ADAPTING TO A CHANGING CLIMATE

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PIMPAC

These materials were developed through input from a workshop that was held from September 6-11, 2010 in Pohnpei, Federated States of Micronesia with representatives from the following agencies, organizations, and communities:

Chuuk Department of Agriculture

Commonwealth of the Northern Mariana Islands
Coastal Resource Management Office

Conservation Society of Pohnpei

Conservation Society of Chuuk

Enipein Community, Pohnpei, Federated States of Micronesia

Federated States of Micronesia Community College

Federated States of Micronesia Protected Area Network

Federated States of Micronesia - Pacific Adaptation to Climate Change

International Organization for Migration

Island Environmental Services

Island Food Community of Pohnpei

Kosrae Conservation and Safety Organization

Marshall Islands Conservation Society

Marshall Islands Marine Resource Authority

Micronesia Conservation Trust

Namdrik Community, Republic of Marshall Islands

NOAA Coral Reef Conservation Program

Ngarchelong Community, Republic of Palau

Nimpal Channel MCA communities - Weloy, Yap

Pacific Islands Managed and Protected Area Community

Palau Conservation Society

Palau International Coral Reef Center

Pohnpei Department of Agriculture

Republic of Marshall Islands Environmental Protection Agency

Republic of Marshall Islands Office of Environmental Planning and Coordination

Sea Change Consulting

Secretariat of the Pacific Community

The Nature Conservancy

United States Geological Survey

University of Guam

Yap Institute for Natural Science

A complete list of participants can be found in the workshop report through MCT and/or in the PIMPAC Management and Adaptation Planning Guidance.

Regional climate science information was also provided by NOAA's National Weather Service.

Purpose of this booklet:

This booklet was developed as part of an outreach toolkit for community-based climate change adaptation in Micronesia. The toolkit contains the following materials:

1. An "Adapting to A Changing Climate" portable flipchart providing visual illustrations of key concepts, including:
   - o What is climate change?
   - o Why should communities care about it and get involved?
   - o What are the potential impacts to communities and the resources they depend on?
   - o What can communities do to prepare for and adapt to climate change?

2. Facilitator's Notes – a set of notes for the facilitator who is using the flipchart to carry out outreach in communities. This document provides key messages and talking points to be discussed on each page of the flipchart.

3. An "Adapting to A Changing Climate" booklet (this document) which is intended to provide both visual material and key messages from the flipchart in a smaller document that can be kept in communities for ongoing use.

4. A revised PIMPAC management planning guidance document that outlines the process for stakeholder-based management and adaptation planning for a locally managed area.

This booklet is best used in a facilitated session with the flipchart as a way for community members to follow along with the group discussions.

A Healthy Micronesian Community

This illustration shows a healthy Micronesian community. It is providing abundant resources for sustainable use by local residents. A healthy intact community and natural resources will also help to buffer against the impacts of climate change. Elements of this healthy community include

1) Watershed

i. Intact native upland vegetation
  1. Provides protection from landslides
  2. Prevents sediment from polluting streams
  3. Filters pollutants to keep them from entering freshwater springs and lenses
  4. Helps maintain rates of rainfall through transpiration
  5. Provides habitat for important wildlife
  6. Prevents invasive plants from establishing themselves
  7. Provides opportunities for eco-tourism (bird watching, hiking, etc.)

ii. Intact riparian vegetation (next to rivers/streams)
  1. Protects water quality by capturing, storing, and filtering water through the soil before it gets to freshwater springs, lenses, rivers, and streams
  2. Holds stream bank soils in place and protects them from erosion and undercutting by floodwaters
  3. Protects the coral reef from sediment and pollutants
  4. Provides habitat for important wildlife

2) Coastline and Beaches

i. Intact vegetation along the shore and no development close to shore
  1. Provides nesting areas for sea turtles and essential habitats for shorebirds and intertidal invertebrates
  2. Shoreline protection from storm surges
  3. Stabilizes coastline to prevent or slow rates of erosion by absorbing and dissipating wave energy
  4. Helps prevent salt spray from getting inland to crops/homes
  5. Provides recreational areas for local residents
  6. Valuable for eco-tourism

3) Coastal Vegetation/ Mangroves

i. Healthy intact mangroves and/or other vegetation
  1. Provides protection from storm surges
  2. Stabilizes coastline to prevent or slow rates of erosion
  3. Helps prevent salt spray from getting inland to crops/homes
  4. Provides feeding grounds, nursery, and habitat for important fish and invertebrates
  5. Traps sediment from land and prevents it from getting onto the coral reef

4) Seagrass

i. Healthy intact seagrass beds
  1. Protect coastline from currents and therefore reduce erosion
  2. Provide critical habitat, breeding grounds, nursery areas, and food for important fish, invertebrates, and other marine life (e.g., turtles, marine mammals)
  3. Trap sediment from land, improving water clarity and preventing it from getting onto the coral reef
  4. Take up nutrients from land runoff as a food source, reducing harmful amounts of these nutrients from reaching the coral reef, where they can result in unhealthy algae blooms

5) Coral Reefs

i. Healthy coral reefs
  1. Provide a buffer against storm surges by breaking wave energy
  2. Provide nursery areas, habitat, and food for important fish, invertebrates, and other marine life (e.g., turtles, marine mammals)
  3. Used for recreation and tourism – can provide income

ii. Diverse invertebrates and fish species
  1. A wide variety of marine life is part of a healthier, stronger system that can withstand changes over time

iii. Big predator fish (e.g., sharks, groupers, jacks)
  1. Critical to balance reef fish and other marine populations and support healthy ecosystems

iv. Herbivores (e.g., parrotfish, rabbitfish, surgeonfish, urchins)
  1. Help prevent algae from overgrowing coral and potentially killing it

6) People/Children

i. People are able to sustain their families by using the resources directly and from diverse sources of income.
ii. People are aware of what makes the community healthy (natural and social resources) and take actions to protect them for future generations.
iii. People are able to practice their culture, and children can learn about island self-sufficiency through traditional knowledge and evolving cultural practices and have pride in their community.
iv. Homes safe from storms and landslides
v. Safe drinking water systems
vi. Variety of healthy foods available (through agriculture and fishery)
vii. Healthy, happy children
viii. Community demonstrating leadership
ix. Strong community ties
x. Availability of community services and good infrastructure
xi. Reliable transportation system in case of emergency evacuation
xii. Diverse sources of income


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"Impacts from these threats will likely get worse with climate change"
2

This illustration shows a Micronesian community that has been degraded by multiple threats. This degraded community cannot provide abundant resources for local residents. The impacts from these threats are likely to worsen over time with climate change. Elements of this threatened community include

1) Threatened Watershed

i. Widespread clearing of native forests/vegetation
ii. No vegetation adjacent to streams
iii. Pollution (e.g., piggeries, trash)
iv. Sedimentation/runoff from cleared land
v. Bad agricultural practices (e.g., mono-cropping, overuse of fertilizers and pesticides, land clearing, removal of native vegetation)
vi. Overrun with invasive species that threaten native plants and animals; invasive plant species don't hold soil well
vii. Polluted freshwater sources (e.g. springs, lenses, rivers, streams)
viii. Clearing of vegetation adjacent to freshwater sources causing loss of water (from evaporation)
ix. Prolonged, severe droughts
x. Poorly planned development projects (no proper environmental mitigation in place)
xi. Unpaved roads
xii. Denuded landscape from burning

2) Threatened Coastline/ Mangroves/ Seagrass Beds

i. Clearing of native vegetation (mangroves/trees) along the shore
ii. Coastal erosion
iii. Dredging of sand – loss of seagrass
iv. Overharvesting of species that live in these areas (too many people harvesting, taking very large fish/shellfish that can supply the reef with more offspring, or taking very small fish/shellfish that were not able to reproduce)
v. Environmentally damaging types of coastal development (e.g., seawalls, roads without appropriate culverts)
vi. Saltwater intrusion and inundation of drinking supplies and gardens
vii. Invasive coastal species overrunning native species
viii. Loss of sea turtle nesting habitat

3) Threatened Coral Reefs

i. Overfishing (too many people fishing in one area, taking very large fish that can supply the reef with more offspring, or taking very small fish that are not able to reproduce); taking from spawning aggregations; taking too many herbivores, which can lead to algae smothering coral
ii. Destructive fishing practices – dynamite fishing, nets with small mesh, scuba spearfishing, spearfishing at night, abandoned gillnets
iii. Mass tourism, destructive tourism practices – walking on or touching the reef
iv. Sedimentation from cleared land can smother reefs
v. Increased nutrients from runoff can lead to crown-of-thorns starfish or algal outbreaks
vi. Climate-related threats, including
  - mass coral bleaching from sea surface temperature rise
  - increased ocean acidification, which can weaken and kill the corals
vii. Other threats – boating and anchor damage, oil spills, invasive species, coral mining

4) Threatened People/Children

i. People are not able to sustain their families on the resources and have few sources of income because resources are depleted and other sources of income are not available.
ii. People are not aware of tools and approaches to help improve community health (natural resources and social resources) and are therefore not well equipped to take actions to protect them for future generations.
iii. Traditional knowledge and local cultural practices are not passed down to younger generations because the way of life has changed drastically.
iv. Homes and community infrastructure and services are located in flood zones.
v. No sustainable, local source of drinking water (bottled water is not sustainable)
vi. Damaged food crops, lack of food variety, dependency on imported foods
vii. Unknown future for children to live/stay in this area
viii. People working together less and lack of community cohesion
ix. Health issues
  1. Increased illness from water- and vector-borne diseases during flooding
  2. Physical stress and dehydration from extreme heat and drought
  3. Increased incidences of chronic illness (e.g., heart disease, diabetes) from dependence on processed, imported foods and unhealthy lifestyle
  4. Mental and emotional stress from
     a. Decline in food and drinking water sources
     b. Decline of income sources
     c. Limitations in ability to practice culture and contribute to community

These threats are likely to be worsened over time with climate change and variability.

A Healthy Micronesian Atoll Community

This illustration shows a healthy Micronesian Atoll community. It is providing abundant resources for sustainable use by local residents. A healthy intact community and natural resources will also help to buffer against the impacts of climate change. Elements of this healthy atoll community include

1) **Native Vegetation and Agriculture**
   i. Intact native vegetation
      1. Filters pollutants, keeping them from entering freshwater springs and lenses
      2. Holds soil and prevents erosion
      3. Holds water
      4. Provides protection from strong winds and salt spray
      5. Provides habitat and food for wildlife
   ii. Well-managed agriculture
      1. Provides food sources and income
      2. Prevents spread of invasive species
      3. Help prevents saltwater intrusion

2) **Freshwater Resources (Lens)**
   i. Intact freshwater lens, unpolluted and well managed
   ii. Wells designed and managed to allow sustainable use. There are freshwater catchments, storage, and well-maintained distribution systems.
   iii. Use of solar distillation systems to supplement water supplies during dry season

3) **Coastal Vegetation and Beaches**
   i. Intact vegetation along the shore and no development close to shore
      1. Provides nesting areas for marine turtles and essential habitats for shorebirds and intertidal invertebrates
      2. Provides shoreline protection from storm surges
      3. Stabilizes coastline to prevent or slow rates of erosion by absorbing and dissipating wave energy
      4. Helps prevent salt spray from getting inland to crops/homes
      5. Provides recreational areas for local residents
      6. Valuable for tourism
      7. Provides habitat and food for native wildlife
   ii. Healthy intact mangroves and/or other vegetation
      1. Provide protection from storm surges
      2. Stabilize coastline to prevent or slow rates of erosion
      3. Help prevent salt spray from getting inland to crops/homes
      4. Provide feeding grounds, nursery, and habitat for important fish and invertebrates
      5. Trap sediment from land and prevent it from getting onto the coral reef

4) **Seagrass**
   i. Healthy intact seagrass beds
      1. Protect coastline from currents and therefore reduce erosion
      2. Provide critical habitat, breeding grounds and nursery areas, and food for important fish, invertebrates, and other marine life (e.g. turtles, marine mammals)
      3. Trap sediment from land, improving water clarity and preventing it from getting onto the coral reef.
      4. Uptake nutrients from land runoff as a food source, reducing harmful amounts of these nutrients from reaching the coral reef, where they can result in unhealthy algae blooms

