	Energy production, transmission and distribution, renewable energy solar	Mitigation Scenario	With existing measures	Type of policy instrument	Project
Estimated Action cost	15,000,000 US Dollars	Geographical area included	States of Yap, Kosrae and Pohnpei	Methodology and assumption	ADB project documents
CO_2 reduction	2,533 tons per annum				
Related SDGs	SDG 7.2, SDG 11, SDG 13.a				
Related NDC target	INDC: By 2025 reduce emissions from 150,000 tons per annum to about 108,000 tCO2eq; NDC[154]: By 2030, reduce carbon dioxide emissions from electricity generation by more than 65% below 2000 levels				
Related national strategy	FSM Strategic Development Plan 2004-2023, Strategic goal 3: reduce energy use and convert to renewable energy sources/ minimize emission of greenhouse gases/ Infrastructure Development Plan 2016-2025 (IDP) / FSM Energy Master Plan (2018)				
Impact	Sustainable social and economic development of the FSM promoted through the provision and utilization of cost-effective, safe, reliable, and sustainable energy services, reduced reliance on fossil fuel.				
Related indicators	CO_2 emissions mitigated due to transition to renewable energy power production				

Finance

Funder name	Status	Type of instrument	Type of funding	Recipient	Amount	Currency	Data Source
Asian Development Bank	Under implementation	Grant	Sovereign Project grant	DoFA	15,000,000	USD	https://www.adb.org/projects/49450-023/main

Mitigation Action ID: M4

Title	Micronesia Public Sector Buildings Energy Efficiency (MPSBEE) Project				
Objective	The objective of the MPSBEE project is the improved application of energy conserving and energy efficient (EC&EE) techniques and practices in the design, retrofit, and ongoing O&M of public sector buildings in FSM.				
Description	The MPSBEE project specific activities include: evaluate the current energy performance and energy use baseline situation in FSM public sector buildings; identify and quantify energy savings from available Energy Savings Measures (ESMs) and their inter-dependencies; identify and quantify ESM investment needs, energy savings paybacks and improvements in environmental conditions; and design, specify, implement, monitor and evaluate, document, and publicize reductions in public sector energy (electricity use), esp. in cooling, lighting and hot water supply.				
Action Type	Mitigation	Adaptation priority	Secondary	Mitigation priority	High
Status of implementation	Under implementation	Start date	October 2019	Full implementation date	September 2022
Sector category	Energy Efficiency (EE)	Institutional responsible [Executing agency]	UNDP	Implementing agency	Division of Energy, Department of Resources and Development

Activities covered	Energy conserving and energy efficient techniques; energy audit, design, retrofit, operation and maintenance of public sector buildings	Mitigation Scenario	With existing measures	Type of policy instrument	Project
Action cost	1,776,483 USD	Geographical area included	Nationwide	Methodology and assumption	Project Identification Form (PIF) & ProDoc
CO_2 reduction	Incremental GHG emission reduction from the buildings sector: 3,974 tCO_2e				
Related SDGs	SDG 7				
Related NDC target	INDC: unconditionally reduce its GHG emissions by 28 percent by 2025, compared to 2000; conditionally reduce emissions by up to 35 percent in 2025, compared to 2000, subject to additional international financial, technical, and capacity building support. / See NDC targets above				
Related national strategy	FSM National Energy policy target of a 50% improvement in EE by 2020/ Strategic Development Plan 2004-2023, Strategic goal 3: reduce energy use and convert to renewable energy sources/ minimize emission of greenhouse gases/ Infrastructure Development Plan 2016-2025 (IDP) / FSM Energy Master Plan (2018)				
Impact	Improved Energy Efficiency to meet the FSM National Energy Policy target and address INDC targets				
Related indicators	Energy Efficiency reduce CO2 emissions and reliance from imported fuel				

Finance

Funder name	Status	Type of instrument	Type of funding	Recipient	Amount	Currency	Data Source
UNDP	Under implementation	Grant	GEF/LDCF/SCCF Trust Funds	R&D	1,776,483	USD	https://www.thegef.org/project/micronesia-public-sector-buildings-energy-efficiency-mpsbee-project

Mitigation Action ID: M5

Title	Sustainable Energy and Accompanying Measures (SEAM)				
Objective	The overall objective is to enable the FSM population to utilize affordable, reliable and environmentally sound energy services and benefit from transparent and efficient management of public funds. The specific objectives are to increase access to renewable electricity and support private sector investment in energy efficiency and renewable energy; to improve the transparency and effectiveness of the public financial management system and to strengthen engagement of CSOs in national development priorities within the energy sector.				
Description	SEAM is comprised of five (5) main Components: (1) Strengthen the Project Financing Management (PFM) within the FSM Department of Finance; (2) SEAM Renewable Energy and Energy Efficiency (REEE) with generic name FSM Sustainable Energy (FSM.SE), implemented by the Pacific Community (SPC); (3) Civil Society Organizations Support Programme by Micronesian Trust Conservation (MCT); (4) support measures to the NAO Administration; and (5) Evaluation support.				
Action Type	Mitigation	Adaptation priority	Secondary	Mitigation priority	High
Status of implementation	Under implementation	Start date	2020	Full implementation date	2025

Sector category	Energy (energy supply and combustion)	Institutional responsible [Executing agency]	European Union Delegation for the Pacific (EUDP)	Implementing agency	Component 1: World Bank Component 2: SPC Component 3: Micronesia Conservation Trust
Activities covered	Energy production, transmission and distribution, renewable energy solar	Mitigation Scenario	With existing measures	Type of policy instrument	EU Commission Decision, Brussels, 14.8.2019 C (2019) 6145 final
Action cost	14,200,000 euro Component 2: 11.625 million euro	Geographical area included	Nationwide	Methodology and assumption	Action document
CO_2 reduction	28% reduction in emissions from the year 2000 by 2025				
Related SDGs	SDG 7, SDG 13; secondary SDG goals: SDG 3, SDG 4, SDG 5				
Related NDC target	INDC: By 2025 reduce emissions from 150,000 tons per annum to about 108,000 tCO2eq; See NDC targets above				
Related national strategy	FSM Strategic Development Plan 2004-2023, Strategic goal 3: reduce energy use and convert to renewable energy sources/ minimize emission of greenhouse gases. / Infrastructure Development Plan 2016-2025 (IDP) / FSM Energy Master Plan (2018)				
Impact	Increased access to electricity, improved quality of delivery and reduced reliance on fossil fuels for generation				
Related indicators	CO2 emissions mitigated due to scaling up of renewable energy and improved energy efficiency				

Finance

Funder name	Status	Type of instrument	Type of funding	Recipient	Amount	Currency	Data Source
11th European Development Fund	Under implementation	Grant	EDF		14,200,000	Euro	https://ec.europa.eu/international-partnerships/system/files/aap-financing-micronesia-annex-c-2019-6145_en.pdf

Mitigation Action ID: M6

Title	Sustainable energy development and access project				
Objective	Improve reliability of electricity supply, expand access to electricity and scale up renewable energy generation				
Description	There are five components to the project, the first component being improving reliability of electricity supply in Pohnpei State. This component will address PUC's challenges with insufficient available generation capacity, which is way below the installed capacity, to cover peak demand in a stable manner and reduce unscheduled shutdowns of power supply and unsecure waste oil storage. The second component is the expanding access to electricity in Chuuk State. This component will support CPUC to expand access to electricity in Chuuk State, where the access rate is the lowest in the country (27 percent) due to the remoteness of several islands. The third component is the scaling up renewable energy generation in Chuuk, Yap, and Kosrae States. This component will support CPUC to install the state's first utility-scale solar power plant to reduce fuel cost of diesel-based power generation and relieve CPUC from the financial burden incurred by access expansion on the outer islands. The component will also support YSPSC and KUA to significantly mitigate the curtailment of the existing RE output and enable the integration of more variable RE through storage capacity and high-speed gensets. The fourth component is the institutional strengthening and capacity building in the energy sector. This component aims at reinforcing the sector's operational and environmental sustainability by improving institutional capacities for governance, identifying strategies to attract private sector investments and exploring access to other efficient energy solutions.				
Action Type	Cross-cutting	Adaptation priority	-	Mitigation priority	High

Status of implementation	Planned	Start/Approval date	December 2018	Full implementation date	November 2023
Sector category	Energy (energy supply and combustion)	Institutional responsible [Executing agency]	Department of Finance and Administration	Implementing agency	Department of Resources and Development
Activities covered	Energy transmission and distribution, renewable energy solar, public administration-renewable	Mitigation Scenario	With existing measures	Type of policy instrument	Project
Estimated Action cost	30,000,000 US Dollars	Geographical area included	Nationwide	Methodology and assumption	Project document and assessments
CO_2 reduction	137,000 tCO2e				
Related SDGs	SDG 7.2, SDG 13.a				
Related NDC target	INDC: By 2025 reduce emissions from 150,000 tons per annum to about 108,000 tCO2eq; See NDC targets above				
Related national strategy	FSM Strategic Development Plan 2004-2023, Strategic goal 3: reduce energy use and convert to renewable energy sources/ minimize emission of greenhouse gases. / Infrastructure Development Plan 2016-2025 (IDP) / FSM Energy Master Plan (2018).				
Impact	Increased access to electricity, improved quality of delivery and reduced reliance on fossil fuels for generation				
Related indicators	CO2 emissions mitigated due to scaling up of renewable energy and improved energy efficiency				

Finance

Funder name	Status	Type of instrument	Type of funding	Recipient	Amount	Currency	Data Source
World Bank	Planned	Grant	International Development Association (IDA)	DoFA	30,000,000	USD	https://projects.worldbank.org/en/projects-operations/project-detail/P165183

Annex 3

Gender in traditional systems and roles in the FSM states. (Text extracted from: Yap and Chuuk- Lambeth and Santiago 2001; Pohnpei – Lambeth 2000; Kosrae – Lambeth and Abraham 2001).

