



Climate Factsheet

Federated State of Micronesia (FSM)

People and Geography

- » The Federated States of Micronesia (FSM) is a cluster of 607 remote islands in the western Pacific about 2,500 miles southwest of Hawaii, located just above the equator between one degree south and 14 degrees north latitude, and between 135- and 166-degrees east longitude.^{1,2}
- » Out of 607 small islands, 74 of them are inhabited.¹
- » The landmass is 702 sq km, including 6112 km of coastline.²
- » The exclusive economic zone in FSM covers an area of over 2.5 million sq. km.¹
- » FSM is made up of four semi-autonomous states: Yap, Chuuk, Pohnpei and Kosrae.²
- » The distance between the eastern-most state (Kosrae) and the western-most state (Yap) is 2,700 km.¹
- » Many of the islands in FSM are extinct shield volcanoes, with steep and rugged centers that are densely vegetated and eroded. Mangroves grow around the coastal fringes. Land elevations range up to about 760 m. Other islands are relatively flat, small, and swampy, with low-lying, forested atoll islets, typically one to five meter above mean sea level.¹
- » Yap state includes 119 sq km of land area, 1049 sq km of lagoon area, Chuuk state includes 127 sq km of land area, 2132 sq km of lagoon area, Pohnpei includes 342 sq km of land area and 769 sq km of lagoon area and lastly Kosrae state includes 110 sq km of land area and no lagoon area.¹
- » The capital of FSM, Palikir, is located in Pohnpei state. The FSM has four levels of governance – National,

state, municipal, and traditional. The national Government headquartered at Palikir has three branches. Executive, Legislative and Judicial.¹

The major vegetation types in the FSM are native

Upland forest
Agroforest
Mangrove forest
Savanna
Other shrubs
Grasslands

About a third of FSM's land area is suitable for agriculture, but less than 5% of agricultural land is arable.¹

- » Approximately 60% of water resources in FSM exist as surface water in the form of small, intermittent streams which remains low for about 20% of the year and the remaining 40% of the islands' water resources exist as groundwater in small, dispersed zones of sedimentary deposits, weathered volcanic, and weathered schist.¹
- » On the outer islands of FSM, there are no piped water systems, and the residents rely exclusively on individual rainwater catchments and dug wells.¹

The population (2010) of¹

Yap	11,373
Chuuk	48,654
Pohnpei	36,196
Kosrae	6,616

- » Projections to 2030 suggest no population growth from 2010 onwards and less than 10% total growth up to 2050.¹
- » The urbanization rate has increased from 21.8% in 2000 to 22.3% in 2010 as a result of people migrating from the outer islands to the main population center in each state.¹
- » The percentage of urban population in Yap in 2010 varied from 7.4% in Yap to 32.6% in Kosrae, with Pohnpei at 16.8% and Chuuk at 28.5%.¹
- » 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).¹

Out of 31,789 employed persons in 2000



52%

were engaged in farming and fishing, 70% were involved in subsistence activities, 30% were involved in commercial farming and fishing.¹

- » Average incomes per household for the atolls range from US\$35 to US\$628/week and more than 50% of households of most atolls state that their incomes were not sufficient.¹
- » A high unemployment rate, compounded by large household sizes, is resulting in growing poverty and hardship in FSM.¹
- » Agricultural production is relatively small, but is the primary resource traded domestically. Another most significant resource for the FSM is the ocean.

FSM's Exclusive Economic Zone (EEZ) covers the world's major equatorial tuna migratory paths making tuna a primary fishery resource.¹

- » In the fiscal year 2008 – 2010, agriculture contributed 15.5% and fisheries 11.5% to the FSM's economy.¹
- » The staple food of Micronesia includes taro, coconut, breadfruit, banana, yam, sweet potato, citrus, and sugar cane.¹
- » In 2010 FSM's exports represented about 12% of Gross Domestic Product (GDP) dominated by fisheries (Tuna – 69.1%, live clams, carb/lobster, trochus shell, and reef fish) and agricultural products (betel nut, cooked food, kava, and piper leaves).¹
- » In 2010 FSM's imports represented about 57% of GDP (valued at US\$ 297.5 million). Major imports were food, beverages/tobacco, household goods, construction materials, fuels, machinery, and transport equipment/parts.¹
- » Food imports increased from around US\$17 million in 2000 to US\$43.1 million in 2010. Rice, ramen, noodles, flour, and bread were the major food items being imported.¹
- » According to the FSM Department of Resources and Development, 2011, around 70% of the households have income below US\$15,000.¹

