USP

THE UNIVERSITY OF THE SOUTH PACIFIC

Factsheets on Climate Change Related Issues in the Pacific

THE UNIVERSITY OF THE
SOUTH PACIFIC

Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, Fiji Islands
Phone: +679 323 2894
Fax: +679 323 2891

CLIMATE CHANGE: THE HUMAN INTERFERENCE

PACE-SD Factsheet Series: No 1

Human activities

Human activities, particularly the burning of fossil fuels and forest clearing, have released significant quantities of carbon dioxide (CO_2) and other greenhouse gases (GHGs) into the atmosphere, which has led to global warming that is unprecedented in the history of Planet Earth.

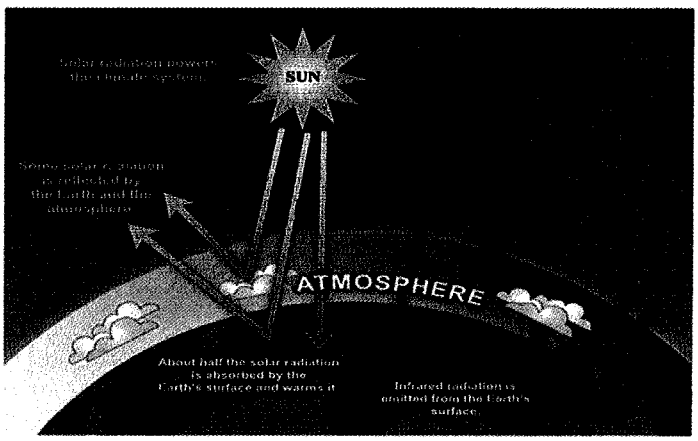


Figure 1: The greenhouse effect (Source: McMullen, 2009: 4)

Indeed, the **'natural' greenhouse effect** is essential for life on Earth by helping to maintain the average global temperature of 15°C, compared to the much colder -30° C temperature of the outer atmosphere, due to the GHGs — CO_2, nitrous oxide (N_2O) and methane (CH_4). Energy from the sun travels through space and reaches the Earth as short wave or solar radiation. This short wave radiation is absorbed by the Earth's surface, causing the Earth to warm and emit infrared or long wave radiation into space (see Figure 1).

However, the atmospheric concentration of CO_2 has increased by more than 30% since pre-industrial times, trapping more heat in the lower atmosphere. The result has been an **'enhanced' greenhouse effect** and observed changes to the global mean climate.

GHGs and their origins

The stocks and flows of the principal GHGs, those naturally occurring as well as those industrially produced by humankind, are summarised in Table 1. The most abundant and discussed GHG is CO_2. Methane is the next most significant in terms of its contribution to global warming.

Table 1: A summary of the major GHGs (covered under the Kyoto Protocol), including their primary sources and global warming potential (Source: Lal, 2011)

Gases (from pre-industrial times to the current levels)	**Sources**	**Global warming potential**
Carbon dioxide, CO_2 (280ppmv—379ppmv)*	Burning of fossil fuels	1
Nitrous oxide, N_2O (270ppbv—319ppbv)	Burning of fuels Manufacture and use of fertilisers	310 times higher than CO_2
Methane, CH_4 (0.70ppmv—1.774ppmv)	Coal mining Landfills/waste decomposition Livestock digestive processes Wetland rice cultivation	21 times higher than CO_2
Hydrofluorocarbons, HCFs (0—17pptv)	Refrigeration units Manufacture of semiconductors	140 to 11,700 times higher than CO_2
Perfluorocarbons, PFCs	Aluminium smelting Uranium enrichment Replacement of CFCs Manufacture of semiconductors	7,400 times higher than CO_2
Sulphur Hexafluoride, SF_6 (0—4.2pptv)	Insulation of high-voltage equipment Cable cooling systems	23,900 times higher than CO_2

*ppmv=parts per million by volume; ppbv=parts per billion by volume; pptv=parts per trillion by volume.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/

PACE-SD Factsheet Series: No 1

Key changes associated with global warming

The IPCC (2007) has examined the results from many different models to indicate potential global changes by 2100. Along with global average surface temperature increases, the IPCC concluded that:

- It is very likely that there will be more frequent hot extremes, heat waves and heavy precipitation events.
- It is very likely that there will be more precipitation at higher latitudes and likely that there will be less precipitation in most subtropical land areas.
- It is likely that tropical cyclones will become more intense, with larger peak wind speeds and more frequent heavy precipitation associated with ongoing increases in tropical sea surface temperatures.
- The sea level will rise by between 18 and 59 centimetres, and oceans will become more acidic.

How do we know that climate change is real?

When we look back over the years, have we noticed changes to our environment, land and sea:

◊ Has the temperature risen? Is summer hotter now? And winter warmer?

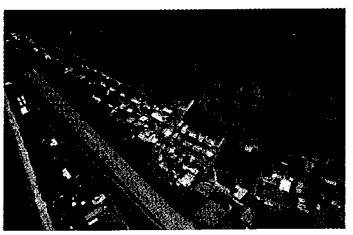
◊ Has there been more frequent rainfall? Or maybe less?