State	Traditional system
Yap	In the main islands of Yap power and authority is defined in terms of land. The **tabinaw**, or estate (patrilineal), is the fundamental unit of land and resource ownership (including marine resources), and usually refers to one extended (patrilineal) family. Social organization on the outer islands differs considerably from that of the main Yap group. The major socio-political groupings are based on matrilineal clans, and clans are ranked according to their sequence of arrival on the different islands. Traditionally, the chiefs controlled the distribution and use of land resources and accessible marine resources. Rights could be given, earned and inherited. Ownership of shallow reefs and the intertidal flats and their resources was traditionally held by the adjacent landowner. Marine resources on the main Yap group of high islands were traditionally managed within a hierarchical system of village networks. Villages were grouped into networks of chiefly villages and lower ranked allies. Reef areas and specific fishing rights were allocated to the tabinaw (patrilineal estate), to villages, and to associations of villages. Fishing rights were broken into several different rights which were ranked, with higher ranking fishing methods being subject to stricter rules. Fishing rights included rights over geographical areas, use of a certain habitat, ownership of a specific gear, use of a particular method or rights to a specific species. The management of marine resources on the outer islands of Yap State varies significantly from that of the main Yap group. Branches of the matrilineal clans are found on all the outer islands, while some of the smaller clans are found on only a few islands. Generally, the eldest son of the most senior woman of the clan is the chief. Marine areas are managed, not owned, by the chiefs (in consultation with the other clan elders) for the benefit of the whole clan. Control of marine areas and resources also varies slightly between the different outer islands.
Chuuk	The basic unit of Chuukese life has always been the lineage, a kin group traced through the females in the family back to the oldest surviving woman. The lineage group would live together on a single estate and work together under the authority of the senior man in the lineage, often the brother of the oldest woman. When a woman married the couple would generally move in with the woman's family rather than the man's (Oneisom, 1994). Land was the main resource and was inseparable from the family. Land was also seen to include the reef and fishing areas. Land rights could be acquired through the father's side as well as the mother's side of the family and treatment of the land depended on how it was acquired. The lineage estate, from the mother's side, was not permanently divided among lineage members, rather sub-groups were given use rights to portions of the land. Land from the father's side passed from father to his sons and was owned, not simply used (Hezel 1994). Today the lineage head still has a strong say over the disposal of lineage land but most of his other authority has declined with modernization and spread of the cash economy. The importance of the lineage as a single working unit has given way to smaller household units.

Pohnpei	Outside the capital of Kolonia, influential lines of chiefs and nobility control the five municipalities: Sokehs, Nett, U, Madolenihmw, and Kitti. Each has a nahnmwarki, or "high chief", and a nahnken, or "talking chief"; these titles are inherited matrilineally through a political or cultural succession. Below the hereditary nobility are other social classes of landowners and commoners. Land in the traditional society was owned by the nahnmwarki. This traditional ruler leased the land to property owners who in turn oversaw its use by commoners. Traditionally, much of the work carried out by an individual was done so at the request, and on behalf of, the extended family group. The senior man in the lineage supervised lineage affairs and coordinated work assignments while his female counterpart directed women's activities on behalf of the lineage (Barnabas & Hezel 1993). Today there have been many changes and people spend more time on work for their own household, though lineage labor is still used on occasion for community or lineage feasts. The traditional family was divided clearly upon sex and age lines with the status of each person being clearly defined and reinforced by respect behavior. Son to father or daughter to mother, submission to the parent's authority was not questioned. Within the code of behavior of each family member there was also a stringent code of respect behavior between the sexes. Girls were expected to assume a lower position and be humble when their brothers were around. Brothers had to avoid allusions to any sexual matters or bodily functions in the presence of their sisters. The changes in respect behavior have been dramatic, both between parents and children, and between the sexes. One thing that has remained relatively unchanged in cultural roles and practices is the role of women in the household. Women still perform the domestic duties as they always have. They keep house, cook, and take care of children. Older girls continue to have responsibility for the care of younger siblings. Although women never held strong public roles in traditional Pohnpei an life they did have a certain amount of authority in certain areas, such as how lineage land was apportioned and who would use what parcel of the land. Women were often the initiators of projects in the community and played an important role as peacemakers in conflicts. With all tasks, there were very clear, complementary roles for men and women. If men constructed the house, women would weave the thatch. Each did a separate, though equally important, task. Women's roles have changed significantly in recent years. Many of the roles of women were rooted in the extended family and, as this has broken down, women have lost much of their traditional informal authority. Men's traditional roles have been eroded as well, though they generally have been given access to new roles in modern society—entering the modern workforce while continuing their role in the home. To some extent the principle of complementary roles is still strong, i.e. if men are doing a particular task or activity, then women shouldn't be. This, combined with the traditional "separation of powers" that prevents women from taking public office and acting as spokespersons in the community, have left women today with a much narrower, less powerful, and often less respected role in modern society (Barnabas & Hezel 1993).
Kosrae	The socially important group in Kosrae is the extended family of several generations, held together through the male line and with authority in the hands of the oldest members. The extended family maintains an overall supervision of its members, with separate and clearly defined rights and duties for family members. Over the years there have been many changes in Kosraean society, but the extended family, with its duties, obligations, and rewards, is still a strong force. Clans are also found on various parts of the island, with members being descendants of a common ancestor and clanship being traced through the female line. The extended family includes those who marry into the group, but those people generally retain membership of their own clan. In this way the clan may be very large and scattered over the community. Clans usually have a name — often that of animals — and in the past may have served to define rights to land and to regulate marriage by prohibiting marriage within the same clan (Ashby 1985; Alkire 1977). Prior to European contact Kosrae had a centralized traditional political system, which was closely tied to land tenure (Alkire 1997).

ANNEX 4

List of Local Women's Organizations and Government Gender Offices in the FSM

Organization Name	Type of Organization	Description of Organization	Examples of gender and climate change work
FSM Women Council	NGO/CBO	The Council act as umbrella for State Women's Associations, including: Chuuk Women's Council (CWC), Kosrae Women's Association (KWA), Pohnpei Women's Council (PWC) and Yap Women's Association (YWA). The Council was formally established in 2018. The council serves as the Secretariat for all future FSM National Women Conferences. They have planned work in mainstreaming gender across sectors. Their mission aligns to the FSM gender policy.	As a council they have not implemented climate change projects yet. However, each individual member of the council has worked on climate change projects (water projects, food security, rehabilitation). Results of these projects are reported back to the Council to share lessons learned and good practices among Council's members.
Gender Support Office (GSO)	State government Office, under the Yap's Department of Youth and Civic Affairs	Yap Gender Support Office (GSO) is a state government office that promotes and supports Yap's broader social interests. Including information sharing, community education and other activities for improved gender equality	The GSO supports activities oriented to clean up, they are implementing a community food security projects and they assist other organizations and agencies on gender issues.
Pohnpei Women's Council (PWC)	Local Association/CBO	The PWC is the registered umbrella entity that gathers together all women's groups and association of Pohnpei.	The individual women's groups, under the PWA, have implemented several climate change projects within Pohnpei (e.g. food security, water security, erosion control).
Chuuk Women's Council (CWC)	Local NGO	CWC is an umbrella organization for the different women's organizations in Chuuk State, Federated States of Micronesia, which promotes women's leadership, education on health and gender issues, environmental conservation, and the preservation of traditional and cultural crafts. CWC conservation projects aim to preserve the environment for future generations with an emphasis on education and sustainability. In 2019 they hosted and lead the development of the FSM Women council Action Plan.	CWC has been and is currently implementing Ecosystem based Adaptation and climate change adaptation projects, and promoting food security and alternative livelihoods for women. They have been involved in the Solar Mamas project with the Micronesia Conservation Trust (MCT) in 2016 and they have been active in mangrove rehabilitation and forest restoration projects.