Globally, Micronesia is ranked

135 in the Climate Risk Index for 2018.³

Climate

- » Tropical climate, with high humidity and low mean annual temperature (about 27°C) and temperature variability in the season is minor.²

One of the most important climatic trends is a rainy season and a dry season.⁴



The **wet season** is normally between May and October

the **cool dry season** from April to November 

- » The rainfall is extremely high on the volcanic islands of Kosrae, Pohnpei and Chuuk whereas Yap experiences a monsoon climatic pattern, with more frequent periods of drought.¹

- » The east-west zone from 4-8°N in Micronesia receives maximum annual rainfall. The amounts decrease as one progresses northward, where the dry season becomes more prolonged, due to the mid-Pacific subtropical high-pressure area and its accompanying trade winds.¹
- » The climate of Chuuk is hot and humid with an average temperature of 81°F (27°C), and little variation throughout the year. Average annual precipitation is 122 in (3,100 mm), with the months of January to March being drier.¹

» Pohnpei is generally hot and humid with a mean temperature of 81°F (27°C) with little variation from month to month. The mean annual rainfall is 190 in (4826 mm), with January and February being slightly drier than the average of all months.¹

» Kosrae's climate is characterized by high temperatures, heavy rainfall, and high humidity. The average annual rainfall measured in coastal Lelu is 203 in (5000 mm) whereas the mountainous interior rainfall is estimated to be as high as 300 in (7,500 mm) annually. Average temperature for Kosrae is 81°F (27°C) at sea level.¹

» FSM experiences relatively little seasonal variability in mean air temperatures at below 1.5 ° C between its hottest and coldest months. The mean temperature for the year (1901-2016) is 27.1 ° C. The mean annual rainfall (1901-2016) stands at 3,810.4 mm.⁵

» Weather patterns such as El Niño, La Niña and the Intertropical Convergence Zone have considerable impact.⁴

» Under El Nino conditions the country experiences drought. All extremely dry years on Pohnpei have occurred during the year following an El Nino event. In some years, drought conditions have continued through the wet season.¹

» The driest year on record in Pohnpei and throughout most of Micronesia occurred in 1998, following the major El Nino of 1997.¹

» The main tropical cyclone season for the western north Pacific extends from mid-May through mid-December. The highest frequency of occurrence of typhoons in the western north Pacific is in an area just to the northeast of Luzon in the Philippine Sea.¹



On average, 28 tropical storms and typhoons occur annually,

compared to about ten for the north Atlantic basin. Of the 28 tropical cyclones, 18 become typhoons, and four become super typhoons.¹

» There is an increased risk of a typhoon for Pohnpei during El Nino years, and a decreased risk during the year following El Nino and during La Nina years.¹

Global Climate Change



Temperature

» As of 2019, the same year was the second warmest year in the 140-year record globally.⁶

» Global land and ocean surface temperature departure were +0.95°C (+1.71°F) above the long-term average⁶, which is only 0.04°C (0.07°F) less than the record high value of +0.99°C (+1.78°F) set in 2016 and 0.02°C (0.04°F) higher than the now third highest value set in 2015 (+0.93°C / +1.67°F).⁶

» The five warmest years in the 1880–2019 record have all occurred since 2015, while nine of the 10 warmest years have occurred since 2005.⁶

» The year 2019 marks the 43rd consecutive year (since 1977) with global land and ocean temperatures, at least nominally, above the 20th century average.⁶