◊ Has there been an increase in extreme weather events?

◊ Are the tides becoming stronger?

◊ Have there been any changes in plant or animal life?

◊ Has there been a rise in sea level?



Images of Tuvalu (Source: Karen McNamara)

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

References
Intergovernmental Panel on Climate Change (2001) *Third Assessment Report*, Cambridge University Press, Cambridge, UK.
Intergovernmental Panel on Climate Change (2007) *Fourth Assessment Report*, Cambridge University Press, Cambridge, UK.
Lal, M. (2011) Course material for 'EV414', USP, Suva, Fiji.
McMullen, C.P. (editor) (2009) *Climate Change Science Compendium*, UNEP, Nairobi, Kenya.

IMPACTS OF CLIMATE CHANGE

Climate change is already happening according to scientific evidence and local observations

Many Pacific Islands are experiencing the impacts of climate change now

Climate change: Worldwide impacts

Globally, both observed and projected impacts of climate change can have significant social, economic and environmental implications for countries. Figure 1 illustrates the projected impacts on various sectors, a function of global temperature rise.

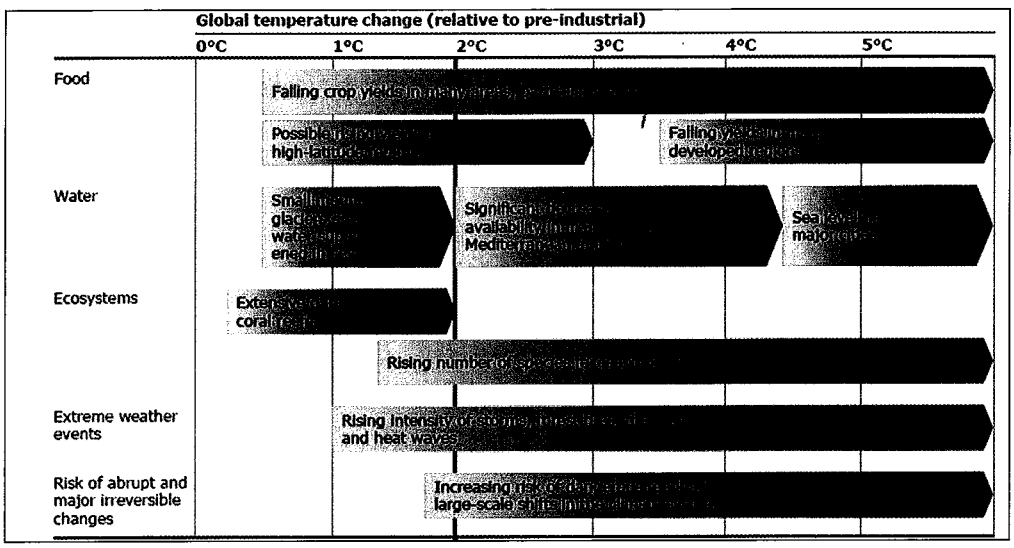


Figure 1: Projected impacts of climate change on various sectors (Source: Stern, 2006)

How will climate change affect our lives in the Pacific?

Food security: agriculture and fisheries

* Changes in **rainfall** patterns, and the increased frequency and intensity of **cyclones** are major **threats** to agriculture (such as productivity levels and pests).
* It is estimated that in Fiji, **agricultural losses** (due to climate change) could reach **US $23-52 million/year** by 2050.
* Pacific Islands' most important natural resource — **tuna** fisheries — could **migrate** towards the central Pacific ocean and adversely affect peoples' sustainable livelihood as well as economy.

Root crops (taro and cassava) have provided good nutrition to Pacific Islanders for hundreds of years (Source: Shiri Ram)

Water resources

* Pacific countries are extremely vulnerable to **reduced rainfall**. Low-lying coral atolls are especially threatened.
* Tarawa Atoll (Kiribati) is expected to have a 10% reduction in rainfall — estimated to result in a 20% reduction in freshwater supplies.
* Sea level rise is set to **push water tables to the surface**, resulting in further declines in freshwater.
* An **accentuated ENSO cycle** (due to climate change) could further threaten freshwater supplies.

THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/

IMPACTS OF CLIMATE CHANGE

The impacts of climate change are significant. Agriculture, tourism, coastal infrastructure, ecosystems, health, water supplies, ocean resources and fisheries are all likely to be affected.

Human health / well being

- Anticipated climate change will lead to increasing rates of **vector-borne diseases** (such as malaria, dengue fever and filariasis). The 1997/1998 dengue outbreak in Fiji resulted in 24,000 infections, 13 deaths and US$3-6 million in economic losses.
- Higher **temperatures** and **water** scarcity can increase individual rates of **diarrhoea**.
- **Cyclones**, **floods** and **storm** surges can cause **physical injury** and loss of life.