Yap Women's Association (YWA)	NGO	The Yap Women's Association is a traditional woman role established as a non-profit organization representing 73 registered women's groups of Yap state. YWA creates local programs that provide a working mother traditional education in day care and schooling for their children, fresh local food markets for their families as well as laundry-mats in the villages. The association is fuelling these programs with local products through custom programs benefiting child development, cultural preservation and food security.	The individual women's groups, under the YWA, have implemented several climate change projects in Yap (e.g. food security, water security, erosion control) and collaborated with CBOs for climate change awareness and education.
Women in Farming in Kosrae (WIFK)	Local NGO	Women in Farming Kosrae (WIFK) is a local NGO chartered in August 2011, comprising men and women from all of Kosrae's municipalities. WIFK's primary mission is to enhance community health and wellness, and livelihoods of families and communities in Kosrae.	WIFK identified among their climate vulnerabilities and nature-based adaptation needs the improvement of soil health to enhance home gardening (vegetables and some other crops). They are currently implementing EbA solution (including portable dry litter pig pens) to improve food security and enhance the resilience of their communities.
Island Pride	Local NGO	Founded in 2017, Island PRIDE (Promoting Resilience through Involvement, Development & Education) is a youth and women led NGO based in Chuuk, Micronesia dedicated to raising community resilience to climate change impacts.	Island pride developed and led the #TheLastStrawCampaign in partnership with the Chuuk State Chamber of Commerce to increase resilience of communities in Chuuk. During the campaign Island Pride partnered up with several local restaurants supplying them with hundreds of reusable stainless-steel straws for free to try out, as an alternative to plastic. They also conducted Climate Action Network (CAN) camp, training young women on leadership and coral reef monitoring to enhance local climate change action.
Organization Name	Type of Organization	Description of Organization	Examples of gender and climate change work
Tamil Resources Conservation Trust (TRCT)	Local NGO	TRCT is a community grass-roots organization established in 2011 by the Tamil Council to manage all the natural resources of Tamil municipality and to support other communities in Yap State in managing their natural resources.	TRCT has implemented several climate change projects in Tamil's community in the lens of Ridge to Reef. Among these projects are: water security under FSM R2R; food security through the development and management of a community plant nursery that aims to provide seedlings to the community; planting

			of trees as fire breaker against wildfires in Tamil savannah.
Tamil Women Association (TWA)	Local NGO	Highlighting Women's role in community as nurturer and care-taker of families and environment. Projects implemented are towards food security in the community of Tamil.	TWA has supported the Tamil plant nursery for food security. They also have been involved in planting nipa palm for coastal erosion control against Sea Level Rise.
Okaw Women's Association	Local NGO	Highlight women's role in all relevant activities and projects in the community of Okaw	

Regional and International Organizations Working on Gendered Climate Change Projects

Organization Name	Type of Organization	Description of Organization	Examples of gender and climate change work
The Pacific Community (SPC)	Inter-governmental Organization (IGO)	SPC is the principal scientific and technical organization in the Pacific region. It works for the well-being of Pacific people through the effective and innovative application of science and knowledge, guided by a deep understanding of Pacific Island contexts and cultures. The organization covers more than 20 sectors, including fisheries science, public health surveillance, geoscience and conservation of plant genetic resources for food security.	They are implementing an energy efficiency project that will ensure communities across FSM, particularly the state of Chuuk have improved access to affordable, reliable and environmentally sound energy services into the future. The Sustainable Energy and Accompanying Measures (SEAM) project funded by the European Union (EU) and implemented by SPC will contribute to making energy access cheaper for the people of FSM by reducing the use of fossil fuels, flipping the switch to renewable energy sources. They assisted in developing the Climate Change and Disaster Risk Finance Report that included gender and social inclusion analysis and Yap to manage drought.
Micronesia Conservation Trust (MCT)	NGO	Works with NGOs, women groups and associations across the FSM to assess climate vulnerabilities of FSM's communities (through VA and LEAP), assigns grants for implementation of adaptation projects (e.g. through the Adaptation fund, Green Climate Fund), promote climate change awareness and programs for implementing renewable energy projects with women groups in	Solar Mamas -2016- training of eight (8) women from Pohnpei (Parem, Lenger, Mwahnd, Depehk and Takaiou Islands), Kosrae (Walung Village) and Chuuk (Parem Island) to become certified solar engineers and operate solar energy systems.

		FSM (e.g., solar mamas). MCT promotes regional capacity growth through scholarships, trainings and workshops. Ensure management and collection of monitoring data for Protected Areas, working with key partners as PIMPAC, University of Guam and National Government (e.g., Department of Resources and Development on PAN).	
The Nature Conservancy (TNC)	NGO	Works with women groups and association across the FSM to implement adaptation projects and increase awareness of climate change impacts and Ecosystem based adaptation (EbA) options. They have been active in the gender space and conducted a series of learning exchanges and workshop bringing together women leaders from FSM, Palau, Marshall Islands and Papua New Guinea.	TNC has been involved in a series of workshops aiming to capture and report on impacts of climate change on women and their families. TNC is currently working with women groups and association to implement EbA solutions and enhance awareness and preparedness on climate change
Pacific Resources for Education and Learning (PREL)	NGO	"Throughout the Pacific, PREL collaborates with schools, agencies, and communities to transform schooling and promote dynamic reciprocal learning communities built on strong social and cultural capital." PREL is implementing the Pacific Climate Education Partnership (2), which aim to empowering communities and students to address climate change issues and increase resilience through education and awareness".	PREL has collaborated, providing resources and expertise, to workshops, on the low-lying atoll of Pakin, to train the community in improving food security and agroforestry in the face of increasing climate change impacts. This hands-on training included also water quality testing and methods to improve soil fertility.
International Organization for Migrants	International Organization	IOM is an international organization … In Micronesia they monitor rates of migrants, support climate change displaced populations and through programs such as the Climate Adaptation, Disaster Risk Reduction, and Education (CADRE) Programme, they aim to build the resilience of vulnerable communities in the FSM and the RMI to natural hazards, particularly those that are climate induced.	Utilizing IOM's existing presence in the region and expertise in climate change adaptation and disaster preparedness, IOM will target approximately 10,000 school-aged students at up to 50 schools and surrounding communities with the Climate Adaptation, Disaster Risk Reduction, and Education (CADRE) Programme. IOM contributes to water security and they have partnered with the FSM Government and USAID for reconstruction following typhoon Maysak in 2015.

Catholic Relief Services (CRS)	NGO	CRS supports communities in Yap, FSM, to effectively prepare and respond to natural disasters. CRS also helps communities make informed decisions in their livelihood preferences.	CRS have helped the local leaders and community members effectively prepare and respond to natural disasters, adopt typhoon-resilient livelihood strategies and good hygiene practices. They conducted vulnerability assessment in Yap and supported households through a microfinance loan program.

Component 1: National Greenhouse Gas Inventory Updated

Objective Indicator*	End of Project Target**	Action to enhance gender responsiveness	Gender Target	Expected Outcomes	Responsible party	Timeline	Available Budget
1. Institutional and structural capacity of the FSM is built to ensure full transparency and reporting in accordance with Paris Agreement commitments.	*1.1 Collection of data for the five key thematic sectors (Energy, Industrial Processes, Solvent and other Product Use, Agriculture, Land-Use, Land-Use Change and Forestry and Waste).*	**1.1.1** Identify relevant data sources *[Note: IPCC data collection guidelines do not have gender specific criteria.]*		- Determine the sectors with significant emission and where resources can be targeted.	- Project Management Unit (PMU) with support and indications from consultants	-	-
	1.2 Training and capacity building activities on data collection, analysis on the use of 2006 IPCC guidelines on national GHG inventories and Uncertainty Management and the IPCC Good Practice Guidance on Land Use, Land Change and Forestry.	**1.2.1** Ensure capacity building for data collection for each of the five (5) sectors (Energy, Industrial Processes, Solvent and other Product Use, Agriculture, Land-Use, Land-Use Change and Forestry and Waste) includes both men and women.	• Ensure that trainings and capacity building are equally accessed, and that equitable representation of male and female participants is guaranteed. • Identify stakeholders and partners that can participate to trainings and capacity buildings (e.g. women groups, social affairs etc. in addition to energy sector workers).	- Ensure that women and men are receiving training and building their technical capacity in data collection methods in each of the five (5) key sectors.	- PMU with assistance from consultants	-	-
		1.2.2 Ensure equal access to trainings in IPCC Guidelines on National GHG Inventories and Uncertainty Management and IPCC Good Practices Guidance on Land Use, Land Change and Forestry to both men and women.	• Adapt IPCC guidelines to simplify so that information is easily understood – user friendly - and information can be easily dispersed and applicable (make it more practical/pragmatic) and ensure that they are gender inclusive.	- Ensure that women and men are both included in the training and enhancing their capacity.	- DECEM with assistance from other departments and divisions and support of State Governor Offices	-	-

*Objective Indicator: from ProDoc Project Results Framework; **End of project targets: from ProDoc Project Results Framework

Objective Indicator*	End of Project Target**	Action to enhance gender responsiveness	Gender Target	Outcomes	Responsible party	Timeline	Available Budget
1. Institutional and structural capacity of the FSM is built to ensure full transparency and reporting in accordance with Paris Agreement commitments.	*1.3 Institutional strengthening and capacity building including the thematic working groups for efficient and timely development and submission of GHG inventories.*	**1.3.1** Include gender specific groups (e.g., women organizations, youth groups, etc.) in the institutional strengthening and capacity building process to work together with DECEM and states.	• Determine number of capacity building to take place per to set-up baseline for number of trainings. • Establish a list of groups that should receive the trainings and who are central for data gathering. • Coordination and consultation between DECEM and gender organizations is established and strengthened. • Ensure that women's groups are included in the trainings.	- By creating the number of trainings to be conducted per year will support direct action in capacity building. - Establishing a list of key organizations to receive training will ensure that organizations working with women and other members of society are not only receiving training, but that future data collection is gender sensitive and inclusive.	- Government; DECEM - Assistance from the Department of Health and Social Affairs - Gender Office- in providing specific technical support - States gender Offices	-	-
	1.4 Set-up of the GHG emission data collection system within the national Statistics office to allow the continued collection of greenhouse gas information.	**1.4.1** Identification of priority sectors and key sector components (e.g., energy-electricity) for collection of sex disaggregated data that could then be included in a set-up of GHG emission data collection system within the National Statistics Office to allow continued collection of greenhouse gas information.	• Sex disaggregated data built into the set-up of GHG emission collection • Validate data collection system for long-term data collection.	- Data for the NC and BUR are now collected to include sex-disaggregated information. Gender-responsive approach is streamlined in the process. - MoU with national institutions to support the collection of sex-disaggregated data	- National Government: DECEM and FSM Statistic Division - States Statistics branch Offices	-	-
		1.4.2 Identify relevant data sources	• Network of agencies and stakeholders producing relevant data are identified. • Data gaps are identified and addressed.	- Preparation of list of stakeholders that would support future NC and BUR	- DECEM with assistance from the FSM Statistic Division	-	-