Sea Level Rise

- » Global mean sea level has risen about 21–24 centimeters (8–9 inches) since 1880, with about a third of that coming in just the last two and a half decades.⁷
- » The rising water level is mostly due to a combination of meltwater from glaciers and ice sheets and thermal expansion of seawater as it warms.⁷
- » In 2019, global mean sea level was 87.61 mm (3.4 inches) above the 1993 average—the highest annual average in the satellite record (1993-present).⁷
- » From 2018 to 2019, global sea level rose 6.1 mm (0.24 inches).⁷
- » The rate of sea level rise has doubled since 1993 compared to the 20th century average.⁷

Ocean Acidification and Temperature

- » Oceans are absorbing about 25% of the carbon dioxide emitted to the atmosphere annually and as a result are becoming more acidic.⁸
- » The world's oceans have absorbed about 93% of the excess heat caused by greenhouse gas warming since the mid-20th century.⁹
- » Ocean heat content has increased at all depths.⁹
- » Increasing sea surface temperatures, rising sea levels, changing patterns of precipitation and winds, and ocean circulation are contributing to overall decline in oxygen concentrations in the oceans.⁹

Regional Climate Change

- » Averaged as a whole as of 2019, the same year in Oceania was the 1st warmest year in the 140-year record.⁶
- » The warmest recorded temperatures occurred in the equatorial western Pacific, encompassing the geographic area containing the island of Tuvalu.⁹
- » In the Pacific region, land-surface temperatures have been rising at the rate of +0.17°C (0.31°F) per decade since the 1980s, slightly ahead of the global trend.¹⁰
- » Since 2005, nearly all surface stations have seen annual temperature anomalies above the long-term average.¹⁰
- » Warming trends of a similar magnitude are evident in both annual and seasonal mean air temperatures in Tuvalu (1950-2009) with the strongest trend found in dry-season mean air temperature (+0.24C per decade).¹¹

- » Ocean temperatures have risen gradually since the 1950's with the rate increasing over time and since the 1970 as the rate of warming has been approximately 0.11°C and 0.08°C per decade in the eastern and western region respectively.¹¹
- » The western tropical Pacific has experienced rates up to four times the global average between 1993 and 2009.¹²
- » Although Pohnpei's annual rainfall has decreased, temperatures, sea levels, and ocean acidification trends have risen.¹³

The major impacts of climate change in Micronesia include an increase in⁴

Air

Ocean temperatures

Drought

Sea levels

Ocean acidity



Sea surface temperatures are **warming approximately by 0.20°F (0.11°C) and 0.14°F (0.08°C) per decade** from 1970 to 2009, in the eastern and western regions respectively.¹

- » Pohnpei, Yap and Chuuk have experienced increases in maximum annual air temperatures by 0.18°F to 0.25°F (0.10 °C to 0.14°C) per decade.¹
- » The aragonite saturation state (a measure of ocean acidification) in the FSM region has declined from about 4.5 in the late 18th century to 3.9 by 2000.¹
- » The interannual variability in sea level around FSM of about 10 in (26 cm), after removal of the seasonal cycle.¹

Since 1993 sea level in the FSM has been rising at an **average of 0.39 in (10 mm) per year** which is well above the global mean of about 0.12 in (3 mm) per year over the same period.¹

» During an El Niño year, the mean sea level drops across most of Micronesia. During La Niña years, sea levels rise above the normal values. These changes in sea level are highly coherent across the region from Yap to Guam, Chuuk, Pohnpei, and Kosrae.¹

The major climate risks due to climate change¹⁴

- Droughts
- Typhoons
- Tropical storms
- Storm-waves
- Flooding
- Landslides
- High sea surges in its outer- islands
- Variable rainfall patterns
- Higher than normal high tides
- Large sea swell
- Increased impact of storm surge

FSM's contribution on a global scale is 0.003% of global CO2 emissions¹



» The total amount of CO2 emitted in the FSM as a result of fossil fuel combustion is estimated to be 151.91 gigagrams in 2000.¹

» CO2 emissions from biomass fuel consumption in the FSM are estimated to be 28.87 gigagrams in 2000.¹