The dengue mosquito (Aedes Aegypti) (Source: Paul Zborowski)

Economy and infrastructure

- More frequent and severe **extreme events** will undermine **human resources** and threaten **economic development**.
- Much of the **infrastructure** in Pacific countries (such as roads, airports and ports) is situated in **coastal areas**, making it at risk from **flooding** and **inundation**. In Fiji or Samoa, a 0.5m rise in sea level and a cyclone event would cause major damage to port facilities.
- The **tourism** industry is likely to be affected due to the decline in ecosystems, especially coral **reefs**.

An island resort in Fiji; tourism is an important economic sector throughout the Pacific (Source: news.com.au)

Biodiversity and coastal resources

- Coastal **wetlands**, **fisheries**, coral **reefs** and **mangrove** habitats will be **threatened** by sea level rise and/or warming ocean temperatures.
- **Extinction** of certain **endemic species** could ensue, particularly in high-altitude forests in some Pacific countries.
- Increasing **extreme events** (such as cyclones) are likely to cause severe and lasting damage to **biodiversity** (especially in forests).
- Likely increases in coastal **erosion**, flooding, **inundation** and **saline intrusion**.
- **Coral reefs** will continue to be **stressed** (resulting in bleaching, disease) due to increasing ocean temperatures, sea level rise and cyclones (see Figure 2).
- Within the next 30-50 years, **coral bleaching** could expand significantly in Pacific countries and seriously damage marine ecology.

Bleached coral, which is the whitening of diverse corals, is attributed to higher water temperatures

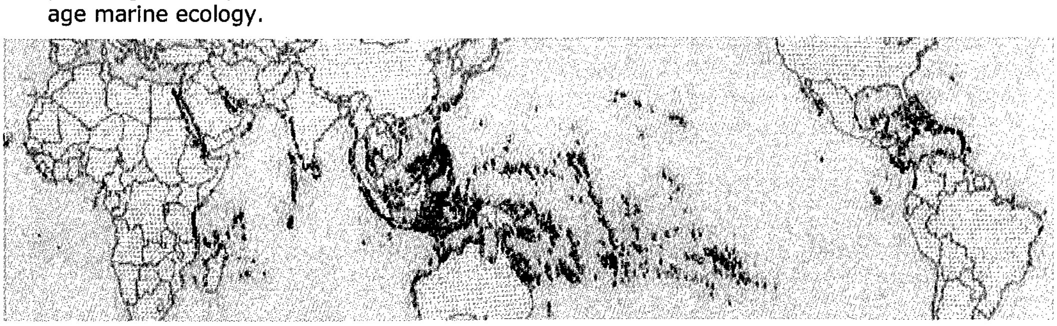


Figure 2: Potential risk to coral reefs from human threats — low risk (blue), medium risk (yellow) and high risk (red) (Source: IPCC, 2007: 699)

THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

References

Intergovernmental Panel on Climate Change (2007) *Fourth Assessment Report*, Cambridge University Press, Cambridge, UK.

Stern, N. (2006) *Stern Review on the Economics of Climate Change*, UK Government, London.

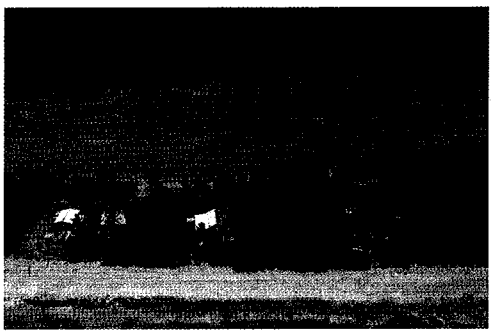
DISASTERS AND CLIMATE CHANGE

PACE-SD Factsheet Series: No 3

The impacts of climate change

Hazards (and subsequent disasters) are heavily influenced by climatic factors, and as such **climate change** will likely **worsen these events**. Climate change will add further stress by:

- Increasing the number and scale of natural hazards; and
- Increasing the vulnerability of communities through ecosystem changes, reductions in water and food security, and changes to livelihoods.



View of a small coastal village in Funafuti Atoll, Tuvalu (Source: Karen McNamara)

Moreover, Pacific countries contain small, highly dispersed land areas and populations — with many low-lying atolls and many people who **live by the sea**. For example, in Fiji, half the population lives within 60 kilometres of the shore and 90% of villages are on the coast. Increased coastal erosion from climate change and sea level rise will be a key concern for both disaster risk reduction and climate change adaptation.

In the Pacific, community participation is a core traditional strength. This involvement can act as a framework for disaster risk reduction and management.