*Objective Indicator: from ProDoc Project Results Framework; **End of project targets: from ProDoc Project Results Framework

Component 2: Climate Change Mitigation

Objective Indicator*	End of Project Target**	Action to enhance gender responsiveness	Gender Target	Outcomes	Responsible party	Timeline	Available Budget
2. Mitigation actions developed and monitored with enhanced capacity to collect and analyze data collected.	***2.1*** *Identification of all potential mitigation options for each sector listed in the GHG inventory; and prioritization of mitigation options for each sector and categorization as long, medium and short-term priorities.*	**2.1.1** Collection, collation, analysis and archiving of sex-disaggregated data for the different sectors of the economy, with particular detail for the energy sector. **2.1.2** Technology solutions for the different mitigation options in various sectors are assessed through cost-benefit analysis that identify distribution of benefits for genders. **2.1.3** Include gender specific options for consideration in mitigation plans for each sector, that are prioritized and categorized as long, medium and short-term. Ensure that options are designed to be gender inclusive **2.1.4** Use GHG inventories to create proxies of fuel uses – fuel types.	• Mitigation options per sector listed in GHG inventory and vulnerability assessment include women and men activities. • Determine in which sectors and areas the different genders are contributing to GHG emissions, and if possible, to which extent. • Identification of gender responsive indicators to align with strategic objectives.	- Targeted activities identified for women and men ensure that the resources they are highly dependent on are adequately managed. - Women and men are part of mitigation planning and are included in mitigation implementation activities. - Identification of genders contribution to emission. - Types of agriculture practices conducted by men and women are determined to develop appropriate action to curtail and/or stop poor agricultural practices.	- GHG Specialist and PMU - Mitigation consultant with assistance from GHG specialist	-	-

*Objective Indicator: from ProDoc Project Results Framework; **End of project targets: from ProDoc Project Results Framework

Objective Indicator*	End of Project Target**	Action to enhance gender responsiveness	Gender Target	Outcomes	Responsible party	Timeline	Available Budget
2. Mitigation actions developed and monitored with enhanced capacity to collect and analyze data collected.	*2.2 Development of Mitigation Scenarios (Emission Forecast) based on the available data from the GHG inventory, as well as socio-economic information, and preparation of a series of mitigation scenarios to 2030 and 2050.*	**2.2.1** Mitigation scenarios are developed that include gender specific information along with socioeconomic information, collected from GHG Inventory and vulnerability assessments. Women and men are involved in the development of the scenarios	• Mitigation options, that are gender inclusive, for each of the sectors are categorized as long, medium, and short-term. • Priority areas of mitigation include gender information	- Mitigation scenarios are now gender mainstreamed and include socio-economic information. - Climate and gender issues for priority area of the mitigation are presented in the scenarios	- PMU and consultants with support from the GHG specialist	-	-
	2.3 Preparation of financially sound mitigation project profiles for existing and possible future implementation in the energy sector.	**2.3.1** Add a gender reminder to ensure consistency across sectors and develop specific gender and climate change sensitive indicators to enable monitoring of gender issues.	• The prepared financially sound mitigation project profiles are gender responsive and incorporate gender aspects	- Needed information in the development of action plans that address natural resource use by all genders become available through the Gender inclusive mitigation scenarios.	- PMU and consultants with support from the GHG specialist		
	2.4 Training and capacity building on the use of appropriate technologies, methodologies and tools for	**2.4.1** Conduct trainings and capacity building on gender and climate change mitigation, specifically on the use of appropriate technologies and tools for assessment and mitigation options and the development of mitigation scenarios.	• Trainings are gender-inclusive to ensure that women are not left behind and that their capacity is being built. • The different interactions of men and women in the different sectors are integrated	- Women and men receive training and build their technical capacity on technologies and tools that are appropriate for assessing mitigation options and scenarios.	- PMU and consultants with assistance from and State focal points	-	-

	assessment of mitigations options and development of mitigation scenarios.	**2.4.2** Ensure women and men have equal access and are included in workshops, and training and capacity building exercises.	• Ensure capacity of both genders is being built.				

Component 3: Vulnerability Assessment & Climate Change Adaptation

Objective Indicator*	End of Project Target**	Action to enhance gender responsiveness	Gender Target	Outcomes	Responsible party	Timeline	Available Budget
3. Adaptation measures for vulnerable key sectors are developed and proposed.	3.1 *Further assessment and elaboration of the climatic scenario for Micronesia including past, present and future projection.*	**3.1.1** Include sex disaggregated data in further assessments and elaboration of climate scenario for Micronesia.	- Four (4) climatic scenarios are produced in 4 states and impacts on gender included. • Identify gender responsiveness to indicators to align with strategic objectives.	• Understanding on how climate change impacts the different genders.	•PMU in collaboration with consultants •M&E specialist – UNDP(1)	-	-
		3.1.2 Assessments should include and incorporate information about the different use of resources from women and men by sector.	• Economic proxies (literature reviews) analysis, based on sex-disaggregated data and information, conducted for key sectors: agriculture, forestry and fisheries.	• Strengthened information of impacts to all parts of society. Pillar for adaptation strategies opportunities, should a resource be loss.	•PMU and consultants with assistance from DECEM and FSM Statistic Division	-	-
	3.2 *Identification of vulnerable sectors in Micronesia based on the latest assessment and studies.*	**3.2.1** Identify vulnerable sectors in Micronesia, that includes sectors that are female dominate and include domestic activities that are not always measured or economically quantified.	• Sex disaggregated data and data gaps are included in the baseline information.	• Women and men are equally represented among the sectors impacted by climate change.	- PMU and consultants with support from and DECEM	-	-
	3.3 *Strengthen adequate baseline information to*	**3.3.1** Identify and include sex disaggregated data to strengthen baseline information and develop specific gender sensitive criteria and	• Sex disaggregated data and data gaps are included in the baseline information.	• Women and men are equally represented in the evaluation of climate change changes and impacts.	- PMU in collaboration with consultants	-	-

	measure changes and assess impacts.	indicators to measure changes and assess impacts in priority areas.			- M&E specialist - UNDP		

*Objective Indicator: from ProDoc Project Results Framework; **End of project targets: from ProDoc Project Results Framework
(1)Consult with UNDP M&E Specialist and gender specialist to review the proposed criteria and indicators for monitoring and validate with FSM national and state government.

Objective Indicator*	End of Project Target**	Action to enhance gender responsiveness	Gender Target	Outcomes	Responsible party	Timeline	Available Budget
3. Adaptation measures for vulnerable key sectors are developed and proposed.	*3.4 Description of current vulnerability and adaptation efforts; future risks including national/sectoral adaptation policies, strategies and measures.*	**3.4.1** Description of current vulnerability and adaptation efforts should include different stakeholders and organizations that take into account women participation in the various sectors and the impacts to their livelihoods and daily activities.	• Preparation of stakeholder map, including identification of stakeholder and organizations working with women and men in various sectors.		- PMU in collaboration with identified consultants - PMU with assistance from DECEM and States	-	-
		3.4.2 Promote the participation of women and youth groups including human rights advocates, vulnerable communities, Faith Based Organizations in both the national and state government consultations, in close consultations with DECEM.		- Women are equally and equitably represented in adaptation actions in all key sectors. - Gender-equitable representation is achieved in national sectoral adaptation policies, strategies and measures.			
		3.4.3 Future risks including national/sectoral adaptation policies, strategies and measures, should be assessed to ensure that they are gender inclusive.	- Gender inclusive risk assessments established for national/sectoral policies, strategies and measures.		- PMU and consultants, with assistance from DECEM and States	-	-
		3.4.4 National and state policies, strategies and measures analyzed to ensure gender mainstreaming and recommendations provided to ensure gender (female and male) are included and fully protected under future policies, strategies and measures.			• PMU and consultants with assistance from states and FSM national stakeholders	-	-

*Objective Indicator: from ProDoc Project Results Framework; **End of project targets: from ProDoc Project Results Framework

Objective Indicator*	End of Project Target**	Action to enhance gender responsiveness	Gender Target	Outcomes	Responsible party	Timeline	Available Budget
3. Adaptation measures for vulnerable key sectors are developed and proposed.	*3.5 Identified potential adaptation actions for priority sectors including opportunities and barriers.*	**3.5.1** Adaptation actions include women in each of the priority sectors, opportunities identified for female participation, and barriers recognized, and actions provided to mitigate or eliminate those barriers.	- Identified adaptation actions are gender inclusive in the priority sectors. - Barriers for female and male inclusion are identified and examples are reported. - Opportunities identified for female participation. - A list of actions to mitigate and/or eliminate barriers for female and male inclusion.	- Recommendations to improve gender inclusion and overcome barriers to gender inclusion in all key sectors are identified and are provided.	- PMU with support from consultants and State focal points	-	-

*Objective Indicator: from ProDoc Project Results Framework; **End of project targets: from ProDoc Project Results Framework

Component 4: Domestic Measurement, Reporting and Verification

Objective Indicator*	End of Project Target**	Action to enhance gender responsiveness	Gender Target	Outcomes	Responsible party	Timeline	Available Budget
4. Domestic Measurement, Reporting and Verification system established and supported.	*4.1 Domestic MRV system established and supported.*	**4.1.1** Sex-disaggregated data sets created for each of the 5 key sectors.	- Establishment of a gender-responsive Governance structure and institutional framework for the MRV system, including equal representation of men and women.	- The MRV system is gender-responsive and inclusive of men and women.	- PMU with consultants	-	-
		4.1.2. Capacity of men and women built to collect and process data.	- Capacity of both men and women is built to provide to information to the Domestic MRV system.	- Capacity building developed for both men and women	- PMU with consultants	-	-
		4.1.3 Train technical staff, comprised of both men and women in 5 key sectors to collect sex disaggregated data in GHG data collection methodologies and insert them into GHG Inventory and MRV system.	- Data integration and sharing processes to be used by both men and women is developed and utilized as a source for information sharing and transparent reporting	- Capacity building developed for both men and women	- PMU and consultants with assistance from GHG specialist	-	-
		4.1.4 Ensure to include gender-responsive performance indicators to measure progress in implementation of mitigation actions	- Impact of mitigation actions is measured for men and women.	- Mitigation actions are inclusive of the impacts on men and women.	- PMU and consultants with assistance from GHG specialist - M&E specialist – UNDP[1]	-	-

*Objective Indicator: from ProDoc Project Results Framework; **End of project targets: from ProDoc Project Results Framework

[1] Consult with UNDP M&E Specialist and gender specialist to review the proposed criteria and indicators for monitoring and validate with FSM national and state government

References

ADB (2017). Pacific Economic Monitoring, December 2017. Asian Development Bank, Manila, Philippines, www.adb.org/pacmonitor (last accessed July 2021).