» The major source of greenhouse gas emissions from agricultural activities includes, methane, and nitrous oxide from domestic livestock, methane emissions from flooded rice fields, non-CO2 emission from burning of savannas, non-CO2 emission from burning of agricultural residues, direct emission of nitrous oxide (N2O) from agricultural soils, direct emission of nitrous oxide from animal production and indirect nitrous oxide emission from the use of fertilizer in agriculture.¹

» FSM's methane emissions from agriculture were 0.028 gigagrams and from solid waste disposal sites was 0.034 gigagrams.¹

» CO2 emissions from the use of mineral products was 0.071 gigagrams and Non-Methane Volatile Organic Compound (NMVOC) emissions was 23.97 gigagrams in 2000.¹

Comparing the emissions from 1994 and 2000, there was an 8% reduction in **CO2 emission** whereas CO2 removals increased by 20% between the periods.¹

Future Climate Projections

» The climate change models simulate a slight increase (<1.8°F; <1°C) in annual and seasonal mean surface air temperature by 2030. However, by 2090, under the A2 (high) emissions scenario, temperature increases greater than 4.5°F (2.5°C). However, ENSO is expected to continue to be an important source of variability for FSM and the wider region.¹

» FSM's Second National Communication discusses how CMIP3 models expect no improvement in rainfall by 2030 but with most simulations forecasting rainfall rises of more than 5 percent by 2090 under a high emissions scenario.¹⁵

» According to the Second National Communication of FSM, the severity and frequency of days of extreme heat are expected to increase up to 2100 over the decades.¹⁵

» By 2030, under a high emissions scenario, the rise in sea level is projected to be in the range of 2 – 6 inches (5-15 cm) with increases of 8–24 inches (20–60 cm) indicated by 2090 under the higher emissions scenarios.¹

» The sea-level rise combined with natural year-to-year changes will accentuate the impact of storm surges and coastal flooding.⁵

» Projections used to stimulate ocean acidification indicate that the annual maximum aragonite saturation state in the FSM region will fall below 3.5 by about 2030 and continue to decline thereafter.¹

» Ocean acidification will continue as of 2019, the same year the health of reef ecosystems which is likely to be compounded by other stressors including coral bleaching, storm damage and fishing pressure.⁵



Temperatures have warmed and will continue to warm with **more very hot days in the future.**⁵

Ocean acidification has been increasing in the Federated States of Micronesia's waters. It will continue to increase and **threaten coral reef ecosystems.**⁵



» Annual and wet season rainfall since 1952 has decreased at Pohnpei but at Yap there has been no clear change. Rainfall is generally projected to increase over this century with more extreme rainfall days and less droughts.⁵

» The forecasts on a global scale specify that a decline is likely in the number of Typhoons late 21st century. Throughout this century, droughts are anticipated to be less frequent.⁵

Impacts of Climate Change

» As a small island developing nation, the FSM is one of the country's most directly threatened by long-term global warming resulting from an increased level of greenhouse gases accumulating in the earth's atmosphere.¹⁶

» Regarding the effects of global warming, the FSM is particularly vulnerable to accelerated sea-level rise.¹⁶

» On low atoll islets, coastal areas, sea level rise causes marine inundation that damages groundwater resources, taro beds, soil, and agro-forestry resources whereas on high islands, coastal communities experience intensifying storm runoff, increased flooding, and drainage problems.¹

» In 2007 and in 2008, many FSM communities were flooded by a combination of large swell and spring high tides that eroded beaches, undercut, and damaged roads, intruded aquifers and wetlands, and inundated communities. Seawater intrusion surged up the water table, killing taro, breadfruit, and other foods. There was a short supply of food and drinking water. Freshwater ponds and wetlands turned brackish and which have not yet recovered fully. Approximately 60% of inhabited atoll islets cropping sites in use for generations were physically and chemically damaged or destroyed.¹



**US\$8 million
in losses**

On average, in one-year FSM is expected to incur US\$8 million in losses due to **tropical cyclones and earthquakes**.¹

» In the coming 50 years FSM has a 50% chance of experiencing natural disaster losses exceeding US\$105 million and casualties larger than 220 people. There is a 10% chance of experiencing a loss exceeding US\$470 million and casualties larger than 600 people.¹