Socio-economic implications of disasters

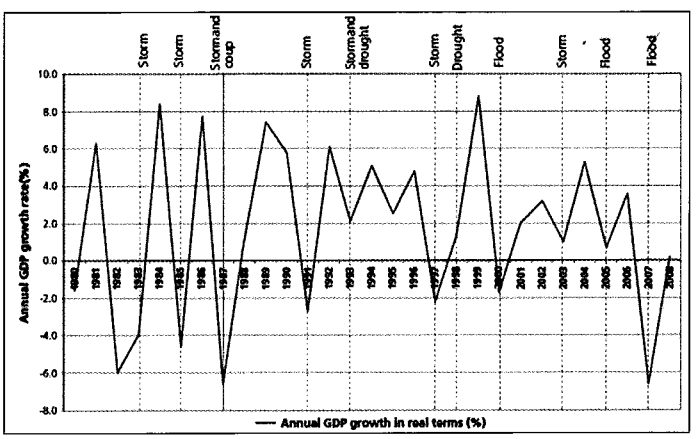


Figure 2: Annual fluctuations in GDP relative to a natural hazard event, Fiji, 1980-2008 (Source: ESCAP/ISDR, 2010: 27)

Disasters often have a severe and lasting impact on **economic and human development**. In small economies, the movements of gross domestic product (GDP) can closely track patterns of hazard events. As Figure 2 shows, GDP movement is related to the occurrence of natural hazard events such as storms, droughts and floods. These events can represent devastating setbacks — destroying significant transport, power and communication networks, along with productive and social infrastructure.

Pacific countries have small economies and very low national savings, and thus have less capacity to absorb impacts and recover and as such have a **very high economic vulnerability to disasters**. For Pacific countries, disasters can have a disproportionately high impact on their economies. For example, Samoa has reported average economic disaster costs of 46% of their annual GDP (World Bank, 2006). In 2004, Cyclone Heta caused immediate losses for Niue amounting to over five times that of their GDP (SOPAC, 2008). In addition, there are many indirect costs through loss of infrastructure that reduces access to markets or educational opportunities.

What can we do in our community to prepare?

- Enhance public awareness and education, such as teaching children to run uphill or to an elevated structure when the sea retreats.
- Ensure that vulnerable areas have clearly marked escape routes.
- Map the hazardous areas in your area to know which are most prone to erosion and inundation.
- Set houses back from high water levels.
- Maintain natural wave breakers by protecting coral reefs, mangroves and sand banks.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

References
ESCAP/ISDR (2010) *Protecting Development Gains: Reducing Disaster Vulnerability and Building Resilience in Asia and the Pacific*, ESCAP/ISDR, Bangkok.
Gero, A., Meheux, K. and Dominey-Howes, D. (2010) *Disaster Risk Reduction and Climate Change Adaptation in the Pacific: The Challenge of Integration*, UNSW, Sydney.
SOPAC (2008) *Disaster Risk Management in the Pacific: Economic Analysis and Advocacy*, SOPAC Secretariat, Fiji.
World Bank (2006) *Not If But When: Adapting to Natural Hazards in the Pacific Islands Region: A Policy Note*, World Bank, East Asia and the Pacific.

DISASTERS AND CLIMATE CHANGE

PACE-SD Factsheet Series: No 3

Whether disasters are single large scale events or small scale ongoing crises, they cause immediate economic damage, have a significant impact on human development, and can cause loss of life.

Disasters worldwide

A disaster is when a natural hazard impacts on an ill-prepared or vulnerable community, resulting in damage, disruption and casualties. These can include hydrometeorlogical disasters such as droughts, floods, storms, extreme temperatures and wildfires, as well as geological disasters such as landslides, volcanoes, earthquakes and tsunamis. Worldwide, disasters have increased: between 1980-1989 and 1999-2009, the number of disaster events rose from 1,690 to 3,886.

What is our risk to disaster?
Disaster Risk = Hazard x Exposure x Vulnerability
Hazard: The type and intensity of an event
Exposure: The number of people and the scale of assets exposed to an event
Vulnerability: The capacity to cope with and recover from an event

Disasters in the Pacific

The Pacific region experiences some of the **world's worst natural hazards**, such as earthquakes, volcanic eruptions, cyclones, floods, tsunamis, landslides and annual monsoons. It is the combination of an exposed, vulnerable and ill-prepared community with a hazard event that results in a disaster. Since the 1950s, **disasters** in the Pacific have directly affected more than **3.4 million people** and led to more than **1,700 reported deaths** in the region (excluding Papua New Guinea). In the 1990s, reported disasters cost the Pacific Islands region **$2.8 billion** in 2004 terms (World Bank, 2006).

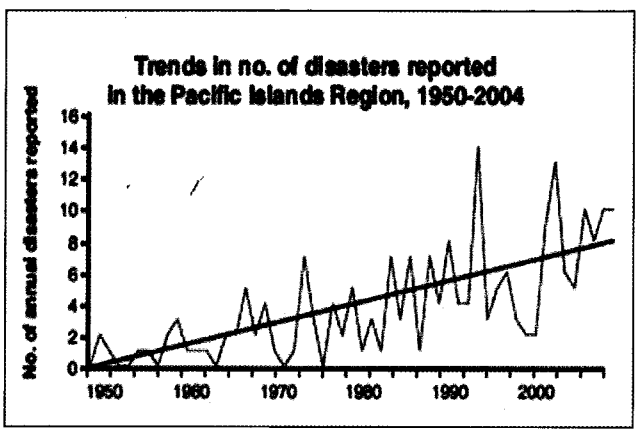
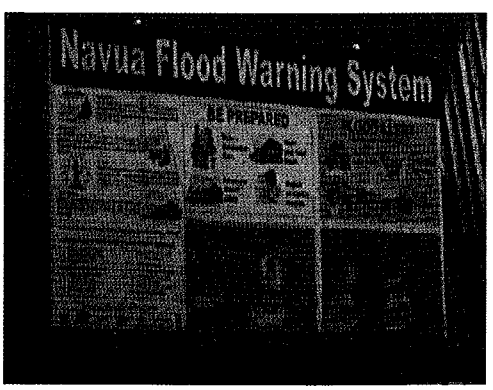