5) **Coral Reefs**
   i. Healthy coral reefs
      1. Provide a buffer against storm surges by breaking wave energy
      2. Provide nursery areas, habitat, and food for important fish, invertebrates, and other marine life (e.g., turtles, marine mammals)
      3. Used for recreation and tourism – can provide income
   ii. Diverse invertebrates and fish species
      1. A wide variety of marine life is part of a healthier, stronger system that can withstand changes (impacts?)
   iii. Big predator fish (e.g. sharks, groupers, jacks)
      1. Critical to balance reef fish and other marine populations and support healthy ecosystems
   iv. Herbivores (e.g. parrotfish, rabbitfish, surgeonfish, urchins)
      1. Help prevent algae from overgrowing coral and potentially killing it

6) **People/Children**
   i. People are able to sustain their families by using the resources directly and from diverse sources of income.
   ii. People are aware of what makes the community healthy (natural and social resources) and take actions to protect them for future generations.
   iii. People are able to practice their culture, and children can learn about island self-sufficiency through traditional knowledge and evolving cultural practices and have pride in their community.
   iv. Homes safe from storms and landslides
   v. Safe drinking water systems
   vi. Variety of healthy foods available (through agriculture and fishery)
   vii. Healthy, happy children
   viii. Community demonstrating leadership
   ix. Strong community ties
   x. Availability of community services and good infrastructure
   xi. Reliable transportation system in case of emergency evacuation

A Threatened Micronesian Atoll Community

This illustration shows a Micronesian atoll community that has been degraded by multiple threats. This degraded atoll community cannot provide abundant resources for local residents. The impacts from these threats are likely to worsen over time with climate change. Elements of this threatened community include

1) Threatened Native Vegetation and Agriculture

i. Clearing of native vegetation for firewood and development
ii. Unmanaged or bad agricultural practices – (e.g., no composting of taro patches, monocropping, removal of native vegetation)
iii. Overrun with invasive species that threaten native plants and animals; invasive plant species don't hold soil well
iv. Prolonged, severe droughts

2) Threatened Freshwater Resources

i. Pollutants on the ground that seep into freshwater lens
ii. People collecting too much freshwater from wells so they are not able to recharge

3) Threatened Coastline/ Mangroves/ Seagrass Beds

i. Clearing of native vegetation (mangroves/trees/shoreline shrubs) along the shore
ii. Coastal erosion
iii. Dredging of sand – loss of seagrass
iv. Overharvesting of species that live in these areas (too many people harvesting, taking very large fish/shellfish that can supply the reef with more offspring, or taking very small fish/shellfish that were not able to reproduce)
v. Environmentally damaging types of coastal development (e.g. seawalls)
vi. Saltwater intrusion and inundation of drinking supplies and gardens

4) Threatened Coral Reefs

i. Overfishing (too many people fishing in one area, taking very large fish that can supply the reef with more offspring, or taking very small fish that are not able to reproduce); taking from spawning aggregations; taking too many herbivores, which can lead to algae smothering coral
ii. Destructive fishing practices – nets with small mesh, cyanide and native plants used to poison fish, breaking small corals, dynamite fishing, scuba/night spearfishing, abandoned gillnets
iii. Mass tourism, destructive tourism practices – walking on or touching the reef
iv. Sedimentation from cleared land can smother reefs.
v. Increased nutrients from runoff can lead to crown-of-thorns starfish or algal outbreaks.
vi. Climate-related threats, including
- Mass coral bleaching from sea surface temperature rise
- Increased ocean acidification, which can weaken and kill the corals

vii. Other threats – Illegal foreign fisheries, massive commercial harvesting, boating and anchor damage, oil spills, invasive species, coral mining

5) Threatened People/Children

i. People are not able to sustain their families on the resources and have few sources of income because resources are depleted and other sources of income are not available.
ii. People are not aware of tools and approaches to help improve community health (natural resources and social resources) and are therefore not well equipped to take actions to protect them for future generations.
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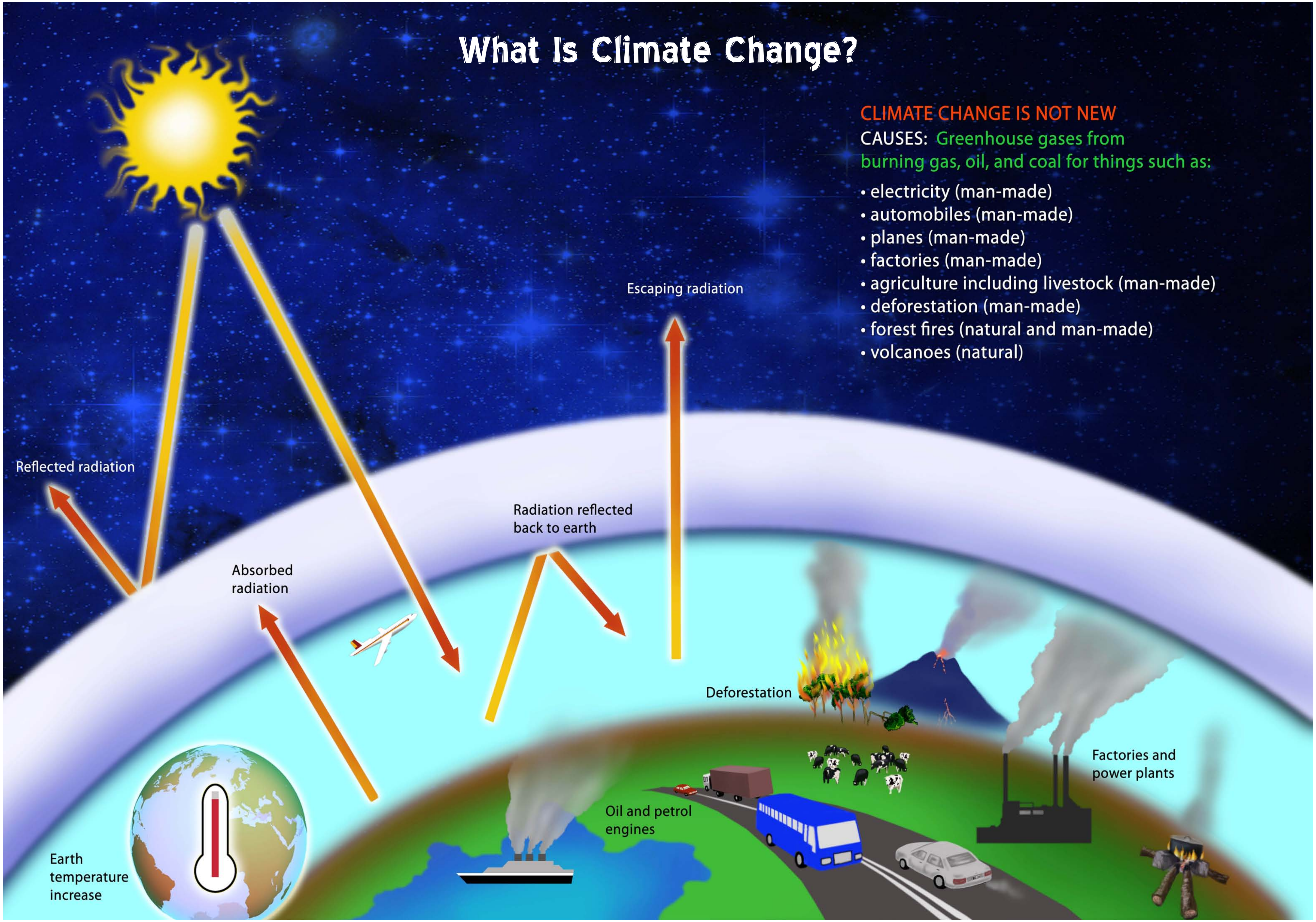
4. Mental and emotional stress from
- Decline in food and drinking water sources
- Decline of income sources
- Limitations in ability to practice culture and contribute to community

x. Migration issue (communities are losing young adults in their teens, 20s, and 30s) to high islands so there are not enough people left to carry on some cultural practices and do things like maintain taro patches

These threats are likely to be worsened over time with climate change and variability.


What Is Climate Change?
CLIMATE CHANGE IS NOT NEW
CAUSES: Greenhouse gases from
burning gas, oil, and coal for things such as:
• electricity (man-made)
• automobiles (man-made)
• planes (man-made)
• factories (man-made)
• agriculture including livestock (man-made)
• deforestation (man-made)
• forest fires (natural and man-made)
• volcanoes (natural)
Escaping radiation
Reflected radiation
Radiation reflected back to earth
Absorbed radiation
Deforestation
Factories and power plants
Oil and petrol engines
Earth temperature increase

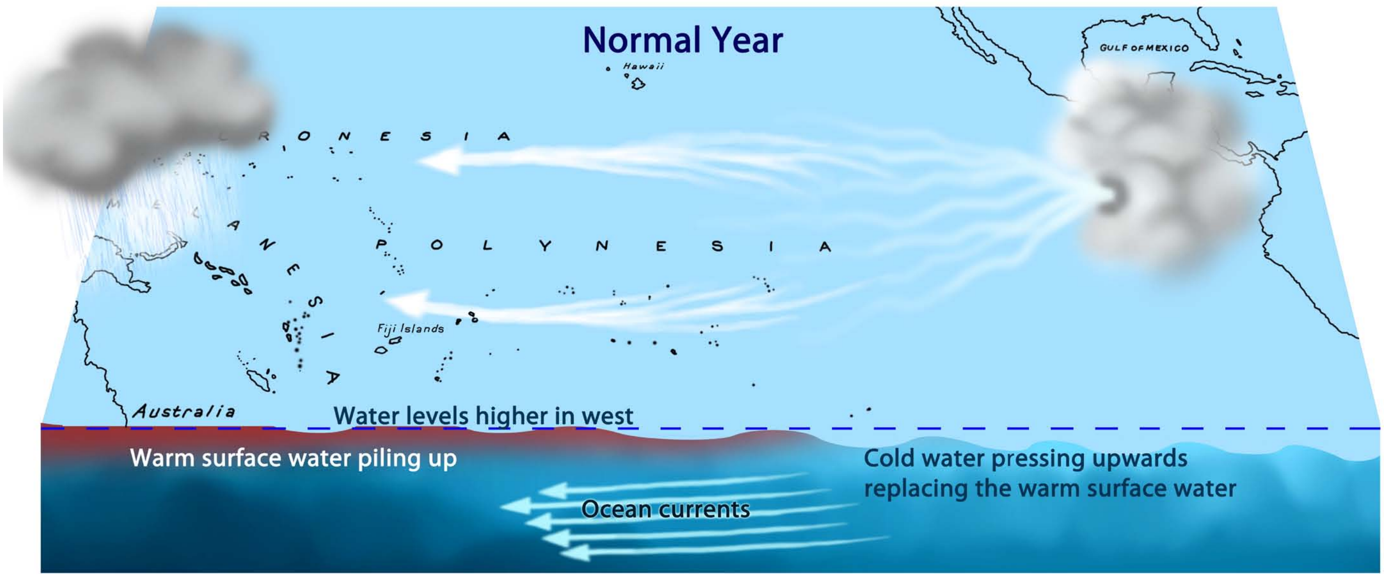
This illustration shows some of the causes of climate change.