» Wide spread of islands and presence of hospitals in the mainland of each state make evacuation to or from the main islands of each state difficult and dangerous, and severely limits access to food, water, and medical care and supplies after a typhoon.¹

» According to the local residents on several islands, the freshwater wetlands and lakes that have been historically important for food production have turned brackish over the past two decades.¹

» Evidence shows that most taro patches are already affected by salt-water inundation season.¹

» Rising sea levels are hurting the country's tourism industry.¹³

Food security is an ongoing issue in FSM, with increased land stresses that undermine agricultural activities and



food supply, coastal erosion and increased pest and disease in major crops such as taro and banana.¹⁷

» Food security is a highly impacted sector in response to climate change due to sea level rise in agricultural farms near coastal areas, salt-water inundation and increasing flooding and drainage problem.¹

» Climate displacement, relocation, external and international migration is occurring within the state of Yap and other islands as a result of increased sea level rise along the coast and saltwater increase in their wells.¹⁴

Mitigation and Adaptation to Climate Change

» Mitigation projects focus on **strengthening the application of traditional knowledge, promotion of renewable energy and energy efficiency**.¹⁹

» Adaptation projects emphasize on **protecting ecosystems, increase food security, improvise home security, protect coasts, and increase freshwater security**.⁴

» FSM became signatory to the UNFCCC in 1992 and the convention was entered into force in 1994. FSM signed the Kyoto Protocol in 1998.¹

» FSM became the party to the Montreal Protocol in 2007.¹

» The national policies designed to address major threats to the sustainability and economic and social viability of the country are:¹

- › Nationwide Climate Change Policy
- › Energy Sector Policy and State Action Plans
- › National Action Plan to Combat Land Degradation
- › National Biodiversity Strategy and Action Plan
- › National Climate Change and Health Action Plan
- › Multi-State Multi-Hazard Mitigation Plan
- › National Plan of Action for Nutrition
- › Agriculture Policy
- › FSM Statewide Assessment and Resource Strategies (FSMSWARS)

- > Food Security Policy
- > Forest Action Plan

» The state policies designed to address major threats to sustainability and economic and social viability are:¹

- > Kosrae Shoreline Management Plan
- > Kosrae State Land Use Plan
- > Pohnpei State Environmental Impact Assessment Regulations
- > Kosrae State Disaster Management Plan
- > Pohnpei Disaster Management Plan

» The key goals of the National Climate Change Policy 2009 on climate change adaptation are to prioritize ecosystem-based approaches, encourage and strengthen the application of traditional knowledge on conservation practices, develop and implement appropriate strategies to improve food production and other relevant sectors, and encourage all the development agencies in FSM to consider projected climate change in the design and implementation as stipulated in the FSM SDP.¹



» The key goals of the National Climate Change Policy 2009 on mitigation are to enforce Kyoto Carbon Dioxide Emission Reduction to mitigate temperature increases, to maintain and enhance FSM as a negative carbon country through effective management of its natural sinks, bio-sequestration (biochar), promotion of renewable energy and energy efficiency, to undertake quick action measures to eliminate GHG and non GHG emissions and to prioritize conventional awareness, and to encourage the application of traditional knowledge on transportation practices and other relevant areas.^{1,19}

» The Strategic Development Plan (SDP) 2004-2023 has been complemented by adoption of National Wide Integrated Disaster Risk Management, 2013 Climate Change Strategy and 2014 Climate Change Act.²⁰

» The SDP recognized the need to mainstream climate change into national planning as well as in all economic development activities.¹

Relevant sectors
Agriculture (and food security)
Energy
Water
Infrastructure
Transport
Finance
Health
Gender

were required to update existing plans to strengthen the responses towards mitigating and adapting to climate change.¹

» The energy sector policy aims to become less dependent on the imported sources of energy by increasing the share of renewable energy sources and having cross-sectoral energy conservation and efficiency standards in place.¹



» FSM joined with Palau, the Marshall Islands, the Commonwealth of the Northern Mariana Islands, and Guam as signatories to the Micronesian Challenge. Thereafter FSM is committed to the near-shore marine resources and the terrestrial resources across Micronesia.¹