Figure 1: Trends in reported disasters in the Pacific Islands region (Source: World Bank, 2006: 4)

Disasters are becoming more intense and frequent (see Figure 1). Since the 1950s, ten of the 15 most extreme events have occurred in the last 20 years. For example, cyclones with winds stronger that 117km/hr have increased in the south-west Pacific, and they are projected to increase in intensity by about 5-20%. **Cyclones are the most common disaster** in the Pacific — accounting for 76% of all reported disasters from 1950-2004 — followed by earthquakes, droughts and floods. Droughts have affected the highest number of people (per event) and tsunamis have caused the highest number of fatalities (per event). During 1950-2004, Fiji (with 38) and Vanuatu (with 37) reported the highest number of disasters (World Bank, 2006).



Early warning system for flooding, Navua, Fiji (Source: Gero et al, 2010: 27)

Disaster risk reduction

Internationally, focus has been geared towards **disaster risk reduction**, in recognition that disasters can compromise development efforts and progress. A number of countries have signed the Hyogo Framework for Action (2005-2015), which is a common global agenda for reducing the risk of disasters.

Disaster risk reduction programs are occurring in a number of communities across the Pacific. For instance, the use of a 'local level risk management' tool to **address risk from severe flooding** in Navua (Fiji), following flooding events in 2003 and 2004.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/

VULNERABILITY OF PACIFIC ISLAND COUNTRIES TO CLIMATE CHANGE

PACE-SD Factsheet Series: No 4

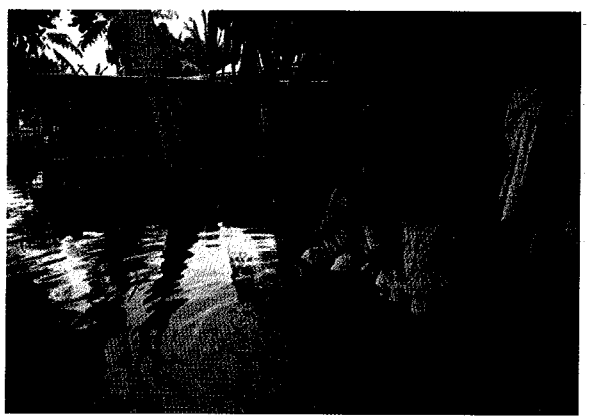
Climate change will affect the Pacific region through changed rainfall patterns, more frequent extreme events, sea level rise, acidification of oceans, coastal land inundation, and losses to ecosystems and biodiversity.

How will climate change affect us in the Pacific?

Sea level rise is caused by three main factors — the melting of ice and glaciers, the thermal expansion of warming ocean water, and the addition of water from land surface runoff. As this continues to occur, sea level rise is expected to intensify **inundation, storm surges and erosion** – thus threatening vital infrastructure and settlements that support livelihoods.

Climate change increases the **frequency and intensity of natural hazards** such as cyclones, flooding and drought. When this happens, people's lives and livelihoods are at great risk. Significant money and time is needed to re-build homes, farms and livelihoods. Worse still, lives can be lost.

When it gets **too dry and hot**, there is a greater number of cases of respiratory problems, concern for heat stroke, and mosquito-borne diseases. There is also drought, which affects peoples' farm production and as a result their livelihood. On the other hand, when there is **a lot of rainfall**, it causes flooding. When flooding occurs, children are at greater risk of scabies, diarrhoea and other water-related diseases.



Tidal flooding on Funafuti Atoll, Tuvalu, February 2005 (Source: Gary Braasch)

Vulnerability assessments for the Pacific

A number of Pacific countries have submitted their National Communications to the UN Framework Convention on Climate Change. Contained within these are sections on climate change impacts, vulnerability and adaptation.

Fiji's National Communication for instance examined the vulnerability of coastal resources and ecosystems, water resources, health and agriculture to climate change. In relation to agriculture, it was identified that Fiji's sugarcane production presented a high vulnerability (and hence economic difficulties for a large sector of the population) to climate change, yet taro and yam production was less vulnerable. Fiji's National Communication determined that climate extremes would intensify and hence water resources are considerably vulnerable due to the higher risk of droughts and floods.