ADB (2020). Assessing and improving policy response to economic shocks in the North Pacific, December 2020. Asian Development Bank, Manila, Philippines.

de Águeda Corneloup I, Mol APJ. (2014). Small island developing states and international climate change negotiations: the power of moral "leadership." Int. Environ. Agreem. Polit. Law Econ. 14(3):281–97

Altunel, Tayyibe Acikgoz and Seda Erkan Buğday (2018). Revenues from Ecotourism Activities in the World January 2019, International Conference on Environment and Forest Conservation.

Andersson AJ, Mackenzie FT, Bates NR. (2008). Life on the margin: implications of ocean acidification on Mg-calcite, high latitude and cold-water marine calcifies. Mar. Ecol. Prog. Ser. 373:265–73.

Appleseed Center for Law and Economic Justice (2011). Broken Promises, Shattered Lives: The case for justice for Micronesians in Hawai'i.

Australian Bureau of Meteorology & CSIRO (2011). Climate Change in the Pacific: Scientific Assessment and New Research Volume 2: Country Reports.

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 Commonwealth Scientific and Industrial Research Organisation, Melbourne, Australia, https://www.pacificclimatechangescience.org/ wp-content/uploads/2014/07/PACCSAP_CountryReports2014_WEB_140710.pdf.

Bailey R.T., Jenson J.W. (2011). Groundwater resources analysis of atoll islands in the FSM using an algebraic model. Technical Report No. 134.

Balick, M.J., ed. (2009). Ethnobotany of Pohnpei: Plants, people and island culture. New York Botanical Garden/University of Hawaii Press. Honolulu.

Bell, et al. (2013). Mixed responses of tropical Pacific fisheries and aquaculture to climate change. Nature Climate Change.

Betzold C. (2010). "Borrowing" power to influence international negotiations: AOSIS in the climate change regime, 1990–1997. Politics 30(3):131–48

Blue Bird Jernigan, V., Maudrie, T.L., Nikolaus, C.J., Benally, T., Johnson, S., Teague, T., Mayes, M., Jacob, T., and Taniguchi, T. (2021). Food sovereignty indicators for indigenous community capacity building and health. Frontiers in Sustainable Food Systems, 5, 1-9. doi: 10.3389/fsufs.2021.704750.

Braun T. (2012). Stocktake of the gender mainstreaming capacity of Pacific island governments: Federated States of Micronesia. Secretariat of the Pacific Community (SPC).

Britten, G.L., Duarte, C.M., and Worm, B. (2021). Recovery of assessed global fish stocks remains uncertain. Proceedings of the National Academy of Sciences, 118(31), 1-3. doi.org/10.1073/pnas.2108532118.

Burgess, A.J., Cano, M.E.C., and Parkes, B. (2022). The deployment of intercropping and agroforestry as adaptation to climate change. Crop and Environment, 1(2), 145-160. https://doi.org/10.1016/j.crope.2022.05.001.

Cartier, L.E., Krzemnicki, M.S., and Ito, M. (2012). Cultured pearl farming and production in the Federated States of Micronesia. Gems and Gemology, 48(2), 108-122.

Castalia Advisory Group (2018). Energy Master Plans for the Federated States of Micronesia. Final Report to the Department of Resources and Development.

CDKN (2016). CDKN Planning for NDC Implementation: A Quick-Start Guide.

Center for Excellence in Disaster Management & Humanitarian Assistance (2019). Federated States of Micronesia Disaster Management Reference Handbook.

Chuuk State (2018). Solid Waste Management Strategy 2019–2028, https://www.sprep.org/attachments/VirLib/Palau/chuuk-solid-waste-management-strategy.pdf.

Cohen AL, Holcomb M. (2009). Why corals care about ocean acidification. Oceanography 22:118–27.

College of Micronesia–FSM (2020). Fall 2020 Semester Summary, http://www.comfsm.fm/?q=irpo- enrollment.

Cuetos-Bueno, J. et al. (2018). Human and environmental gradients predict catch, effort, and species composition in a large Micronesian coral-reef fishery. PLoS ONE, 13(5).

Demir, C., Cevirgen, A. (2006). Management of ecotourism. Nobel Publishing House: İzmir.

Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH (nd). MRV—Measurement, Reporting, Verification, How to Set Up National MRV Systems, Draft 4.0.

Division of Statistics, SBOC (2014). Federated States of Micronesia Households Income and Expenditure Survey 2013/2014: main analysis report. FSM Office of Statistics, Budget, Overseas Development Assistance and Compact Management (SBOC), Palikir, Pohnpei, FSM.

EBSCO, Sustainability Watch (2009). Ecotourism—a Look at the Fastest Growing Segment of the Travel and Tourism Industry. https://ebscosustainability.files. wordpress.com/ 2010/07/eco tourism.pdf, last accessed December 10, 2018.

EconMAP (2020). Assessing the Impact of COVID-19 on the Federated States of Micronesia Economy.

EconMAP (2021). Impact of the COVID-19 Pandemic on the Federated States of Micronesia: Economic Outcomes and Policy Review, https://pubs.pitiviti.org/fsm-covid-impact-update.

Ellison, Joanna (2019). Mangrove vulnerability assessment for Pohnpei, Federated States of Micronesia.

Englberger, L., Marks, G.C., and Fitzgerald, M.H. (2003). Insights on food and nutrition in the Federated States of Micronesia: a review of the literature. Public Health Nutrition, 6(1), 5-17. doi: 10.1079/PHN2002364. PMID: 12581460.

Englberger, K., and Worth, O. (2019). Market study in FSM: A rapid survey of local markets, domestic supply chain and support networks. International Fund for Agricultural Development (IFAD), 1-68.

FAO, Food and Agriculture Organization of the United Nations (2001). State of Food Insecurity in the World 2001. Rome.

FAO, Food and Agriculture Organization of the United Nations (2011). The State of Food and Agriculture 2011: Women and Agriculture, Closing the Gender Gap for Development. Rome.

FAO, Food and Agriculture Organization of the United Nations (2014). Policy measures to increase local food supply and improve food security in the Federated States of Micronesia, 1-44.

FAO, Food and Agriculture Organization of the United Nations (2015). Sustainable Food Systems; Concept and Framework, www.fao.org/3/ca2079en/CA2079EN.

FAO, Food and Agriculture Organization of the United Nations (2018). Sustainable Food Systems: Concepts and Framework; FAO: Rome.

FAO, Food and Agriculture Organization of the United Nations (2020a). Aquaculture Business Investment Planning and Development to Increase Resilience and Improve Food Security, pp. 1-8.

FAO, Food and Agriculture Organization of the United Nations (2020b). Piloting sustainable fish value chains with extended shelf-life products. Technical Cooperation Programme terminal report, TCP/MIC/3604.

FAO, Food and Agriculture Organization of the United Nations (2020c). Strengthening the Capacity of Farmers' Associations to Increase Production and Marketing of Root Crops, Fruits and Vegetables in Federated States of Micronesia.

FAO, Food and Agriculture Organization of the United Nations (2021a). Poverty, malnutrition and food security in Pacific Small Island Developing States. Bangkok.

FAO, Food and Agriculture Organization of the United Nations (2021b). State of Food Security and Nutrition in the World 2021. Rome.

FAO, Food and Agriculture Organization of the United Nations (2022). The State of Food and Agriculture 2022. Leveraging automation in agriculture for transforming agrifood systems. Rome.

FSM (nd). Infrastructure Development Plan FY 2016–2025.

FSM (nd). National Oceanic Fisheries Investment Policy 2018–2023.

FSM (1997). First National Communication to the United Nations Framework Convention on Climate Change, https://unfccc.int/sites/default/files/resource/Micronesia%20INC.pdf.

FSM (2002). Federated States of Micronesia 2000 Population and Housing Census Report: National Census Report, pp. 1-163.

FSM (2013a). Climate Change Act, P.L. No. 18-34, Chapter 8, Subsection 11, Title 25.

FSM (2013b). Policy for Overseas Development Assistance, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.adb.org/sites/default/files/linked-documents/cobp-fsm-2015-2017-sd-03.pdf.

FSM (2014). National Tourism Sector Development Framework and State Government Tourism Investment Plans, Department of Resources & Development.