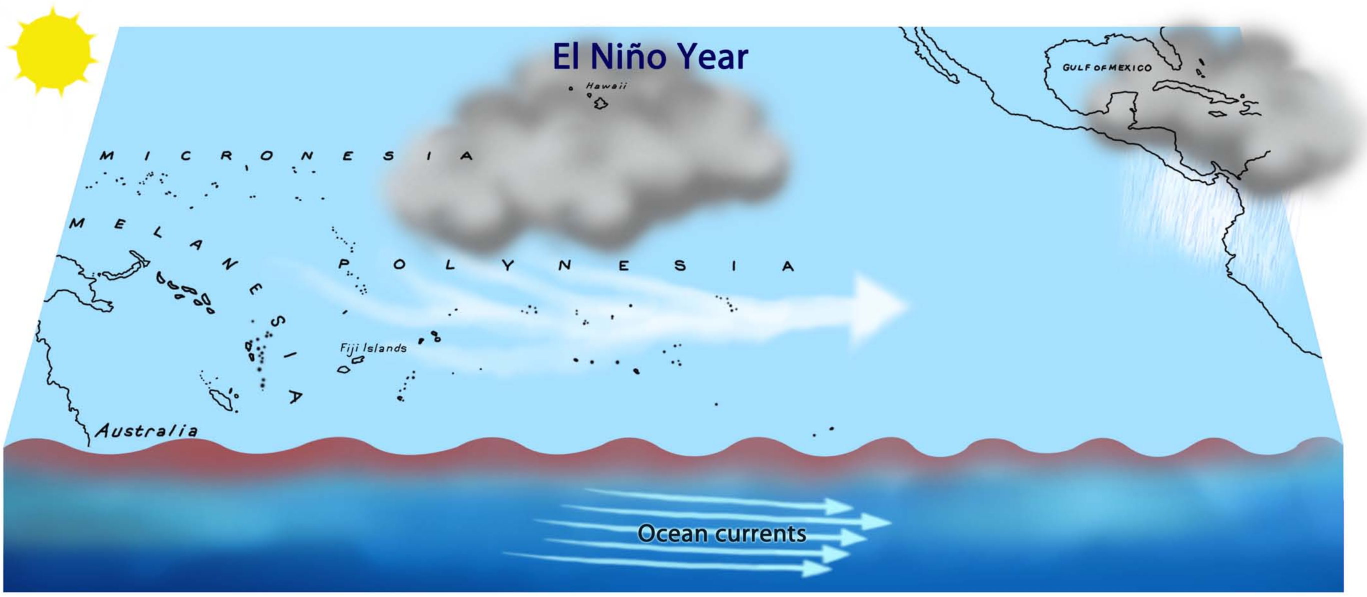
- o Climate change is not new. Throughout history, the earth has warmed and cooled over very long periods of time. However, the earth is now warming at a much faster rate due to human causes, which are accelerating the "greenhouse effect."
- o CAUSES: Greenhouse gases from
  - ⇨ Burning gas, oil, and coal for things such as
    - electricity (man-made)
    - automobiles (man-made)
    - planes (man-made)
    - factories (man-made)
  - ⇨ Industrial agriculture, including intensive raising of livestock (man-made)
  - ⇨ Deforestation (man-made)
  - ⇨ Forest fires (natural and man-made)
  - ⇨ Volcanoes (natural)

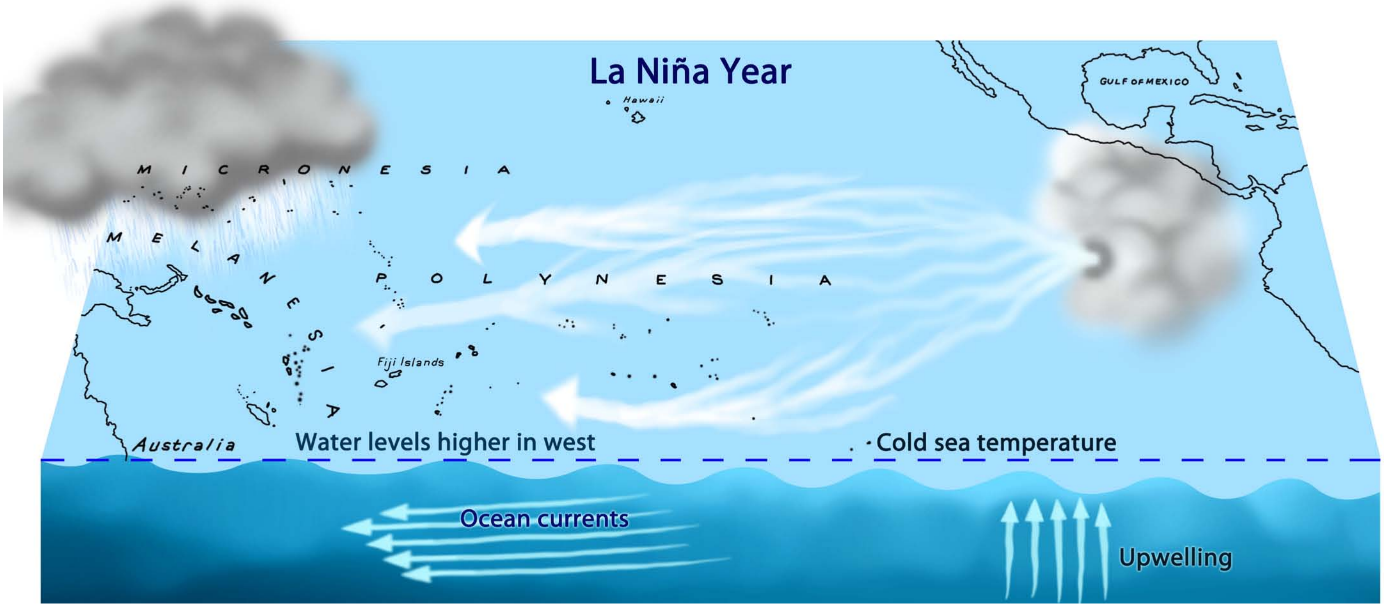
Climate change will cause

- o Greenhouse gases trap the radiated heat from the earth in the atmosphere and cause an increase in temperature on the earth, this is referred to as the "greenhouse effect."
- o Significant increases in greenhouse gases over the past 250 years are increasing the speed at which the earth is warming
- o Global warming causes changes in weather patterns and climate and thus "climate change"
- o significant changes to climate and weather patterns globally in the long term (50+ years)
- o changes to shorter-term average weather patterns (annual rainfall, air temperature) called "climate variability"
- o In the Pacific island region, short-term changes in weather are very dependent on El Nino/ La Nina events

What are El Niño and La Niña?







Over the past two decades, El Nino and La Nina and their associated weather patterns have become extremely important to the lives of the average Micronesian. This illustration explains the weather conditions that are associated with normal years, El Nino years, and La Nina years.

Normal Conditions

- o In the western Pacific, a pool of warm water goes deep into the ocean; the heat makes the water molecules spread farther apart, increasing the water volume; since the extra volume can't go through the floor of the ocean, it expands upward, causing the sea level to rise.
- o The ocean surface is about 1 foot higher in the western equatorial Pacific than in the eastern equatorial Pacific. Because of gravity, the higher sea level should flow back toward the east, but strong equatorial surface winds blowing east to west keep the water piled up in the west.
- o The warm pool also puts a lot of warm, moist air into the atmosphere. This leads to the routine development of thunderstorms and typhoons in the western Pacific.
- o Eventually, "Mother Nature" redistributes the heat in the Pacific and sets off actions that initiate an El Niño.

El Nino Conditions

- o The strong east-to-west surface winds weaken or become west to east. In the ocean, this sets up a wave that extracts heat from the ocean in the western equatorial Pacific and transports it toward the eastern equatorial Pacific.
- o As the ocean heat moves eastward, so does the atmospheric area where thunderstorms and typhoons develop. By March, typhoons may develop around Pohnpei, by April around Kosrae, and around May and June in the Marshall Islands. This is the wet phase of the El Niño. After this wet phase, Micronesia is typically drier during El Niño. Drought begins to set in, and from the following January through April, conditions can be very dry in Micronesia.
- o As the heat in the western Pacific moves eastward, the ocean volume in the west decreases and the sea level drops, sometimes by as much as a foot. In the eastern Pacific, the ocean volume increases and the sea level rises.
- o Drought worsens the occurrences of fires and causes reduced water and food resources on the high islands. Drought is very severe on the low islands. The small aquifers become thinner and thinner. As sea level falls, saltwater eventually gets drawn into the freshwater lens. Eventually, the water becomes too salty to drink and may begin to damage or kill food sources.
- o The clear skies, lack of wind, and intense sunlight at this time heat the western Pacific Ocean. This has led to severe mass coral bleaching in the past.
- o Multiple-year El Niños are rare.
- o Eventually, "Mother Nature" is satisfied with the redistribution of heat and re-starts the equatorial east-to-west surface winds. Sometimes the east-to-west winds get too strong, and they can lead to a La Niña event.

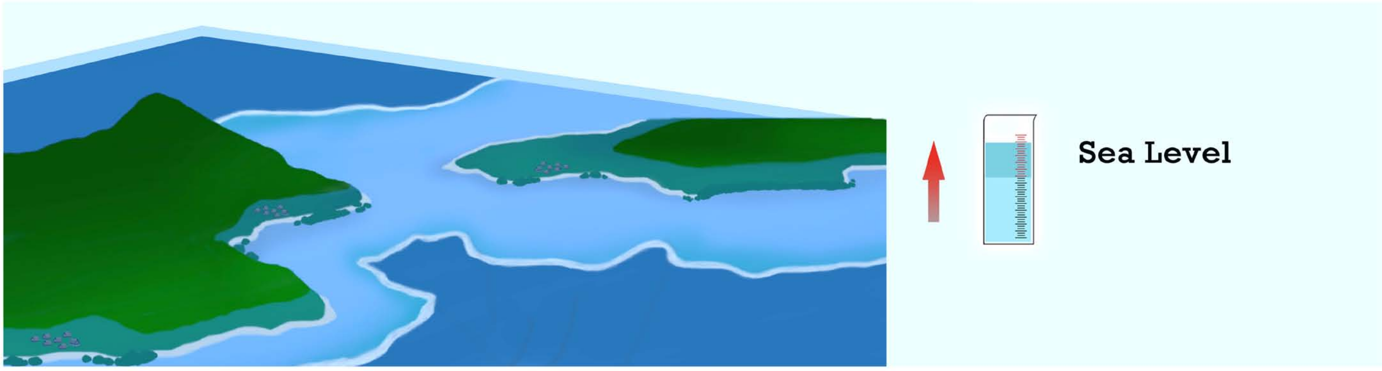
La Nina Conditions

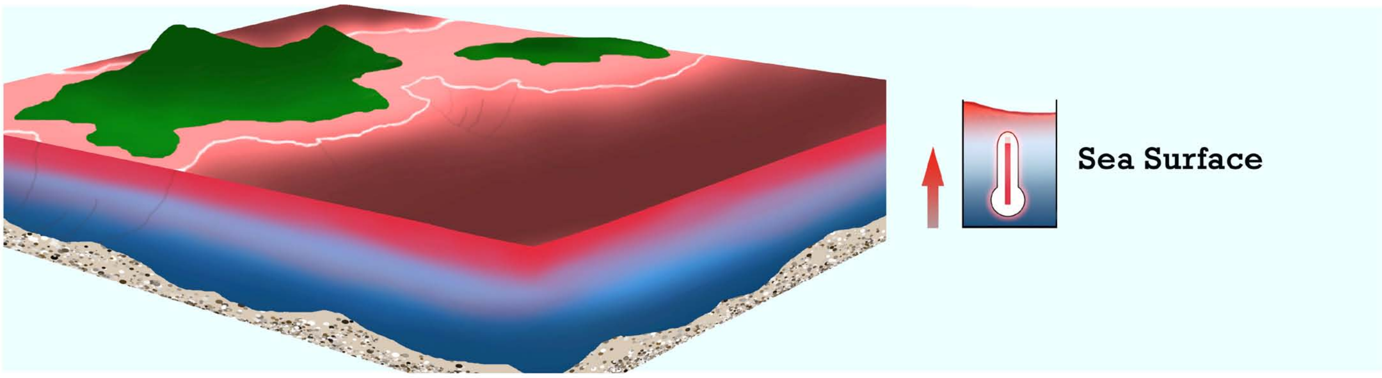
- o When the east-to-west equatorial surface winds increase, the warm water is mixed deeper into the ocean. This process shifts thunderstorm and typhoon development west of the normal locations and causes the sea level to rise as the ocean volume expands.
- o The increased easterly surface winds can cause the sea level to rise as much as a foot above normal. This, coupled with high surf events, especially near new and full moon periods, can cause episodes of coastal inundation and flooding.
- o As the northeast and southeast trade winds intensify during La Niña, they converge just north of the equator. They can create very wet conditions across Micronesia from Mili in the Marshalls, to Kosrae, to the southern Mortlocks in Chuuk State, to Satawal and Woleai in Yap State, and to Peleliu in Palau.
- o Eventually, the trade winds and La Niña will relax, and conditions will revert back to normal/neutral.
- o Multi-year La Niñas (2 or 3 in a row) are fairly common.