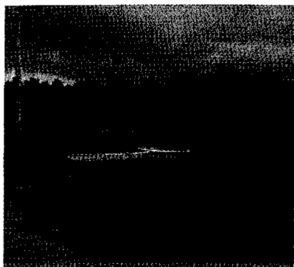
Important for maintaining food security: Transplanting seedlings at the Taiwan garden, Tuvalu (Source: Gary Braasch)

References
CARE (2010) *Community-Based Adaptation Toolkit*, CARE, USA.
Intergovernmental Panel on Climate Change (2001) *Third Assessment Report*, Cambridge University Press, Cambridge, UK.
Schroter, D. and the ATEAM consortium (2004) *Global Change Vulnerability – Assessing the European Human-environment System*, Potsdam Institute for Climate Impact Research, Germany.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID



VULNERABILITY OF PACIFIC ISLAND COUNTRIES TO CLIMATE CHANGE

([illegible] Karen McNamara)

Vulnerability is the level at which an ecological or human system is unable to cope with the adverse impacts of climate change.

Pacific Island countries are most vulnerable to climate change impacts across the globe.

PACE-SD Factsheet Series: No 4

What is vulnerability to climate change?

We all grow up becoming familiar with our surroundings and as such learn how to adapt to certain environmental conditions and cope with substantial climate variability. However, there can be limits to our ability to cope with these changes.

According to the IPCC (2001), **vulnerability** is:

"The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity".

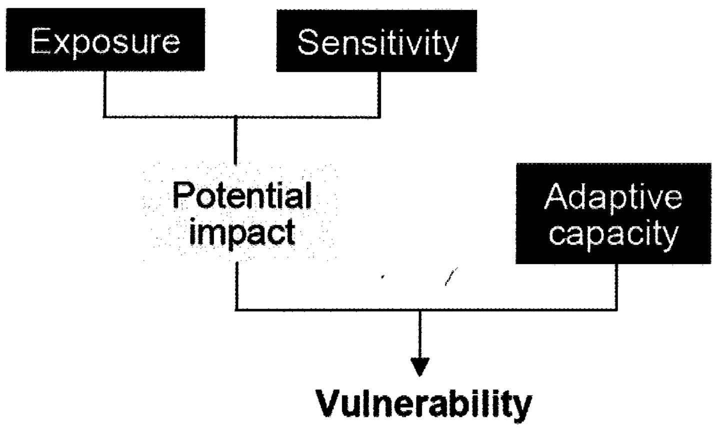


Figure 1: Framework for understanding vulnerability
(Adapted from: Schroter and the ATEAM consortium, 2004)

In referring to Figure 1:

Exposure to climate variability is a function of location and geography. Coastal communities for example will have a higher exposure to sea level rise and cyclones, while semi-arid communities will be more heavily exposed to droughts.

Sensitivity is the level at which a community (or ecosystem) is affected by climate stresses and change. For instance, communities dependent on rain-fed agriculture will be more sensitive to changing rainfall patterns, or an arid or semi-arid ecosystem will be more sensitive to a decrease in rainfall.

Adaptive capacity is the ability of a natural or human system to adjust to climate change, including variability and extremes. This adaptive capacity is shaped by peoples' access to and control over natural, human, social, physical and financial resources (see Table 1).

Table 1: Resources that can influence peoples' adaptive capacity
(Adapted from: CARE, 2010)

Natural	Reliable water sources (quality and quantity), productive land, favourable geomorphology, vegetation and trees, and biodiversity
Social	Social networks (religion, women's networks and landholder based organisations), access to information, education, and decision making structures
Human	Skills and knowledge (formal, traditional, wisdom), and good health to enable labour
Physical	Energy, water and communication infrastructure [illegible]
Financial	Diversified income sources, access to credit and [illegible]

THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/

ADAPTATION OF PACIFIC ISLAND COUNTRIES TO CLIMATE CHANGE

PACE-SD Factsheet Series: No 5

Adaptation to climate change

As a result of a large increase in GHGs, we are beginning to witness the world grappling with the climate change problem. There are two key ways of dealing with this:

1. Mitigation — reducing emissions due to human activity; and
2. Adaptation — adjusting behaviours so that people can cope with the changing conditions.

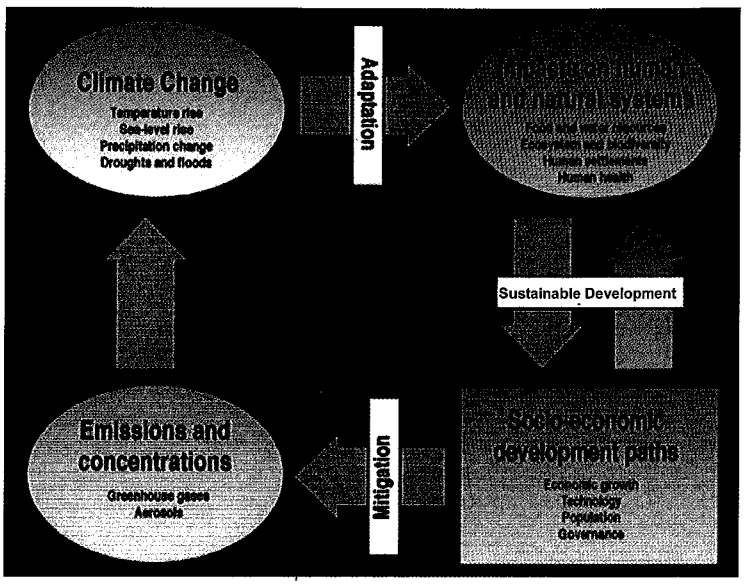


Figure 1: An integrated framework on climate change, illustrating mitigation, adaptation and sustainable development pathways as the key areas in our decision to respond to the impacts of climate change (Source: IPCC, 2001)

While both types of responses are crucial and complementary, climate change is already occurring and will continue to occur— already due to the amount of GHGs in the atmosphere. The strongest mitigation efforts can not avoid the impacts of climate change in the decades to come. As such, it is therefore necessary to adapt to the impacts which are already 'locked in' (see Figure 1).