FSM (2015a) National Tourism Policy. Vol. 1, https://www.fsmstatistics.fm/wp-content/uploads/2019/10/4-FSM-National-Tourism-Policy-Vol-1a_W-Foreword_8July.pdf.

FSM (2015b). Second National Communication to the United Nations Framework Convention on Climate Change, https://unfccc.int/sites/default/files/resource/fsmnc2.pdf.

FSM (2016). Instrument of Ratification, Paris Agreement, https://www.fsmgov.org/treaties/paris_ag.pdf.

FSM (2018). State of the Environment Report.

FSM (2019). Aquaculture Management Development Plan.

FSM (2021). Updated Nationally Determined Contribution of the Federated States Of Micronesia for the Period Through 2030, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://unfccc.int/sites/default/files/NDC/2022-10/Updated_NDC_of_the_Federated_States_of_Micronesia.pdf.

FSM (2023a). National Biodiversity Strategy and Action Plan, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.cbd.int/doc/world/fm/fm-nbsap-v2-en.pdf.

FSM (2023b). Federated States of Micronesia's Strategic Development Plan (2004-2023), 1-193.

FSM Department of Environment, Climate Change & Emergency Management (DECEM) (2016). Integrated Agriculture Census 2016, https://fsm-data.sprep.org/dataset/federated-statess-micronesia-integrated-agriculture-census.

FSM Department of Environment, Climate Change & and Emergency Management (DECEM) (2017). Federated States of Micronesia National Disaster Management Plan 2016. FSM National Government: Palikir, Pohnpei.

FSM Department of Foreign Affairs (2017). Federated States of Micronesia Country Program. Report prepared by Briones-Johnson, L. under the FSM-GCF Readiness Phase, with SPC, https://www.greenclimate.fund/sites/default/files/document/micronesia-country-programme.pdf (last accessed October 2021).

FSM Department of Health and Social Affairs (2014). Federated States of Micronesia family health and safety study. Palikir, Pohnpei, FSM.

FSM Department of Resources and Development (2012a). Federated States of Micronesia Agriculture Policy 2012-2016. FSM National Government: Palikir, Pohnpei.

FSM Department of Resources and Development (2012b). FSM National Energy Policy, Volume I, https://policy.asiapacificenergy.org/sites/default/files/Energy-Policy-volume-I-Updated.pdf, last accessed 25 October 25, 2020.

FSM Department of Resources and Development (2012c). FSM National and states energy action plans, Volume II, https://policy.asiapacificenergy.org/sites/default/files/Energy-Policy-Volume-II-Action-Plans- Updated.pdf (last accessed 25 November 25, 2020).

FSM Department of Resources and Development (2016). Federated States of Micronesia Agriculture Policy, 1-64.

FSM Department of Resources and Development (2020). Federated States of Micronesia Forest Action Plan 2020-2030. Palikir, FSM.

FSM Department of Resources and Development (2022). Second National Conference: Powering the FSM Energy sector presentation. Chuuk State, January 2022, https://gov.fm/files/Day1-01-Energy.pdf (last accessed February 2022).

FSM Department of Resources and Development Fisheries Section (2019). Federated States of Micronesia Aquaculture Management and Development Plan, pp. 1-62.

FSM Department of Resources and Development Statistics Division (2019). Annual Food Imports 2009- 2018.

FSM Department of Resources and Development, SDG Working Group (2020). First Voluntary National Review Report on the Implementation of the 2030 Agenda for Sustainable Development. Palikir, Pohnpei, FSM.

FSM Division of Statistics (2020). 2010-2015 baseline for SDG 6.3.1, https://www.fsmstatistics.fm/sustainable-development-goal-6/.

FSM Division of Statistics, Department of Resources and Development (2020). Statistical news: International merchandise trade statistics Calendar Year 2018. FSMDS Release No: 20.01.

FSM National Government (2023). Planning Committee, 2023. FSM 2023 Action Plan, 1-76.

FSM Office of Economic Affairs of Pohnpei (2010). Agriculture Strategic Action Plan 2011–2015: Pohnpei State, pp. 1-20.

FSM Office of Statistics, Budget, Overseas Development Assistance and Compact Management (2010). Summary Analysis of Key Indicators from the FSM 2010 Census of Population and Housing, https://www.fsmstatistics.fm/wp-content/uploads/2020/04/2010-Summary-Analysis-Key-Indicators.pdf, Palikir, Pohnpei, FSM.

FSM Office of Statistics, Budget, Overseas Development Assistance and Compact Management (2014). Household Income and Expenditure Survey, 2013–14, Main Analysis Report, https://sdd.spc.int/digital_library/federated-statess-micronesia-2013-14-hies-report, Palikir, Pohnpei, FSM.

FSM Petroleum Corporation (nd). Fuel supply data, 2001–2018.

FSM Statistics Office (2020). Population Projection—2020–2025, https://www.fsmstatistics.fm/social/population-statistics/#pagescrollPS001.

Government of the Federated States of Micronesia (2004). Federated States of Micronesia's Strategic Development Plan (2004-2023). The next 20 years: achieving economic growth and self-reliance. Volume I: Policies and Strategies for development. Palikir, Pohnpei, FSM.

Government of the Federated States of Micronesia (2010). The Federated States of Micronesia Fourth National Report to the Convention on Biological Diversity.

Government of the Federated States of Micronesia (2015). Second National Communication under the UN Framework Convention on Climate Change, https://unfccc.int/resource/docs/natc/fsmnc2.pdf (last accessed June 2021).

Government of the Federated States of Micronesia (2020a). The Federated States of Micronesia Sixth National Report to the Convention on Biological Diversity, https://www.cbd.int/doc/nr/nr-06/fm-nr-06- en.pdf (last accessed July 2021).

Government of the Federated States of Micronesia (2020b). Third National Communication/Biennial Update Report to the UNFCCC Gender Analysis.

Government of the Federated States of Micronesia (2020c). First Voluntary National Review on the 2030 Agenda for Sustainable.

Gunter, U., Ceddia, G.M., Leonard, D., Troster, B. (2018). Contribution of international ecotourism to comprehensive economic development and convergence in the Central American and Caribbean region. Journal of Applied Economics, 3614-3629.

Harvard Extension School (nd). Yap Sustainability Degree Harvard, https://www.extension.harvard.edu/academics/graduate-degrees/sustainability-degree.

Health Resources and Services Administration, Federated States of Micronesia (2021). III.B. Overview of the State, https://mchb.tvisdata.hrsa.gov/Narratives/Overview/5287367a-ff2c-4459-b22a-5344998a0548 (last accessed December 21, 2022).

Hernandez-Ortiz, D. et al. (2016). Characteristics and drivers of coral-reef fishery landings in Pohnpei, Federated States of Micronesia. Proc 13th International Coral Reef Symposium.

Hezel, Francis X. and Michael J. Levin (2012). Survey of Federated States of Micronesia Migrants in the United States including Guam and the Commonwealth of Northern Mariana Islands (CNMI), chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://dataspace.princeton.edu/bitstream/88435/dsp01c53 4fr29v/1/DSpaceSurveyofFederatedStatesMicronesia.pdf.

HLPE, High Level Panel of Experts on Food Security and Nutrition (2020). Food Security and Nutrition: Building a Global Narrative Towards 2030: Rome, Italy, 112.

Hodges, R.J., Buzby, J.C., and Bennett, B. (2011). Postharvest losses and waste in developed and less developed countries: opportunities to improve resource use. The Journal of Agricultural Science, 149(S1), 37-45.

Hofmann, G. E., Barry, J. J., Gates, R. D., Hutchins, D. A., Kilnger, T., Sewell, M. A. (2010). The effect of ocean acidification on calcifying organisms in marine ecosystems: An organism-to-ecosystem perspective. Annu. Rev. Ecol. Evol. Syst. 2010. 41:127–47

Houk, P. et al. (2012). Commercial coral-reef fisheries across Micronesia: A need for improving management. Coral Reefs, 31(1), pp.13–26.

Houk, P. et al. (2017). An applied framework to assess exploitation and guide management of coral-reef fisheries. Ecosphere, 8(3).

Houk, P., Camacho, R., Johnson, S., McLean, M., Maxin, S., Anson, J., et al. (2015). The Micronesia Challenge: Assessing the Relative Contribution of Stressors on Coral Reefs to Facilitate Science-to Management Feedback. PLoS ONE 10(6): e0130823. doi:10.1371.

Houk, P., Yalon, A., Maxin, S., Starsinic, C., Mcinnis, A., Gouezo, M., Yimnang Golbuu, Y., van Woesik, R. (2020). Predicting coral-reef futures from El Niño and Pacific Decadal Oscillation events. Scientific Reports (2020) 10:7735, https://doi.org/10.1038/s41598-020-64411-8.

IIED (2017). A guide to transparency under the UNFCCC and the Paris Agreement—Reporting and review: obligations and opportunities. London, United Kingdom: IIED.

Integrated Aquatic Solutions Inc. (2018). Final report of the Federated States of Micronesia coastal fisheries assessment. https://www.fsmstatistics.fm/wp-content/uploads/2019/10/5-Prop-final-2- volumes.pdf, Last accessed October 25, 2020.

International Monetary Fund (2019a). Federated States of Micronesia: 2019 Article IV Consultation, Country Report No. 19/288, Washington D.C.

International Monetary Fund (2019b). Federated States of Micronesia: Climate Change Policy Assessment, IMF Country Report No. 2019/292.

International Monetary Fund (2021). Federated States of Micronesia Country Report No 21/237. Washington D.C.