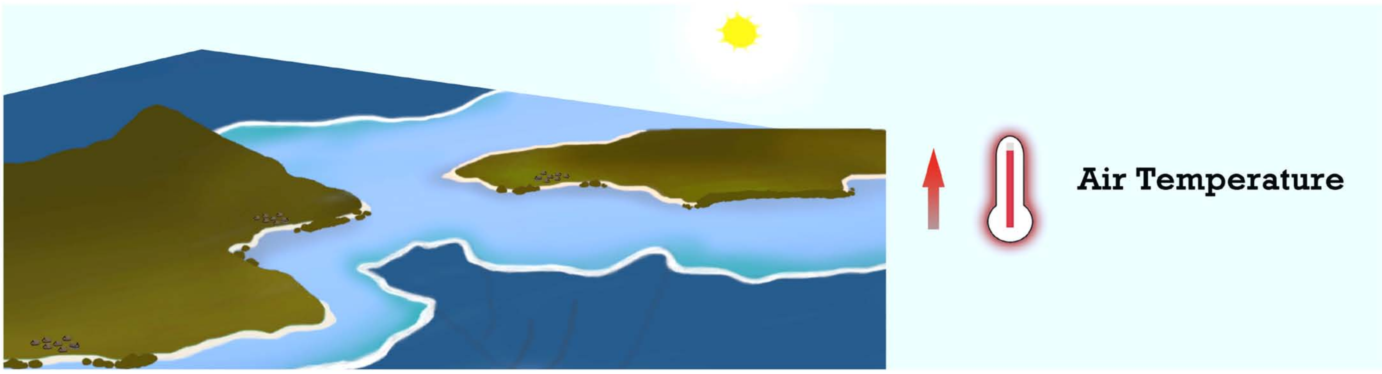
❖ It is unclear how climate change will impact El Niño and La Niña events and if they will become more or less frequent and severe. Scientists are not yet able to predict when an El Niño event will occur but when an event begins, they can predict the general weather/climate conditions for the next 7 to 9 months.

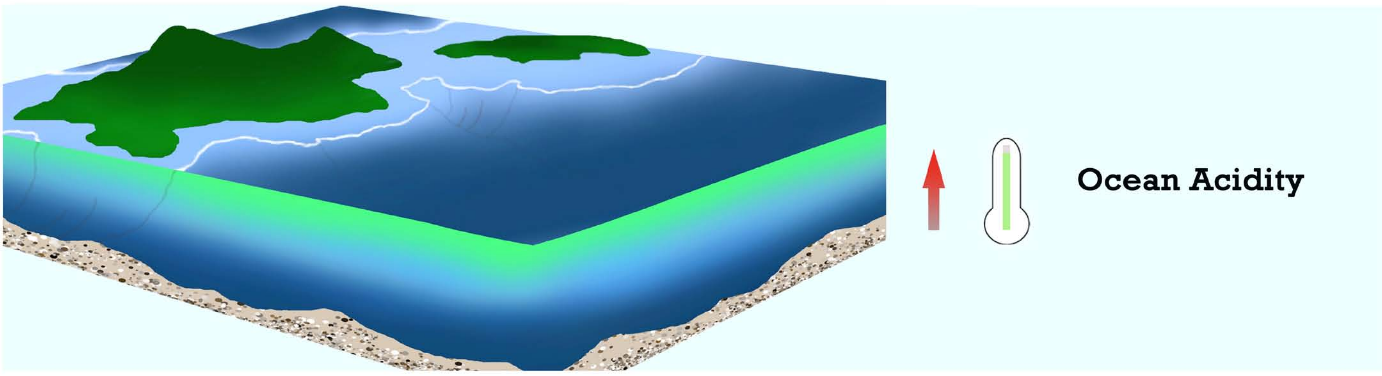
❖ However, it is very important to know if these events are occurring in any given year as it can help a community prepare for impacts from these climate events, such as drought and/or flooding. For example, it is important to have good water catchment systems in place so that during times of rainfall, communities can collect water and prepare for times of drought when an El Niño is predicted. Back-up water catchments should also be put in place to prepare for these severe dry periods.

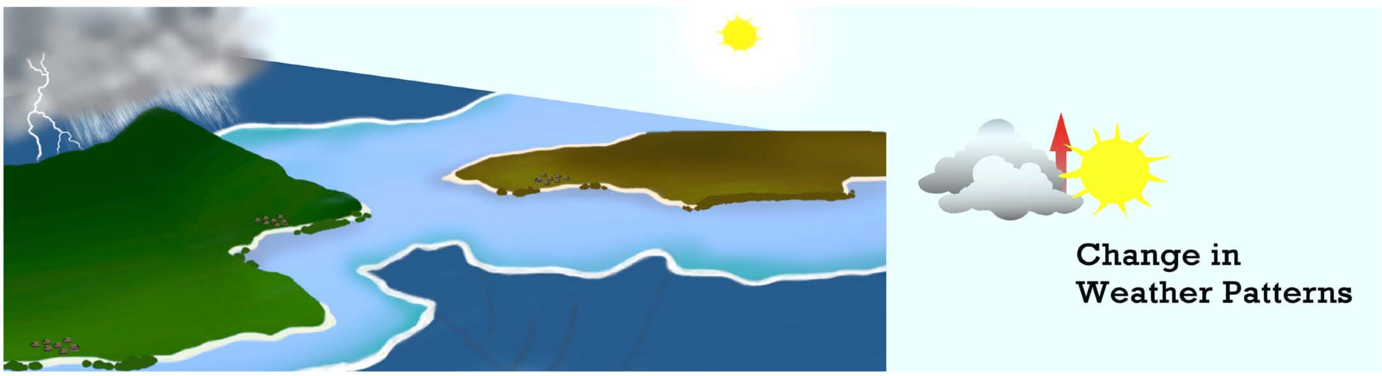
What Changes Can We Expect to See In the Region?











Information presented in this section explains what we know will happen, what is likely to occur, and what we don't know about changes to climate and its impacts in Micronesia.

What does the science say will happen for certain?

- Sea level is rising
- Sea surface temperature is increasing
- Air temperature is increasing
- Acidity of the ocean is increasing

What are possible changes?

- Weather patterns become less predictable
- It's unclear how storm events will change. However, as sea levels rise, any storm events that occur could bring greater storm surges.
- There is evidence some locations (e.g., Marshall Islands) are getting less rainfall. We don't know if this is part of a normal cycle (natural variability) or a result of global climate change.
- Based on a range of models, it is likely that future tropical cyclones (typhoons and hurricanes) will become more intense, with larger peak wind speeds and heavier precipitation associated with ongoing increases of tropical sea surface temperatures. There is less confidence in projections of a global decrease in numbers of tropical cyclones.

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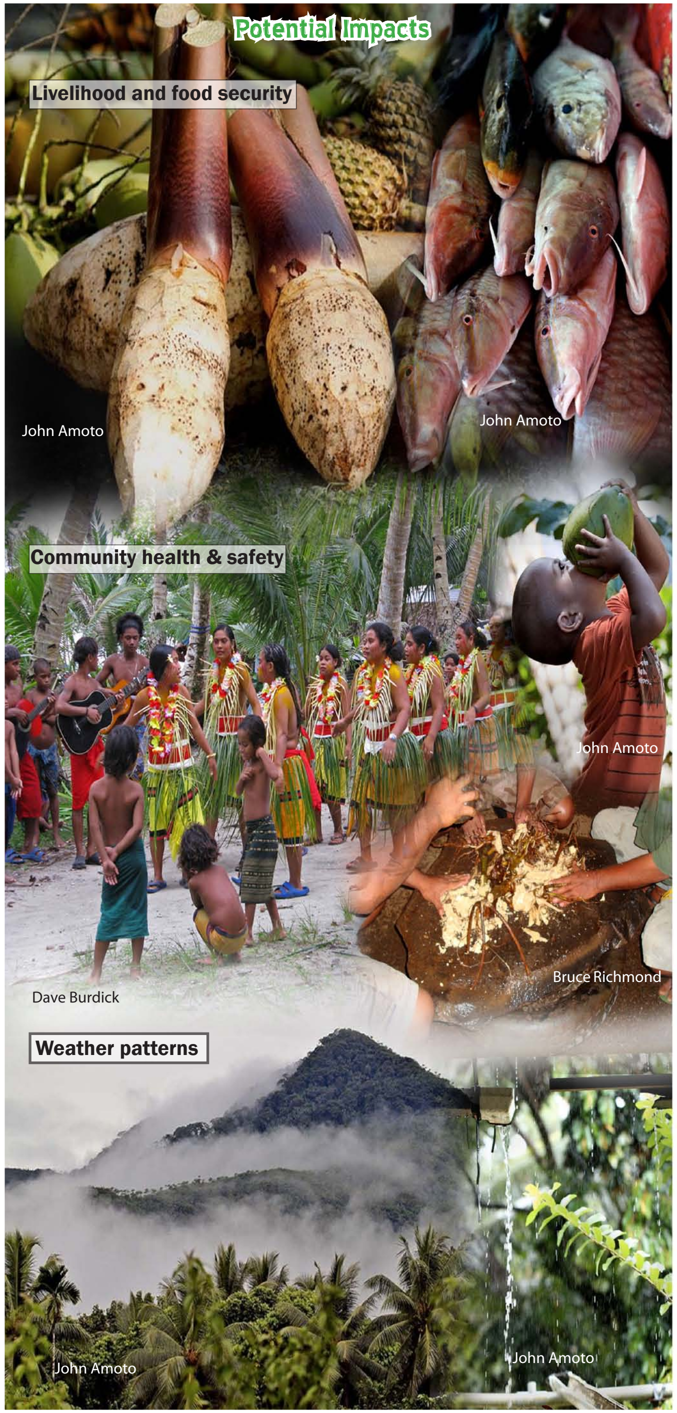
Why Should Our Community Care About Climate Change?



Climate change has potential to significantly impact Micronesia communities. This section provides examples of some possible impacts to Micronesian communities.

Potential Impacts

Climate change can be expected to impact Micronesian culture. It will have an impact on traditional and local ways that islanders utilize natural resources. Specifically it can impact:

- Livelihoods and food security (e.g., taro patches/ fisheries)
- Weather patterns and seasons (e.g., rain/ fruiting seasons)
- Community health and safety (e.g., safe drinking water, cultural practices such as growing sakau)

Impacts We're Already Seeing

Micronesians are already noticing changes in the climate, changes to the environment, and impacts from those changes. These include:

- Salt water inundation/intrusion
- Increased coastal erosion
- Flooding from storm surges or extreme high tides
- Bleaching of coral reefs
- Severe drought during the El Niño in 1997/1998

How Will These Changes Impact Our Community?