According to the IPCC (2007), **adaptation** is:

> *"The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities".*

Adaptation consists of *actions or activities* to reduce the adverse impacts of climate change, including the impacts of climate stresses on both human and natural systems.

The impacts of climate change on Laucala Island, next to the mouth of the Rewa River in Fiji, where sea level has risen and reclaimed more than 20 feet of land (Source: Nichole Tavo)

Types of adaptation

There a number of different approaches to adapt to climate change, however it is important to consider the following four points prior to undertaking any projects:

- *Type* — Proactive adaptation is undertaken in anticipation of an event, and reactive adaptation is if it is done in response.
- *Timing and Location* — Short-term or long-term, localised or widespread.
- *Purpose* — Done autonomously or planned as a result of a policy decision.
- *Agents* — Public or private, government, industry, business or individual.

Adaptation is now recognised as a vital component of the global response to climate change.

THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/

ADAPTATION OF PACIFIC ISLAND COUNTRIES TO CLIMATE CHANGE

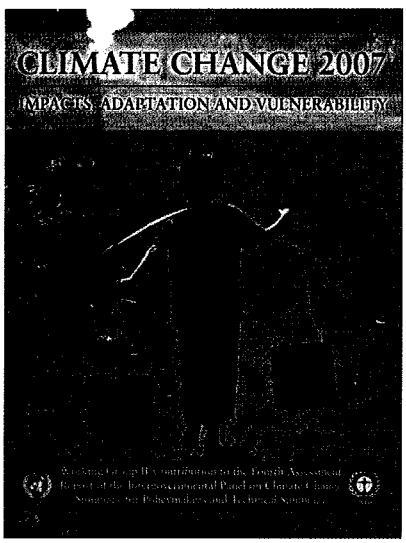
Effective community-based adaptation seeks to sustain the ecosystems that people depend on for their livelihoods and build on the resilience of people to face new challenges.

Examples of adaptation measures

There is a need to enhance the adaptive capacity of communities to the current climate — not only in the Pacific, but across the globe. Moreover, we need to build our individual capacity to respond and adapt to the impacts of climate change.

Some examples of adaptation actions or activities:

- ◊ Establish early warning systems;
- ◊ Improve risk management;
- ◊ Generate awareness activities (on climate change, extreme weather events);
- ◊ Enhance water use efficiency;
- ◊ Increase rainwater harvesting;
- ◊ Build new water reservoirs;
- ◊ Grow resilient staple crops (yam and taro, compared with cassava);
- ◊ Create more garden plots for food security;
- ◊ Plant crops in dug-out canoes or similar;
- ◊ Diversify crops grown;
- ◊ Vary farming practices and crop use;
- ◊ Build houses on stilts;
- ◊ Plant and maintain mangroves and native vegetation;
- ◊ Use forest food resources; and
- ◊ Construct and maintain sea walls (including traditional sea walls).



Adaptation and building resilience

Adaptation is an adjustment in a natural or human system in response to actual or projected climate change impacts. Adaptation is a process that involves **building adaptive capacity**, and **reducing exposure or sensitivity** to climate stresses and change.

Reducing vulnerability is the foundation of adaptation. It is important that we collect and analyse information on exposure and sensitivity to climate stresses, projected climate impacts and adaptive capacity to better understand **who is vulnerable and why**. From this, appropriate adaptation actions or activities can be designed and implemented.

Tuvalu youth face the impacts of King Tide events at their home in Tuvalu (Source: Gary Braasch)

A **resilient community** is one that is well-placed to manage climate stresses, change and hazards — to minimise the effects of such and recover quickly from any negative impacts.

References
Intergovernmental Panel on Climate Change (2001) *Third Assessment Report*, Cambridge University Press, Cambridge, UK.
Intergovernmental Panel on Climate Change (2007) *Fourth Assessment Report*, Cambridge University Press, Cambridge, UK.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

WATER AND CLIMATE CHANGE

PACE-SD Factsheet Series: No 6

Many Pacific countries are likely to be exacerbated due to climate change.

All Pacific Island countries rely on rainfall and have underdeveloped water infrastructure, are at risk from saltwater intrusion and face rising water demands.

The importance of water

Access to good drinking water (quality and quantity) is paramount to the basic necessity of any community. It is essential in our lives; a vital component of our bodies' daily needs.

There is strong evidence that fresh **water resources** are likely to be seriously **compromised** as a result of the impacts of climate change.