International Organization for Migration (2016). Migration in the Federated States of Micronesia: A Country Profile 2015, https://publications.iom.int/books/migration-federated-states-micronesia-country- profile-2015.

IOM Micronesia (2019). Newsletter July 2018-April 2019.

IPCC (2006a). Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, https://www.ipcc-nggip.iges.or.jp/public/gp/english/index.html.

IPCC (2006b). Guidelines for National Greenhouse Gas Inventories, https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html.

Jardim, M.Z., Costa, B.V.L., Pessoa, M.C., and Duarte, C.K. (2021). Ultra-processed foods increase noncommunicable chronic disease risk. Nutrition Research, 95, 19-34. doi: 10.1016/j.nutres.2021.08.006. Epub 2021 Sep 11. PMID: 34798466.

Johnston, M. (2011) Federated States of Micronesia IWRM Outlook Summary and NWTF Report, https://www.preventionweb.net/files/27083_fsmwatsanoutlook.pdf.

Kasalak, M. A. (2015). Dünya'da ekoturizm pazarı ve ekoturizm'in ülke gelirlerine katkıları. Journal of Recreation and Tourism Research 2 (2), 20-26.

Kosrae States (2018). Solid Waste Management Strategy 2018–2027, https://www.sprep.org/attachments/VirLib/Palau/kosrae-solid-waste-management-strategy.pdf.

Krause, S. M. (2016). The production of cultural heritage discourses: Political economy and the intersections of public and private heritage in Yap State, Federated States of Micronesia. PhD Dissertation, University of South Florida.

Labeyrie, V., et al. (2021). The role of crop diversity in climate change adaptation: insights from local observations to inform decision making in agriculture. Current Opinion in Environmental Sustainability, 51, 15–23. doi:10.1016/j.cosust.2021.01.006.

Lambeth L. (2000). An assessment of the role of women in fisheries in Pohnpei Federated States of Micronesia. The Secretariat of the Pacific Communities, Noumea, New Caledonia.

Lambeth L., Abrahm R. (2001a). An assessment of the role of women in fisheries in Kosrae Federated States of Micronesia. Field Report No. 3, The Secretariat of the Pacific Communities, Noumea, New Caledonia.

Lambeth L., Santiago E. (2001b). An assessment of the role of women in fisheries in Chuuk Federated States of Micronesia. Field Report No. 4, The Secretariat of the Pacific Communities, Noumea, New Caledonia.

Lambeth L., Santiago E. (2001c). An assessment of the role of women in fisheries in Yap Federated States of Micronesia. Field Report No. 5, The Secretariat of the Pacific Communities, Noumea, New Caledonia.

Lazrus, H. (2015). Risk perception and climate adaptation in Tuvalu: a combined cultural theory and traditional knowledge approach. Human Organization, 74(1), 52-61. https://doi.org/10.17730/humo.74.1.q0667716284749m8

Liebhold, A., B. Bentz (2011). Insect Disturbance and Climate Change. U.S. Department of Agriculture, Forest Service, Climate Change Resource Center, www.fs.usda.gov/ccrc/topics/insect-disturbance/insect- disturbance.

Lindsay, S.R. (2002). Aquaculture country profile, federated states of Micronesia. Aquaculture Technical Report Series Secretariat of the Pacific Community, Noumea, New Caledonia. 1-33.

Lindsey R. (2022). Climate Change: Global Sea Level. NOAA, Climate Watch Magazine, https://www.climate.gov/news-features/understanding-climate/climate-change-global-sea-level.

Lowe, E. D. (2019). Social Change and Micronesian Suicide Mortality: A Test of Competing Hypotheses. Cross-Cultural Research, 53(1), 3–32 https://doi.org/10.1177/1069397118759004.

Marr, M. A., D. A. Marett, and D. A. Wohlgemuth (2018). "MRV In Practice"—Connecting Bottom-Up and Top-Down Approaches for Developing National MRV Systems for NDCS, https://www.ndcs.undp.org/content/ndc-support-programme/en/home/impact-and-learning/ideas-and-insights/2018/bottom-up-and-top-down-approaches-for-national-mrv-systems.html.

Marra J.J., Kruk M.C. (2017). State of Environmental Conditions in Hawaii and the U.S. Affiliated Pacific Islands under a Changing Climate: 2017, https://coralreefwatch.noaa.gov/satellite/publications/state_of_the_environment_2017_hawaii-usapi_noaa-nesdis-ncei_oct2017.pdf.

Mcleod E. et al. (2018). Raising the voices of Pacific Island women to inform climate adaptation Policies. Marine Policy 93: 178–185.

Meier, M.F.; Wahr, J.M. (2002). Sea level is rising: Do we know why? Proc. Natl. Acad. Sci. USA, 99, 6524–6526.

Merchant, E.V., and Simon, J.E. (2022). Traditional and indigenous foods for food security and sovereignty. In Encyclopedia of Human Nutrition 4th Edition (Elsevier), B9780128218488000000. 10.1016/B978-0-12-821848-8.00076-7.

Mestrovic, T. (2018). What Is Medical Tourism? News Medical, https://www.news-medical.net/health/What-is-Medical-Tourism.aspx.

Micronesia Conservation Trust (MCT) (nd). Gather Baseline Data for Staple Crops and Marine Species for Local Aquaculture Development, and Other Foods and Model Climate Change Impact.

Minx, J. et al. (2023). Focus on Evidence Synthesis for Climate Solutions, Environmental Research Letters, 15: 11, https://iopscience.iop.org/collections/1748-9326_focus_issue_Evidence-Synthesis-Climate-Solutions.

Mohnsen, M., and Yang, H. (2021). Sea cucumbers: aquaculture, biology and ecology. Academic Press. Cambridge. 1-188.

Mollica, N. R., Guo, W., Cohen, A. L., Solow, A. (2018). Ocean acidification affects coral growth by reducing skeletal density. PNAS 115: 1754-1759

The Nature Conservancy (2012). Blueprint for Conserving Biodiversity in the Federated States of Micronesia, https://www.conservationgateway.org/Files/Pages/blueprint-conserving-biod.aspx.

NOAA National Centers for Environmental Information (NCEI) (nd).U.S. Climate Normals Quick Access tool, https://www.ncei.noaa.gov/access/us-climate-normals/#dataset=normals-annualseasonal&timeframe=30&location=FM, last accessed on December 26, 2021.

Oneisom, I. I. (1994) The Changing Family in Chuuk: 1950-1999. Micronesian Counselor. No. 14. Pohnpei FSM: Micronesian Seminar. http://www.micsem.org/pubs/counselor/frames/chgfamfr.htm, last accessed 25 October 2020.

Ourbak T, Magnan AK. (2018). The Paris Agreement and climate change negotiations: Small Islands, big players. Reg. Environ. Change 18:2201–7

Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) (nd). PACCSAP Collection, https://terranova.org.au/repository/paccsap-collection/.

The Pacific Community (2015). Compile and Review Invasive Alien Species Information for the Federated States of Micronesia and its constituent states Chuuk, Kosrae, Pohnpei and Yap. Unpublished draft report for the Secretariat of the Pacific Regional Environmental Programme. 31 pp. Invasive Species Specialist Group, Pacific Regional Office, Auckland, NZ.

The Pacific Community (2017). Women's empowerment in the Pacific: regional overview. 13th Triennial Conference of Pacific Women and 6th Meeting of Ministers for Women.

The Pacific Community (2019). Gender analysis of the fisheries sector in Federated States of Micronesia. Noumea, New Caledonia.

The Pacific Community and the Pacific Islands Forum Secretariat (2019). Federated States of Micronesia Climate Change and Disaster Risk Finance Assessment: Final Report. Suva, Fiji.

Perkins, R. M., and Krause, S. (2018). Adapting to climate change impacts in Yap State, Federated States of Micronesia: the importance of environmental conditions and intangible cultural heritage. Island Studies Journal, 13(1), 65–78. https://doi.org/10.24043/isj.51.

Petzold, Jan, Nadine Andrews, James D. Ford, Christopher Hedemann, and Julio C. Postigo (2020). Indigenous knowledge on climate change adaptation: a global evidence map of academic literature. Environ. Res. Lett. 15 113007, DOI 10.1088/1748-9326/abb330.

Pohnpei State (2019). Solid Waste Management Strategy 2020–2029, https://www.sprep.org/sites/default/files/documents/publications/Pohnpei_SolidWasteMgmt_Strategy.pdf.

Pohnpei State Department of Resources and Development Food Security Policy (2023). Pohnpei State, Federated States of Micronesia.

Popkin, B.M., and Gordon-Larsen P. (2004). The nutrition transition: worldwide obesity dynamics and their determinants. International Journal of Obesity and Related Metabolic Disorders, 28(3), S2-9. doi: 10.1038/sj.ijo.0802804. PMID: 15543214).

Ragone, D. (2009). Breadfruit and its traditional cultivation and use on Pohnpei. Pp 63-88 in, Balick, M.J. (ed). Ethnobotany of Pohnpei: Plants, people and island culture. New York Botanical Garden/University of Hawaii Press. Honolulu.

Ralston, K. (1999). How government policies and regulations can affect dietary choices. In America's Eating Habits: Changes and Consequences, U.S. Department of Agriculture, Economic Research Service, 750, 1-331.

Raynor, B. (1991). Agroforestry systems in Pohnpei: Practices and strategies for development. RAS/86/036 Field Document 4. Pohnpei: FAO/UNDP South Pacific Forestry Development Programme.

Raynor, B., Lorens, A., and Phillip, J. (2009). Yams and their traditional cultivation on Pohnpei. in Balick, M.J. (ed). Ethnobotany of Pohnpei: Plants, people and island culture. New York Botanical Garden/University of Hawaii Press. Honolulu, 40-62.