Changes brought about by climate change have significant potential to impact communities in Micronesia including

- **Sea level rise can cause ➪**
  - Stronger storm surges, flooding, saltwater inundation and intrusion, and coastal erosion, which can cause ➪
  - Loss of and damage to crops, homes, and coastal infrastructure. This leads to ➪
  - Health hazards, loss of food and livelihoods, decreased land for living, and problems with community services

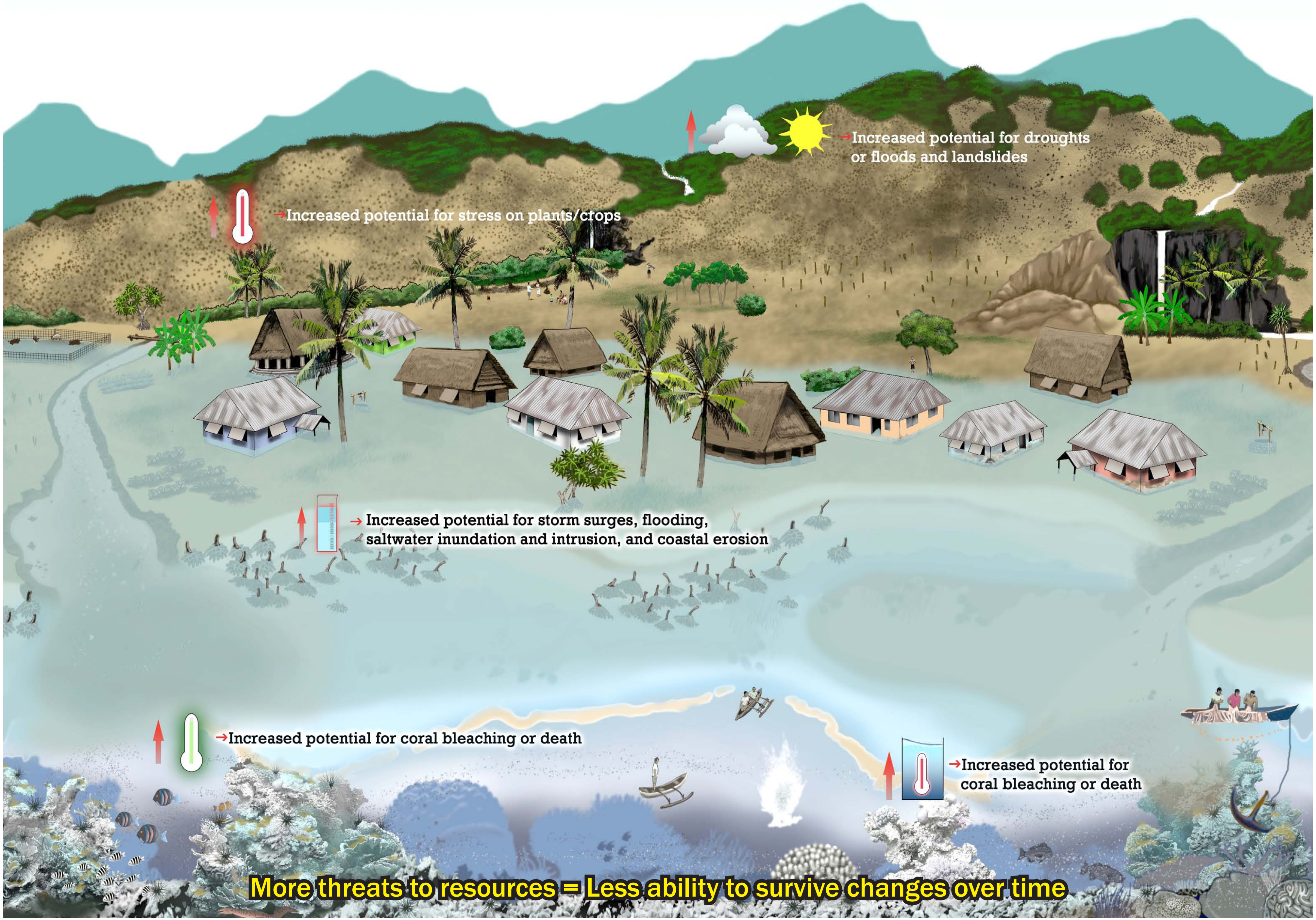
- **Increased sea surface temperature of the ocean can cause ➪**
  - Coral bleaching, which can make corals weak or die and result in ➪
  - Loss of habitat and nursery ground for fish and marine life, and loss of coastal protection, causing ➪
  - Loss of food and/or income for community members who are dependent on fisheries and a loss of coastal areas where homes and farms may be located. This leads to ➪
  - Nutrition problems, loss of livelihoods, and decrease of land for living

- **Increased air temperature can cause ➪**
  - Increased stress on plants, crops, and people, which can cause ➪
  - A loss of food or a health hazard

- **Increased acidity of the ocean can ➪**
  - Make coral structures weaken, grow slower, or die and result in ➪
  - More damage from storm surges, which results in➪
  - Loss of habitat and nursery ground for fish and marine life, and loss of coastal protection, causing ➪
  - Loss of food and/or income for community members who are dependent on fisheries and loss of coastal areas where homes and farms may be located. This leads to ➪
  - Nutrition problems, loss of livelihoods, and decrease of land for living

- **Changes in weather patterns can cause ➪**
  - Droughts if less rain or flooding/landslides if more rain, which cause ➪
  - Damage and loss of crops, homes, and infrastructure, which cause ➪
  - Health problems from water- and vector-borne diseases, and loss of food for community members

Cumulative Impacts



The impacts of multiple threats to resources over time are called cumulative impacts. Cumulative impacts from non-climate change threats degrade and weaken the natural systems by making them more sensitive to climate change impacts. As a result a degraded highly threatened ecosystem is typically more vulnerable to long-term impacts from climate change, while a healthier system has a greater probability of withstanding or recovering from climate change impacts.

In this section we illustrate how cumulative impacts from existing threats can combine with climate change threats to have a greater overall negative impact to important habitats and resources.

1. **Degraded Watershed**
   - o CC THREATS: change in weather patterns (e.g., increase or decrease of rainfall), rising air temperatures
   - o EXISTING THREATS: Destruction of forests/vegetation, pollution (e.g., piggeries, trash), runoff from cleared land, mono-cropping
   - o CC THREATS + EXISTING THREATS = CUMULATIVE IMPACTS AND INCREASED POTENTIAL FOR
     i. Damage or loss of crops and native plants, contamination or loss of drinking water, flooding of homes, soil erosion and landslides, sediment near shore and on reefs, invasive species, stress on people
     ii. Increased negative impact on food, income, and health of the community (e.g., vector- and water-borne diseases)

2. **Degraded Coastline**
   - o CC THREATS: Sea level rise, coastal erosion, increased sea surface temperatures
   - o EXISTING THREATS: Clearing of coastal vegetation, dredging of sand, unsound development of coastal areas and infrastructure, unsustainable clearing of mangroves for firewood and construction material, overharvesting
   - o CC THREATS + EXISTING THREATS = CUMULATIVE IMPACTS AND INCREASED POTENTIAL FOR
     i. Flooding and damage from storm surges, coastal erosion, sedimentation on the reef, damage to habitat important for food fish and shellfish
     ii. Negative impact on food, income, coastal land, property, and health of the community

3. **Degraded Coral Reefs**
   - o CC THREATS: Increased sea surface temperature, increased acidity of the ocean
   - o EXISTING THREATS: Overfishing, destructive fishing practices, anchor damage, oil spills, invasive/nuisance species, dredging, runoff and sedimentation
   - o CC THREATS + EXISTING THREATS = CUMULATIVE IMPACTS AND INCREASED POTENTIAL FOR
     i. Coral bleaching and death, damage to habitat important for food fish and shellfish
     ii. Flooding and damage from storm surges, coastal erosion, decrease in fisheries as habitat is degraded and destroyed
     iii. Increased negative impact on food, income, coastal property

- "Protecting resources now = increasing chances of survival and ability to meet our community needs now and in the future"
- "Pre-cautionary principle" - Preparing for unknown changes and protecting resources is the best approach for long-term community resilience.

o With or without climate change impacts, these are things that will help our community be happier and healthier over time.

Is There Anything We Can do? What are Other Communities Doing to Make a Difference?

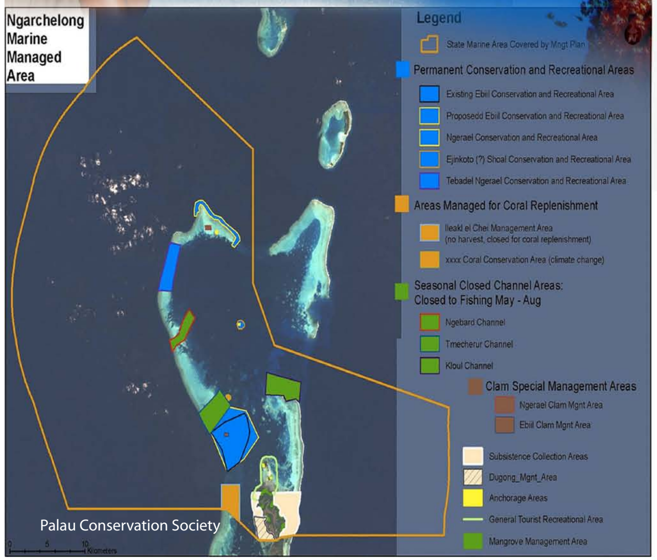
Ngarchelong Community, The Republic of Palau

Threats/Impacts the community is experiencing:

- Bleaching of coral reefs
- Negative impacts on fisheries, tourism and local way of life

Actions :

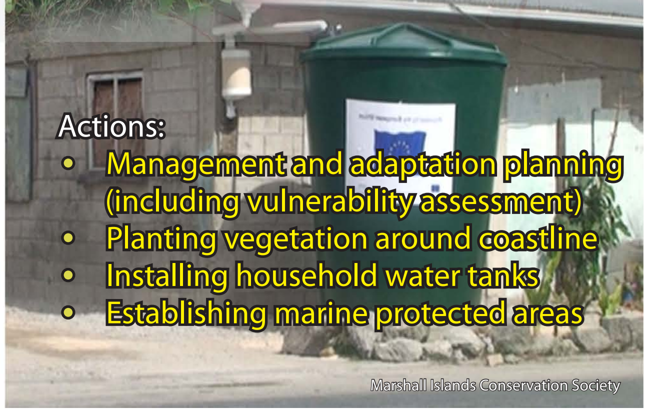
- Establishing a marine managed area
- Protecting resilient coral and fish spawning aggregations



Namdrik Attoll, The Republic of Marshall Islands

Threats/Impacts the community is experiencing:

- Accelerated rates of coastal erosion,
- Severe droughts
- Decline in fisheries



Actions:

- Management and adaptation planning (including vulnerability assessment)
- Planting vegetation around coastline
- Installing household water tanks
- Establishing marine protected areas

Tegua Community, Vanuatu

Threats/Impacts the community is experiencing:

- Regular inundation by ocean water from tidal surges
- Erosion of the islands
- Health problems from mosquitoes and water-borne illness
- Insufficient access to fresh water

Actions:

- The Tegua community relocated to higher grounds
- Installed several water tanks in the community
- Do not experience any of the flooding or water shortages and are finding health benefits from the ability to bath regularly in fresh water

Content and images were provided through Nakalevu, T. and Phillips, B., No date. Post Relocation Survey Report: Tegua Community, Torba Province, Vanuatu, Secretariat of the Pacific Region Environmental Programme. (2007)

There are many things that a community can do to prepare for and adapt to climate change and many things that you are likely already doing! Here are some examples of communities taking action to prepare for, and adapt to climate change impacts.

Namdrik Atoll, Marshall Islands

- Threats the community is experiencing
  - Accelerated rates of coastal erosion
  - Severe droughts in the past ten years that threaten drinking water supplies
  - Decline in fisheries

- Actions the community is taking
  - Carried out a "vulnerability assessment" and "management and adaptation planning" process
  - Planting vegetation around coastline to stabilize the shoreline
  - Installing household water tanks to catch rainwater for consumption
  - Establishing marine protected areas to protect important food fish and other marine life that are important to them

Ngarchelong Community, Palau

- Threats the community is experiencing
  - Mass bleaching of coral reefs occurred in '97/98
  - Concern that high water temperatures and bleaching coral could lead to the large-scale death of coral reefs and have a negative impact on the fisheries, tourism, and local way of life

- Actions the community is taking
  - Working with State government, local conservation groups, and scientists to establish a marine managed area that is designed to support the resilience of the coral reef and fisheries over time
  - The community planning team is considering climate change in the design and planning of the MMA, recommending additional levels of protection to areas that have shown resilience and/or recovery to past bleaching events, as well as important fish spawning aggregations

Tegua Community, Vanuatu

- The community of Tegua was located very close to the high-water mark on a low-lying atoll. The community had to stay in the same area as they shared one water tank and relied on freshwater springs at low tides despite the fact that these sources did not supply sufficient water for consumption and bathing.