» To build resilience, since 2002 more than five upland forests are protected, more than 15 new marine protected areas are established, and designated two UNESCO Biosphere Reserves with NGOs and communities being central to the process.¹

» For the forestry sector, FSM has State-Wide Assessments and Resource Strategies (SWARS), a five-year Forestry Action Plans, which aims to identify their highest priorities for forest resource management and seek implementation of their strategies, with on-island partners and with assistance from the US Department of Agriculture (USDA) Forest Service (FS) and other donors.¹

» Managing the climate and disaster risks facing FSM is extremely challenging due to traditional and restrictive pattern of

- Land use
- Land tenure
- Unstable slopes in the high islands
- The remote nature of population and geography
- Complexities in groundwater availability
- Conflicting plans for watershed use by owners and various groups
- Low motivation and appreciation of climate risk
- Data gaps
- Lack of adequate financing

Due to these factors' communities on atoll islets and other coastal areas are at greater risk from climate change.¹

» Climate risk management focused on community-based adaptation, and implemented through effective land use policies, can improve food and water security, environmental conservation, and sustainability.¹

» Suggested adaptation and mitigation measures for forest and tree resources includes:¹

Sustainable management of forest and tree resources

- > Fire management
- > Forest and tree conservation

Forest restoration and rehabilitation

- > Restoration of Mangrove forest
- > Rehabilitation of coastal forest and trees

Sustainable agriculture system

- › Agro - forestry
- › Introduce different varieties of breadfruits
- › Introduce climate resilient crops

» Suggested adaptation measures for the food security sector are:¹

- › Public Awareness (train and educate farming communities and the public in climatic change and its potential impacts on life, promoting the consumption of local produce)
- › Introduction of salt tolerant species
- › Introduction of heat tolerant crops
- › Improve pest and disease management
- › Crop research
- › Restoration of degraded lands
- › Farm relocation
- › Improve subsistence agriculture
- › Agricultural diversification
- › Promote agroforestry
- › Consumption of local produce strengthened through policy and regulations
- › Engagement of youth in agriculture programs
- › Strengthening farmers association (access of credits and capacity building)
- › Promotion of aquaculture
- › Improve access to income generating opportunities
- › Improve market access for people from the rural and outer islands enhance trading of local produce
- › Promote value added products
- › Enhance food processing and preservation techniques (establishing food processing facilities and/or introduction of simple food processing techniques)
- › Implement a policy towards making agricultural production mandatory on farmland- Encourage landowners to start production
- › Promote land leasing of unfarmed land
- › Improve transportation of food and agricultural products from outer islands to markets in urban centers
- › Prevention of coastal erosion

» Suggested adaptation measures for the coastal management sector are:¹

- › Revegetate the coastlines with Mangroves, Pandanus, etc.
- › Buildings should be set back from the shoreline
- › Extraction of beach sand should be designated and controlled
- › Seawalls and groins structures should be climate-proofed design so that it could uphold future storm surges and high tides.

» In many of the islands, there are no appropriate actions or policy to protect and safeguard watershed and groundwater resources.¹

- » In 2005 KUA (Kosrae Utilities Authority) adopted a comprehensive strategic plan to reduce, and ultimately eliminate, the state's dependence on fossil fuels, to improve the quality, minimize the cost and expand the use of electricity in the State, to achieve equal access for affordable and sustainable renewable energy sources in an environmentally responsible and commercially viable manner.¹
- » FSM is prioritizing photovoltaic solar energy, hydro – energy, wind power, wave energy and biofuels in all the four states as a viable source of energy for the country.¹
- » FSM is encouraging building developers to adopt a set of energy standards well above those prescribed by law within the code of building regulations.¹
- » FSM commits to unconditionally reduce the GHG emissions by 28% below the emissions in 2000 by 2025.²¹
- » Upon availability of additional financial, technical, and capacity building support from the international community (conditional), the FSM can reduce the GHG emissions by 35% below the emissions in 2000 by 2025.²¹

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