The Regional Rights Resource Team of the Pacific Community and the Asia Pacific Forum of National Human Rights Institutions (2019). National Government of the Federated States of Micronesia Scoping study report 2019: on the desirability, feasibility and options for the establishment of a Paris Principles– compliant National Human Rights Institution.

Resilience (2015). What Is food security?, https://www.resilience.org/stories/2015-01-09/what-is-food- security/ (last accessed on 21 December 2022).

Rubinstein, D. H. Epidemic suicide among Micronesian adolescents. Soc Sci Med. 1983;17(10):657-65. doi: 10.1016/0277-9536(83)90372-6. PMID: 6879228.

Rutgers, The State University of New Jersey (2023). Baseline Assessment in Support of Climate-resilient food security for farming households across the Federated States of Micronesia. Technical Report to Micronesia Conservation Trust, Federated States of Micronesia and the Green Climate Fund (in press).

Sakthivel, D., Vijayakumar, N., and Anandan, V. (2015). Extraction of chitin and chitosan from mangrove crab Sesarma plicatum from Thengaithittu estuary Pondicherry southeast coast of India. International Journal of Pharmacy and Pharmaceutical Research, 4(1), 12-24.

Sampson, D., et al. (2021). Food sovereignty and rights-based approaches strengthen food security and nutrition across the globe: a systematic review. Frontiers in Sustainable Food Systems, 5, 686492. doi: 10.3389/fsufs.2021.686492

Schneider, L., M. Rebetez, S. Rasmann (2022). The effect of climate change on invasive crop pests across biomes. Current Opinion in Insect Science 50:100895, https://doi.org/10.1016/j.cois.2022.100895.

Scientific Advisory Board of the UN Secretary-General (2016). Indigenous and Local Knowledge(s) and Science(s)for Sustainable Development, https://unesdoc.unesco.org/ark:/48223/pf0000246104?posInSet=5&queryId=N-EXPLORE-51746775- bfe1-403c-bd6e-bcd8c7ff599d.

Shelley, C. (2008). Capture-based aquaculture of mud crabs (Scylla spp.). p. 255–269. In: Lovatelli A. and Hol- thus P.F. (eds). Capture-based aquaculture. Global overview. FAO Fisheries Technical Paper. No. 508. Rome: Food and Agriculture Organization of the United Nations.

Skendžić S., M. Zovko, I.P. Živković, V. Lešić, D. Lemić. (2021). The impact of climate change on agricultural insect pests. Insects 12(5):440. doi: 10.3390/insects12050440.

Smith, D., Jones, M., Solomon, M., and Meeks, D. (2018). The role of collaboration and community engagement in improving food systems. Journal for Nutrition Education and Behavior, 59(7), S1.

SPC (2022). Assessment of the aquaculture needs, priorities and future direction in the Pacific Islands region.

SPREP (2019). Federated States of Micronesia State of Environment Report. Apia, Samoa.

SPREP (2021). State of environment and conservation in the Pacific Islands: 2020 regional report. Apia, Samoa.

Strauss, Ilana (2018). 70% of Americans Think the Environment Is More Important Than Economic Growth. Treehugger, https://www.treehugger.com/environmental-policy/70-americans-think-environmental-protection-more-important-economic-growth.html.

Subasinghe, R., Soto, D., and Jia, J. (2009). Global aquaculture and its role in sustainable development. Reviews in Aquaculture, 1, 2-9.

Thomas, A., Baptiste, A., Martyr-Koller, M., Pringle, P., Rhiney, K. (2020). Climate Change and Small Island Developing States. Annual Review of Environment and Resources 2020 45:1, 1-27.

Thomas A., Schleussner C.-F., Kumar M. (2018). Small island developing states and 1.5°C. Reg. Environ. Change 18(8):2197–2200.

Thow, A.M., et al. (2022). Regional Governance for Food System Transformations: Learning from the Pacific Island Region. Sustainability, 14, 12700. https://doi.org/10.3390/su141912700.

Tuivavalagi, Nacanieli S. (2022). Climate Resilient Agroforestry practices that can be effectively adapted and utilized in the Federated States of Micronesia. Lotopa, Apia, Samoa.

UNDP (nd). Strategic Plan 2022-2025.

UNDP (2007). Energy and poverty in the Pacific Island Countries. Challenges and the way forward. United Nations Development Programme, Regional Energy Programme for Poverty Reduction, Bangkok, Thailand.

UNDP (2022). Federated States of Micronesia's National Greenhouse Gas (GHG) Inventory.

UNFCCC (nd). The Gender Action Plan, https://unfccc.int/topics/gender/workstreams/the-gender-action- plan.

UNFCCC (2014). Lima COP to Lay Foundation for Paris 2015 Agreement, https://unfccc.int/news/lima- cop-to-lay-foundation-for-paris-2015-agreement.

UNFCCC (2018). NDC Registry, http://www4.unfccc.int/ndcregistry/Pages/Home.aspx.

United Nations (nd). United Nations Secretary-General's Chair Summary and Statement of Action on the UN Food Systems, https://www.un.org/en/foodsystems-summit/news/making-food-systems-work-people- planet-and-prosperity (last accessed 26 December 26, 2022).

United Nations (1975). Report of the World Food Conference. Rome, Italy. November 5–16, 1974.

United Nations (2022). Goal 5: Achieve gender equality and empower all women and girls, https://www.un.org/sustainabledevelopment/gender-equality/.

United Nations Children's Fund (2017). Situation Analysis of Children in the Federated States of Micronesia, UNICEF, Suva.

United Nations Environment Programme (2019). Emissions Gap Report 2019, https://www.unep.org/resources/emissions-gap-report-2019.

USAID (2015). Micronesia-Typhoon Maysak. Fact Sheet # 2, fiscal year (FY) 2015. USDA (2020). Recommendation to increase Mangrove Resilience USDA 2020.

van Woesik, R., Cacciapaglia, C. W. (2019). Carbonate production of Micronesian reefs suppressed by thermal anomalies and Acanthaster as sea-level rises. Plos One 14(11): e0224887.

van Woesik, R., Cacciapaglia, C. W. (2021). Thermal stress jeopardizes carbonate production of coral reefs across the western and central Pacific Ocean. Plos One. 16(4): e0249008.

Waiho, K., et al. (2017). Larval rearing of mud crab (Scylla): What lies ahead? Aquaculture, 493, 37–50. Walshe R, Stancioff CE (2018). Small island perspectives on climate change. Isl. Stud. J. 13(1):13–24.

Wang, J., Ding, X., Gao, H., and Fan, S. (2022). Reshaping Food Policy and Governance to Incentivize and Empower Disadvantaged Groups for Improving Nutrition. Nutrients, 14, 648.

Weeks, R. (2015). Pohnpei's protected area network gap analysis and spatial prioritization. The Nature Conservancy Pohnpei.

Winne, M. (2004). Community food security: promoting food security and building healthy food systems. Washington, D.C.: Congressional Hunger Center.

Woltz, Victoria L. (2022). A comprehensive assessment of mangrove species and carbon stock on Pohnpei, Micronesia.

World Bank (nd). Climate Change Knowledge Portal, https://climateknowledgeportal.worldbank.org/country/federated-states-micronesia (last accessed July 15, 2021).

World Bank (2018). Federated States of Micronesia (P161969): Project for Strengthening Public Financial Management. Combined Project Information Documents / Integrated Safeguards Datasheet, https://documents1.worldbank.org/curated/en/616651522294773431/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Project-for-Strengthening-Public-Financial-Management-P161969.pdf.

World Bank Open Data (nd). Population (Total) Indicator, https://data.worldbank.org/indicator/SP.POP.TOTL (last accessed 2018).

World Health Organization (2017). Double-duty actions. Policy brief. Geneva.

World Wildlife Foundation. 2022. Sustainable Seafood, https://www.worldwildlife.org/industries/sustainable-seafood (last accessed December 21, 2022).

Yap Institute of Natural Science & U.S. Forest Service Institute of Pacific Islands Forestry (2004). Yap State Biodiversity Strategy and Action Plan.

Yap State (2018). Solid Waste Management Strategy 2018–2027, https://www.sprep.org/attachments/VirLib/FSM/yap-solid-waste-management-strategy-2018-2027.pdf.

Acknowledgments

Acknowledgment is given first to the communities and individuals whose lands and peoples were visited and consulted to develop the Federated States of Micronesia's Third National Communication and Biennial Update Report to the UNFCCC Project Report.

Acknowledgment is given to all those who contributed to the technical inputs to the report, involving many experts from different fields and countries.

The Departments and Offices at the State level provided immense information and data for the Report. We graciously acknowledge their contributions, time and effort. At the National level, many individuals from national Government departments and offices also provided many hours in assisting with consultations and reviewing the different parts of the Report. The technical staff and vast data and information obtained from local CSO and NGO partners provided valuable up-to-date information that was incorporated into the Report.

Special acknowledgments go to APLŸS Consulting Agency, Subbarao Consulting Services Ltd., and the Micronesian Conservation Trust (MCT) in conjunction with the Rutgers University School of Environmental and Biological Sciences and Center for Food and Agricultural Ecosystems (RUCAFE) who in concert with DECEM, prepared several of the chapters and assembled this final report.

This report was prepared by the Federated States of Micronesia's Department of Environment, Climate Change & Emergency Management (DECEM).

Finally, the financial and technical contributions of United Nations Development Programme (UNDP) and the Global Environment Facility (GEF) is is gratefully acknowledged.