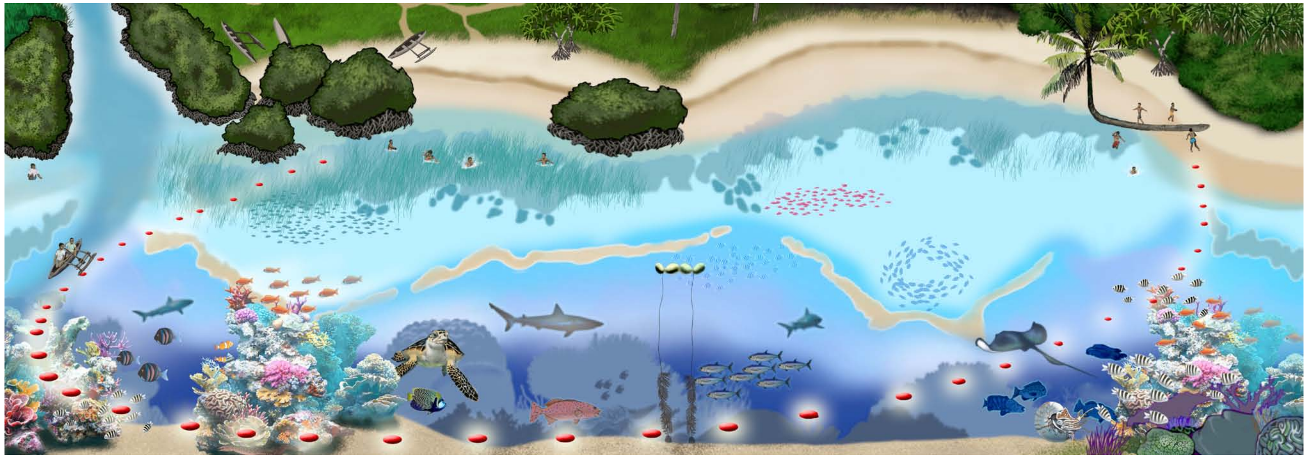
- Threats the community experienced
  - Regular inundation from tidal surges and increased erosion of the islands
  - Flooding that created health problems from mosquitoes and water-borne diseases
  - Water scarcity because they had only one water tank and depended on freshwater springs at low tide for drinking and bathing water

- Actions the community is taking
  - The Tegua community relocated to higher ground and rebuilt homes. The community is confident in their decision to relocate to higher grounds and have no regrets. They no longer experience any of the flooding or water shortages like they did in the old location.
  - They also installed several water tanks in the community, which resulted in an increase in the freshwater supply per family and health benefits from the ability to bath regularly in fresh water.

Adaptation Strategies to Build Resilience of Coral/Fisheries, and Coastal Vegetation

The best way to prepare for climate change and avoid negative impacts to important resources is to keep these resources as healthy and strong as possible

Coral Reefs and Fisheries Adaptation strategies:



1. Establish a Locally Marine Managed Area (LMMA) that includes:
   - Protection of herbivorous fish that eat algae and prevent algae from smothering and killing bleached corals
   - Protection of spawning aggregations
   - Protection of coral reefs near upwelling, flushing, and shading
   - Protection of a range of habitats (beach, mangrove, seagrass, coral)
2. Pelagic Fish Aggregation Devices to reduce pressure on reef fish
3. Small Pond Aquaculture
4. Develop supplementary or alternative livelihoods that are less dependent of reefs

Coastal land/vegetation Adaptation Strategies:

1. Re-planting native coastal vegetation (mangroves, trees)
2. Establish community rules to protect mangroves, coastal vegetation, and seagrass beds (e.g. Set-backs of homes and coastal infrastructure)
3. Coastal protection:
   a. "Hard options" – concrete, stone, seawall
   b. "Soft options" – vegetation, sand bags
4. Work with local and national governments to ensure buildings and roads are not built on shorelines where they are susceptible to sea level rise
5. Reduce cutting of vegetation by using appropriate fuel or renewable energy sources for cooking

The best way to prepare for climate change and avoid negative impacts to important resources is to keep these resources as healthy and strong as possible. Below are some adaptation strategies to help build resiliency of your community and resources that may be important to your community from changes that may occur from climate change or other threats.

Each adaptation strategy requires a different amount of capacity/inputs, including money, people, and expertise. It is important to understand which natural and social resources are most important to you and most vulnerable to climate change to help decide which strategies to undertake.

Coral Reefs and Fisheries Adaptation strategies

1) Establish a locally managed marine area (LMMA) – Establishing, designing, and managing the site can include rules and regulation of various human activities. Some rules might aim to reduce threats such as overfishing and habitat destruction while other rules may increase protection for certain species (e.g., herbivores, turtles). MMAs can be zoned to have different rules in different areas, where some areas are designed to have strict protections of certain species or habitats. These might include "no take" protections of spawning aggregations or mangrove areas. Important things to consider when designing an LMMA are the following:

    - Protection of herbivorous fish (e.g., parrotfish, surgeonfish) that eat algae and lessen the chance of bleached corals dying
    - Protection of spawning aggregations
    - Protection of coral reefs that are near upwelling, flushing, and/or shading
    - Protection of a range of habitats (beach, mangrove, seagrass, coral) to ensure important species are protected throughout their life

2) Pelagic fish aggregation devices (FADs): Nearshore FADs can be deployed near the outer reef to attract pelagic species closer to the community and reduce fishing pressure off the reef. Expertise may be necessary to understand feasibility of this option.

3) Small-scale pond aquaculture - Aquaculture is a way of farming fish. If resources are available to support aquaculture, such as nursery stock and feed, then these small ponds can be developed to provide a more sustainable source of fish for communities through "farming."

4) Develop supplementary or alternative livelihoods that are less dependent on reefs. Finding a means for alternative income not from fishing can reduce pressure off the reef and reduce the dependence of community members on marine resources that might be negatively impacted by climate change.

Coastal Lands and Vegetation Adaptation Strategies

1) Re-planting native coastal vegetation (mangroves, pandanus, trees, shrubs) – replanting vegetation near the shore can help stabilize coastlines, promote accumulation of sand, and slow erosion rates while also providing fruits (e.g., pandanas) or habitat for important species used for food (e.g. mangrove crab and other shellfish).

2) Establish community rules to protect mangroves, coastal vegetation, and seagrass beds - establishing regulations that prohibit destruction or do not allow development right behind mangroves or other vegetation. Work with local and national governments to ensure development of buildings and roads are not built on shorelines where they are susceptible to sea level rise.

3) Coastal protection:
    a. "Hard options" – are made of hard materials such as stones or concrete are often used to build these structures to protect land from the ocean. While these structures can provide coastline protection they also can cause further erosion of beaches in other areas down- current on the shore especially if they are not planned very well. Therefore it is very important to consult with engineers and other experts who can help design options to minimize further erosion of beaches.
    b. "Soft options" - are coastal protection approaches made from soft materials such as plants or sand bags. These materials can be used to build barriers or walls to slow erosion rates. Most soft options can be done for much less funding and with less human resources than hard options. However, they are also less permanent and in some areas less effective than hard options and may require more maintenance over time.

Adaptation Strategies to Build Resilience of Terrestrial and Water Resources

The best way to prepare for climate change and avoid negative impacts to important resources is to keep these resources as healthy and strong as possible

Terrestrial Adaptation Strategies:

1) Establish community rules to protect native upland vegetation and riparian zones, and prevent introduction of invasives
2) Eradicate and manage invasive species
3) Apply wise agricultural practices
4) Restore native upland vegetation

Water resources Adaptation Strategies:

1) Fix leaky pipes
2) Install household or community water catchment and tanks
3) Protect reservoirs
4) Ensure that reservoirs and fresh water lenses are free from pollution and managed to avoid evaporation
5) Ensure wells are designed and managed to allow sustainable use
6) Utilize solar water filters to filter out contaminated well water and to water crops
7) Utilize solar distillation systems to supplement drinking water in remote areas.

Terrestrial Adaptation Strategies

1) Establish community rules to protect upland native vegetation, and riparian zones from clearing, and burning.

2) Eradicate or manage for invasive species. Prevent the introduction of invasive plant species, which typically are less effective at holding soil.

3) Apply wise agricultural practices that minimize the clearing of land and erosion of soil.

4) Restore upland native vegetation.

Water Resources Adaptation Strategies

1) Fix leaky pipes to existing water tanks to ensure that available rainwater is being captured for use.

2) Install household or community water catchments and tanks to conserve for times of limited rain or drought.

3) Protect reservoirs and freshwater lenses – ensure areas that provide drinking water are free from pollution and managed to avoid evaporation.

4) Ensure wells are designed and managed to allow sustainable use.

5) Use of solar water filters to filter contaminants from well water, making it suitable for use to water crops; use solar distillation systems to supplement drinking water in remote areas.

Adaptation Strategies to Build Resilience of Agriculture and Community Well-Being

The best way to prepare for climate change and avoid negative impacts to important resources is to keep these resources as healthy and strong as possible

Agriculture Adaptation Strategies:

1) Diversify agriculture and move crops inland or up, away from inundation areas
2) Use food preservation methods
3) Salt tolerant species are being explored
4) Utilize and enhance traditional food preservation methods
5) Avoid clearing forests and monocropping
6) Use traditional and native crops
7) Eat locally produced and more nutritious traditional foods "Go Local!"
8) For low-lying islands, raise taro patches through traditional practices of filling with compost or concrete beds

Adaptation Strategies that support Community well-being:

1) Apply traditional and local knowledge
2) Provide climate information and build awareness for better preparedness
3) Access to emergency services and transportation
4) Access to health services
5) Develop alternative livelihoods, providing know-how.
6) Develop partnerships with other communities and local organizations
7) Organize the community
8) For low lying areas (and low lying atolls) put new buildings on stilts to prevent flooding

Agriculture Adaptation Strategies

1) Utilize and enhance traditional agro-forestry practices, and diversify new agriculture methods and use shade trees to protect from drought.

2) Avoid clearing forests and monocropping!

3) Move crops inland, away from inundation areas.

4) For low-lying islands, raise taro patches through traditional practices of filling with compost or where needed through the use of concrete beds. Controlled environments such as greenhouses may be needed to protect raised crops from salt spray and extreme heat.

5) Use and enhance traditional food preservation methods (e.g. breadfruit, pandanus, coconut vinegar/molasses) to promote self-sufficiency and enhance community livelihood and to prepare for times of low food production or drought.

6) Salt tolerant species are being explored.

7) Encourage local communities to consume a wide variety of locally produced and more nutritious traditional foods. "Go Local!"

Adaptation Strategies to Support Community Well-being

1) Apply traditional and local knowledge about natural resource management. Traditional and local knowledge most often includes practices, which minimize damage to natural resources while allowing for sustained use.

2) Build partnerships with local agencies and organizations that can support climate change adaptation activities (e.g. resource management, hazard management, health services, community colleges, etc.)

3) Provide climate information and warnings and build awareness for better preparedness for known and potential climate change impacts.

4) Encourage and reward people for supporting and complying with adaptation strategies for natural resources and ecosystems.

5) Ensure people know about and have access to emergency routes and services for extreme events (e.g., floods, typhoons), use high areas for evacuation zones.

6) Ensure people know about and have access to health services to cope with climate related stressors (physical and emotional).

7) In low-lying areas (and low-lying atolls) new buildings should be put on stilts to prevent flooding.

8) Install lightning protectors on buildings.

9) Engage in alternative livelihood programs to diversify income sources.

10) Work with other communities to share lessons and experience.

11) Organize the community and build effective community-based organizations and leaders.

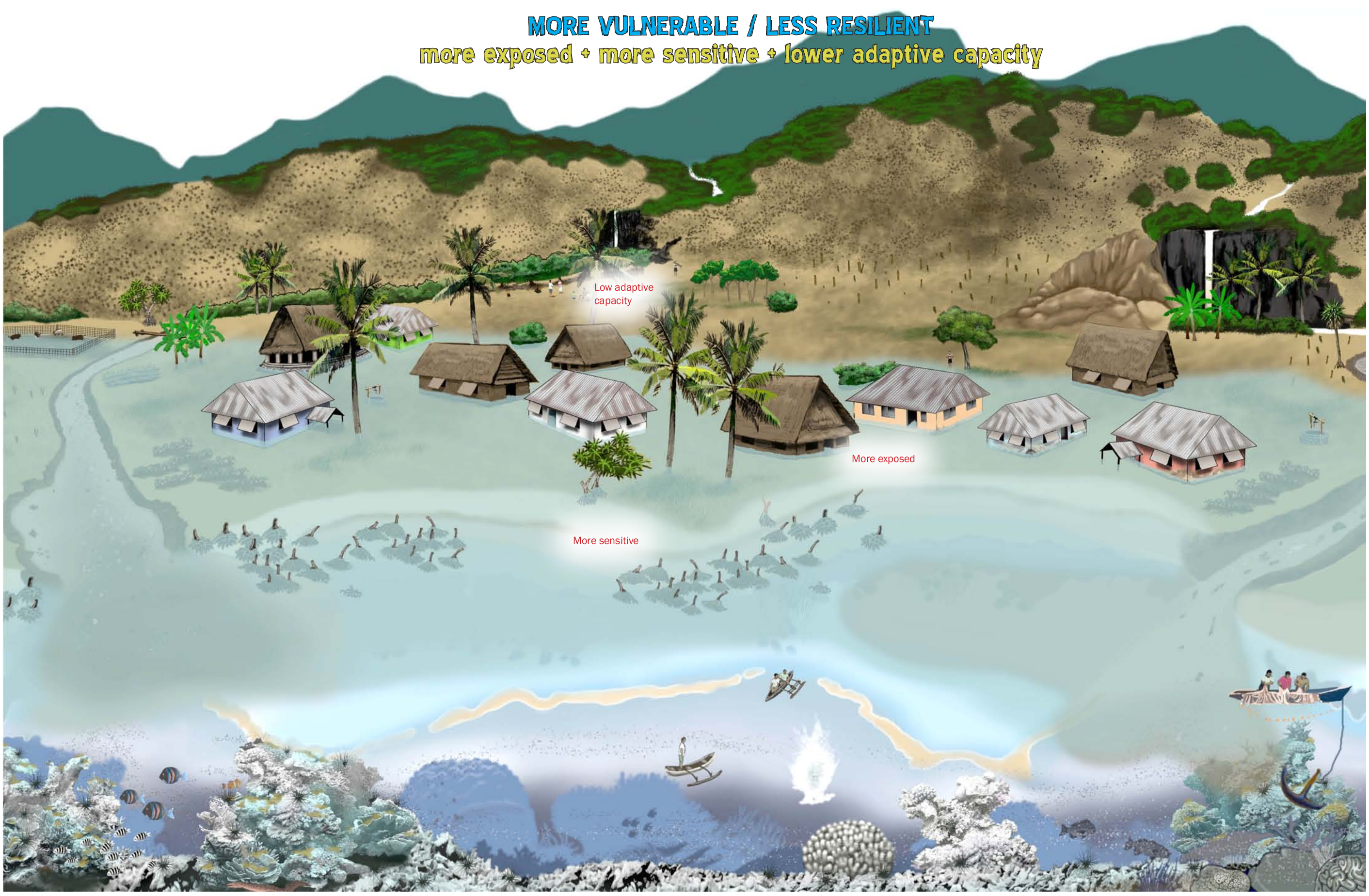
How Can We Understand What is Likely to Happen in Our Community?

MORE RESILIENT / LESS VULNERABLE

Less Exposed + Less Sensitive + Higher Adaptive Capacity

MORE VULNERABLE / LESS RESILIENT

more exposed + more sensitive + lower adaptive capacity



To understand what is happening in your community, it is first important to understand some basic concepts associated with climate change planning. Below we explain some simple concepts and terms that are commonly used in assessing a community's vulnerability to climate change impacts and in developing Management and Adaptation Plans.

The healthy community is:

- MORE RESILIENT / LESS VULNERABLE
  - o less exposed + less sensitive + higher adaptive capacity

The threatened community is:

- MORE VULNERABLE / LESS RESILIENT
  - o more exposed + more sensitive + lower adaptive capacity

- **Vulnerability:** the degree to which human or natural systems are unable to cope with, negative impacts of climate change. Vulnerability is a function of exposure, sensitivity to climate events and the capacity of the systems to adapt to impacts from these events.

- **Resilience** is ecological and/or social ability to absorb, respond to, and bounce back from external stresses and disturbances while still being able to maintain the community's core functions.

- **EXPOSURE:** the extent to which a system comes into contact with climate conditions or specific climate impacts.
  - o Houses and agriculture in the vulnerable community are more exposed to climate change events such as storm surge and inundation due to sea level rise because they are built low and close to shore
  - o Houses and agriculture in the resilient/healthy community are less exposed to climate change events such as increased storm surge due to sea level rise because they are built higher and away from shore (behind mangroves)

- **SENSITIVITY:** the degree to which a built, natural, or human system is negatively affected by changes in climate conditions (e.g., temperature and precipitation) or specific climate change impacts (e.g., sea level rise, coastal erosion).
  - o Community members and natural resources are more sensitive in the vulnerable community because there are several man-made threats that have degraded or damaged the marine resources, and the community is very dependent on fisheries for food. They are also dependent on government resources for fresh water in times in drought since they have no water storage system
  - o Community members and natural resources are less sensitive in the resilient community because the resources are very healthy and the community has a wide variety of food sources including multi-crop agriculture, seasonal fruits, wide range of diverse species in the mangrove, and reef fish. Community members have well-maintained rainwater catchments on their houses and have a community water reservoir as well for times of drought.

- **ADAPTIVE CAPACITY:** potential, capability, or ability of built, natural, and human systems to adapt to impacts of climate change and variability with minimal potential damage or cost.
  - o There is low adaptive capacity in the vulnerable community because community members are not aware of how to protect their resources or how to adapt to climate change. They do not know of alternatives for their livelihoods or access to the resources they need to be able to make changes. They do not have partnerships with local health and hazard management organizations, and are not able to plan for emergencies such as flooding and droughts.
  - o There is high adaptive capacity in the healthy/resilient community because community members are aware of how to protect their resources and to implement strategies to adapt to climate change. They have livelihood alternatives, are willing to make changes and able to access the resources that support them to do so. They do have been working with local health and hazard management organizations to help them plan for emergencies such as flooding and droughts and implement strategies to address critical community needs.

What Can We Do in Our Community to Prepare for These Changes?

1. Get Organised

- Form planning team
- Identify stakeholders
- Develop planning timeline

2. Orienting the Community

What Do We Know?

- Review previous activities
- Review reasons and process for management and adaptation planning
- Review concepts in climate change and tropical island ecology

3. What's Happening in Our Community and What is Important to Us?

- Collect information about current and historical trends
- Identify conditions of natural and social resources
- Identify, prioritize and map natural and social resources targets

4. Management and Adaptation Planning

Where Do We Want to Go?

- Identify your vision for the future
- Identify and prioritize climate and non-climate threats
- Assess the vulnerability of your target resources to climate change impacts
- Identify solutions to address the threats and reduce your vulnerability to climate change impacts

5. Management and Adaptation Planning

How Will We Get There?

- Based on the solutions, formulate goals, objectives and activities
- Prioritize the activities
- Develop rules and zones

6. Review and Adoption

Let's Make It Happen

- Review the plan with the community and stakeholders
- Adapt as needed
- Adopt and celebrate
- Begin implementation

7. Monitoring and Adapting

How Are We Doing?

- Develop ways to measure progress
- Monitor the effectiveness of implementation at achieving the plan's objectives
- Adaptively manage the plan

The graphic above explains the basic steps of a planning process.

- Based on the predictions of climate change and climate variability in Micronesia, you can identify how these changes might impact your community and prepare for these changes by developing a management and adaptation plan. By following the steps above you will be able to prepare your management and adaptation plan and will better understand:

  - your long-term vision
  - your important natural and socio-economic resources
  - non-climate change and climate change threats to those resources
  - the vulnerability of those resources to climate change impacts
  - solutions to address both climate change and non-climate change impacts
  - objectives and actions needed to pursue these solutions
  - other key planning elements

- A vulnerability assessment will be carried out as part of the process to help you understand the likely impacts to your community and your ability to prevent and/or recover from those impacts. The vulnerability assessment can help you understand exposure, sensitivity, and adaptive capacity in your community.

- Once you know which areas of your community and resources are most vulnerable and which are your biggest concerns about climate change impacts you can begin to explore the best strategies to prepare for these changes to build your community resiliency.

- The next page provides specific tools that can be used to carry out a vulnerability assessment

Vulnerability Assessment

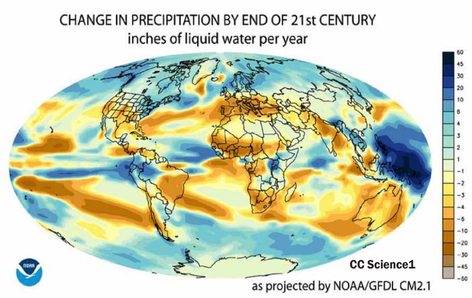
VULNERABILITY MATRIX

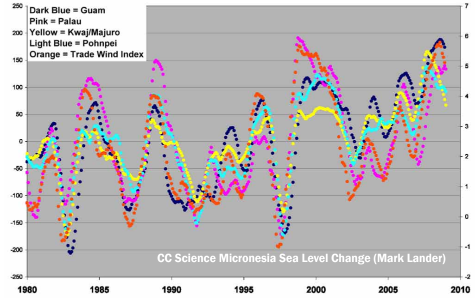
TARGET RESOURCES	THREATS (climate and non-climate)	EXPOSURE	SENSITIVITY	IMPACTS	ADAPTIVE CAPACITY (Natural Resources)	ADAPTIVE CAPACITY (Social Capacity)	VULNERABILITY
What social and natural resource targets are most important to your community?	What are the climate and non-climate threats to your priority social and natural resource targets?	How much area of your target resource are affected by climate change events? Specify which events (All/ Most/ Some/ Little/ None)	How severely will your target resources be impacted by increased climate events? And why? (Severely/ Moderately/ Hardly)	What are the current and likely impacts from these events to your target resources and your community?	How would you rate the ability of your target resources to cope with impacts from climate change events? (High/ Medium/ Low)	How would you rate the ability of your community to cope with potential impacts to target resources from climate change events? (High/ Medium/ Low)	**Rate the vulnerability of each target resources** **(High/ Medium/ Low)**
Water resources	Drought, contamination, lack of storage	Most	Severely by drought because we don't have good storage	Little drinking water, loss of health	Low – if humans don't manage water resources they will not be around in times of drought due to evaporation and salt water contamination	Low– we have experienced emergencies in the recent past. Gov't was needed to support community and provide fresh water	**HIGH**
Coral reef	Dynamite fishing, over fishing, bleaching	All - to sea surface temperature rise	High for the near shore reef because it is threatened by dynamite fishing and overfishing so it is not healthy now	Loss of income, loss of food	Medium – some reefs in the past came back after bleaching events	Medium – some fishermen are able to grow crops when fishing is not good	**MEDIUM**

SWOT ANALYSIS

	Internal	*External*
Positive	**Strengths** • Strong culture and traditional knowledge • Lots of technical capacity • Tourism provides funding • Community leaders are well informed about CC and potential impacts • Existing re-vegetation efforts • Community has shared vision • Experience with climate events such as saltwater inundation and flooding	**Opportunities** • Watershed Association • Increased tourism potential with new protected area • Partnerships with local natural resource agency • Partners with hazard management agency • National Gov't providing support for CC adaptation • Community College • Nearby health clinic • Micronesia Challenge • Other communities doing adaptation
Negative	**Weaknesses** • Capacity - lack of human capacity to implement and enforce • Not enough education & outreach, different levels of awareness • No opportunities for community volunteers • No alternative livelihoods for those dependent on fisheries • Lack of knowledge about how to deal emergencies	**Threats** • Easy for poachers/night fishing • Natural disasters • Poor economy • Unreliable transportation • Need for gov't support in times of emergency

CLIMATE SCIENCE INFORMATION





COMMUNITY MAPPING


Marshall Islands Conservation Society

BIOPHYSICAL ASSESSMENTS


Dave Burdick


Dave Burdick

SOCIAL ASSESSMENT


Christy Loper


Christy Loper


Christy Loper

HISTORICAL TIMELINE / SEASONAL CALENDAR


Marshall Islands Conservation Society

Vulnerability assessment matrix – The vulnerability assessment matrix helps bring together information collected through the tools listed below in an organized way. These tools help a community understand the vulnerability of their priority social and biophysical resources to climate change impacts.

- Collection and review of climate change science information
- Historical timeline
- Seasonal calendar
- Community mapping
- Socio-economic assessment and monitoring
- Biological assessment and monitoring
- SWOT analysis

These tools will help answer the following questions

- How vulnerable are our priority resources to climate change impacts and other threats?

Exposure

- Who is most exposed to these impacts?
- Where do they live?
- Which resources are most exposed? In which area?

Sensitivity

- Who is dependent on impacted resources for income and subsistence needs, and to what extent?
- How healthy are the resources currently?
- Are there additional stressors beyond CC that are impacting these resources?
- Are these resources being managed effectively?
- In an emergency, how able is our community to evacuate and/or communicate to outside the hazard area?

Adaptive Capacity

- What opportunities exist in our community to deal with impacts on these resources (e.g., alternative and supplementary livelihoods, diversity and availability of food options, social network, local environmental governance)?
- What barriers might exist that would keep our community from adapting to these changes (e.g., political/regulatory, physical barriers, competition for use, degraded ecosystems, lack of climate information or access to it)?
- What resources/opportunities/strategies already exist to help our community adapt to possible impacts?
- What are the major gaps/challenges in adapting?

Prioritizing Resource Targets

- Which resources are most important for us to protect?
  Which resources are most vulnerable to climate change and other threats?

TAKING ACTION: A COMMUNITY PLAN TO BUILD RESILIENCE

COMMUNITY MANAGEMENT AND ADAPTATION PLAN SUMMARY

Resource Targets

Water resources, food fish as grouper and bumphead parrotfish, marine turtles, coral reefs, community agriculture, traditional use of natural resources

Vision: A healthy community with intact natural resources providing food, jobs, and quality of life

Non - Climate Change Threats and Impacts

1. Overfishing resulting in shifts in population structure and loss of predators and herbivores
2. Destructive fishing (using chemicals and explosives) destroying reef and marine life populations
3. Pollution from piggeries causing too many nutrients on the reef, which promotes algae growth, and also contaminates the fresh water

CC Threats and Impacts

1. Increased extreme rainfall events causing runoff and sedimentation
2. Increase in sea surface temperature causing coral bleaching
3. Increase in air temperature with long dry periods causing drought and limiting water supplies
4. Sea level rise causing coastal erosion and inundation

Vulnerability (HIGH)

1. High Exposure to CC Impacts: Homes and crops are near the shore
2. Highly Sensitive to CC Impact: The ecosystem is degraded due to non-climate change threats
3. Limited Adaptive Capacity: The community has limited understanding of effective management

Solutions

Reduce Exposure

1. Move crops away from coastal areas
2. Build new homes on stilts

Reduce Sensitivity

1. Restore and protect mangroves to protect against coastal erosion
2. Restore and protect native vegetation
3. Moves piggeries away from the shore
4. Create a managed area to protect spawning aggregations and populations of herbivorous species
5. Install community rainwater catchments

Increase Adaptive Capacity

1. Provide awareness programs on how to reduce threats and prepare for climate change impacts
2. Partner with health organizations to prepare for increased heat events and water-borne illness
3. Work with adjacent communities to protect resources and apply for grant funding

In this section we provide an example of a community that carried out a vulnerability assessment and developed a management and adaptation plan to address their threats and concerns.

After going through a vulnerability assessment, this community realized they were highly vulnerable to climate change impacts. Specifically, their reefs, water resources, coastal crops, and infrastructure were all highly vulnerable because they are exposed to climate events, the ecosystem is degraded due to cumulative impacts, and the community is not familiar with resource management and climate change adaptation.

Given the known and unpredictable changes to future climate conditions, the community has developed a Management and Adaptation Plan. This plan will guide them in how to restore and improve management of natural resources so that their ecosystems are more resilient to these changes.

They also plan to act now to develop more and diverse systems for drinking water, income, and food crops to be more likely to be able to deal with long-term changes.

In summary, the community's Management and Adaptation Plan includes the following information and actions to help reduce their vulnerability and improve the long-term health of their community:

Reduce Exposure

- Move crops, houses, and important infrastructure of community services away from coastal areas.
- Build new homes on stilts.
- Elevate planting plots.

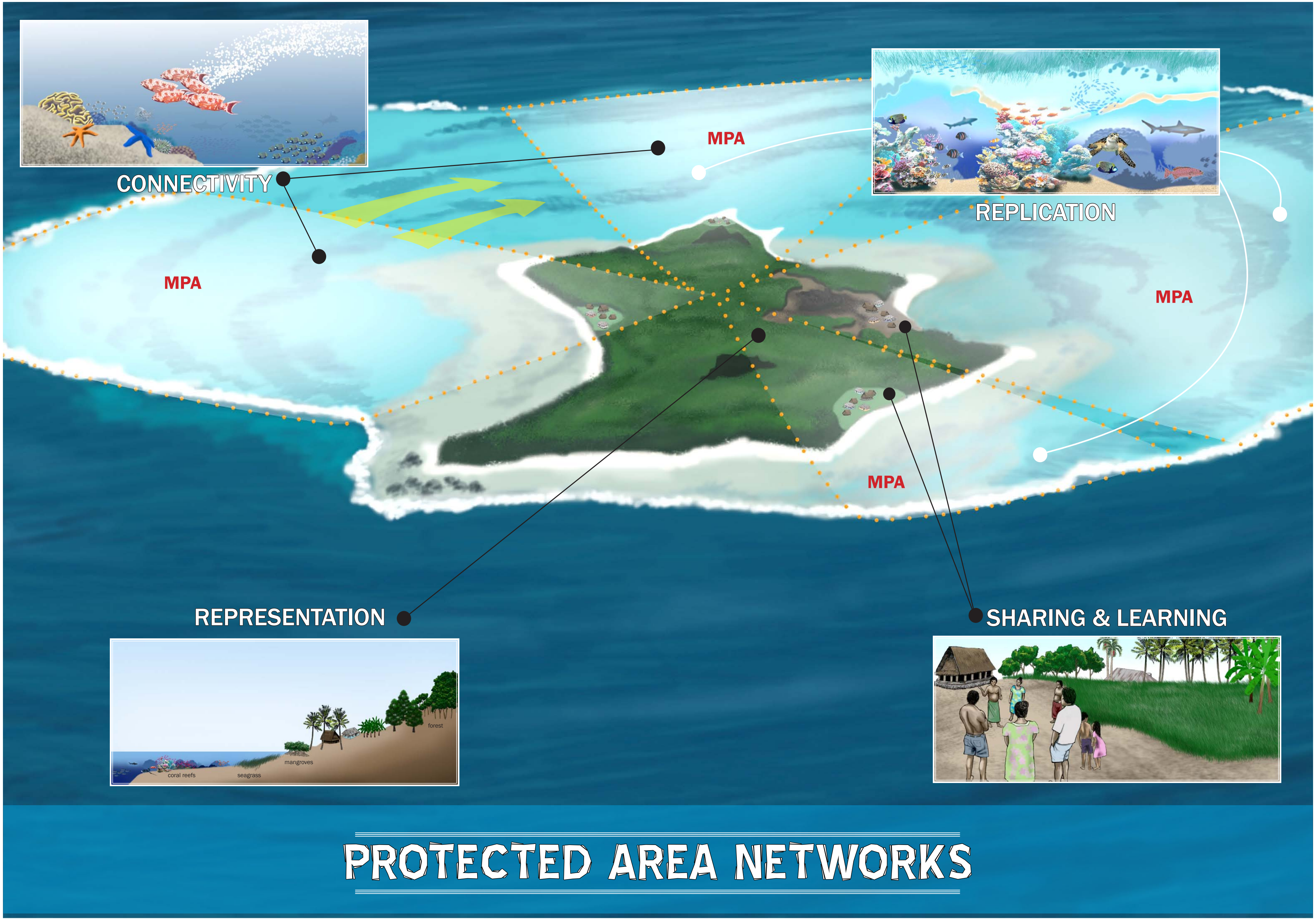
Reduce Sensitivity

- Address non-climate threats effectively.
- Restore and protect mangroves to reduce coastal erosion.
- Restore and protect native vegetation.
- Move piggeries away from the shore and freshwater sources.
- Create a managed area to protect spawning aggregations and populations of herbivorous marine animals.
- Develop alternative income programs for fishermen such as tourism facilities.
- Install community rainwater catchments.

Increase Adaptive Capacity

- Provide outreach and awareness programs so community members know how to reduce threats and prepare for climate change impacts.
- Strengthen livelihood diversification and enabling institutional support.
- Partner with relevant organizations to better prepare for climate impacts, such as with local health organizations to help prepare for increased heat events and to decrease likelihood of water- and vector-borne diseases.
- Build strong social networks.
- Work with adjacent communities to protect resources and apply for grant funding.
- Form a community team to develop and implement the Management and Adaptation Plan.

How Can We Work Together to Be More Resilient?



This section explores how working with other communities to establish protected areas can help improve resilience for everyone.

- The work being carried out at a site level can have meaningful and positive effects in addressing climate change impacts to your community, such as
  - o Protection of coastline from storm surges
  - o Improved fisheries management
  - o Sustainable sources of food and fresh drinking water
- However, most natural systems will require a broader approach than at the community level to secure long-term success and resiliency.
- Your community can be a part of a larger protected area network around your state, country, or region to increase the resiliency of these natural resources, help protect them from the impacts of climate change on a broader scale, and ultimately increase the benefits they provide your community.

Protected area networks are multiple protected areas that are designed to increase natural resource resiliency by keeping specific areas healthy so as climate change occurs they are able to withstand the additional stressors such as sea surface temperature rise and ocean acidification. They do this through

- **Connectivity** – It is important to consider how systems may be connected to one another. Many natural systems within your community may be influenced by or influence other systems in other communities. For example, many seeds and young (e.g., coral, mangroves, coconut palms) are spread to other areas outside your community, just as species in other communities may spread to your community area through winds and current. Therefore, if a group of areas are healthy they are more likely to be able to withstand changes and provide non-protected areas with sources of seeds, larvae, juveniles, and adults.
- **Replication** – It is important for similar ecosystems to be protected in many areas over a broad space. Replication of these protected systems ensures that if one area is negatively impacted, there are likely other areas that can support recovery of damaged areas. Some areas are naturally more resilient to climate change impacts and may be able to survive climate events more than others, for instance, an area of reef that has not bleached or an area that has bleached but recovered. These areas should be considered for protection so they can help provide badly impacted and/or non-protected areas with seeds, larvae, juveniles, and adults to support recovery.
- **Representation** – Protection of all types of ecosystems important for natural resources throughout all of their life stages (seed, larvae, juvenile, adult). It is important to have protected areas that include "representative habitats" for various life stages (e.g., coral reefs, reef flats, seagrass beds, mangroves, beaches, upland forest).

Community Sharing and Learning Networks are multiple communities that work together to share and help each other increase community well-being and resiliency. They do this through

- Informing and raising awareness
- Sharing lessons, knowledge, resources, and experience

Existing groups that can be utilized to share this information include watershed groups, women's groups, school groups, church groups, etc.

Is There Any Help for Our Community to Adapt to Climate Change?

The following organizations and initiatives provide support to communities for natural resource management and climate adaptation planning and implementation

The Micronesia Challenge

Micronesia Conservation Trust

National Government (Policy and Agencies)

Local Organizations

- *Health*
- *Hazard/Disaster Management*
- *Resource Management and Conservation*
- *Education and Research*
- *Meteorological Services*

Community Groups