- ***Only 2.5% of the world's water resources are freshwater.***
- ***Almost 70% of this available freshwater is frozen in icecaps.***
- ***Only 30% is available for consumption (only 0.7% of the total worldwide resource).***
- ***Of this 0.7%, 87% is used for agricultural purposes.***

Impacts of climate change on water

Global temperature increases have contributed to **changes in the water cycle**, such as increasing atmospheric water vapour content, changing rainfall patterns, reduced snow and ice cover, and changes in soil moisture and runoff.

Many climate models suggest that **heavy rainfall events** will in general become more **intense**, increasing runoff and floods, reducing the ability of water to infiltrate the soil and as such impact the regional distribution of surface and groundwater supplies (see Figure 1).

By the middle of the 21st century, **water availability** is projected to **increase** as a result of climate change at **high latitudes** and in some **wet tropical areas**, and **decrease** over some dry regions at **mid-latitudes** and in the **dry tropics**.

Many small islands have limited freshwater sources — and these are especially **vulnerable to future changes** and the **seasonal distribution** of rainfall.

Water scarcity may force people to use **poorer quality sources of freshwater**, such as rivers, which are often contaminated. Settlements that are already water deficient can be expected to face even higher demands for water as the climate warms.

Rising sea levels is an immediate threat to those who live directly along the coastline, in low-lying areas such as river deltas or islands where land is only a few metres above sea level. Rising sea levels will **exacerbate storm damage** and **contaminate freshwater aquifers**. Rainfall is vital to **recharge the freshwater lens** that lies beneath coral atolls, for instance in Kiribati, without which people would not be able to grow plants and crops to sustain their livelihood. A 50cm sea level rise and 25% reduction in average rainfall could lead to a 65% reduction in the size of the freshwater lens on Tarawa Atoll, Kiribati.

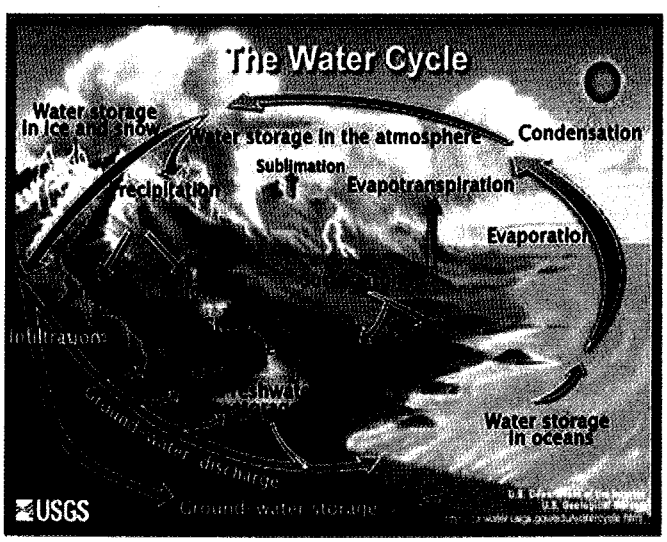


Figure 1: The movement of water through the land, oceans and atmosphere (Source: US Geological Survey)

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/

WATER AND CLIMATE CHANGE

PACE-SD Factsheet Series: No 6

Changing weather patterns can affect both the quantity and quality of water resources for drinking, fish farming, power generation, shipping and recreation.

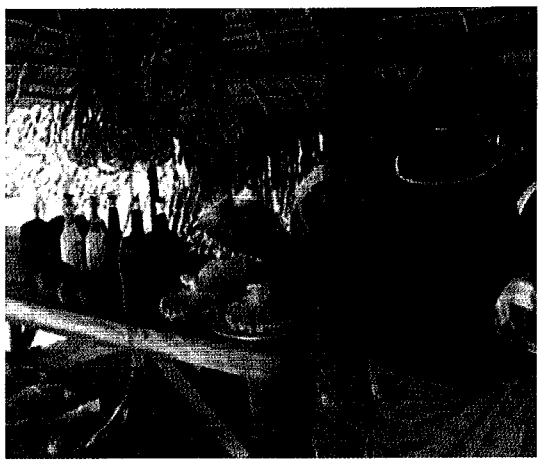
While freshwater resources become more degraded, weather extremes and sea level rise bring more frequent floods in some regions and droughts in others.

Climate change impacts on water quantity

The hydrological cycle is the movement of water between the land surface, oceans and the atmosphere (see Figure 1).

This cyclical movement of water is driven by solar energy and hence an increase in net solar radiation (or temperature) will speed up the processes within this cycle, such as evaporation, condensation and precipitation.

However, this increase in energy in the hydrological cycle will not result in an increase in precipitation in all regions. It is very likely that there will be more rainfall at the tropics and higher latitudes, while decreases are likely in the sub-tropics. Pacific countries are located in both areas, and thus **the region is very susceptible to varying rates of rainfall distribution**.



Selling crops and produce is a vital way for people to sustain their livelihoods in Pacific countries (Source: Carlo Iacovino)

Climate change impacts on water quality

Increased water temperatures and changes in the timing, intensity and duration of precipitation episodes can affect water quality.

Higher temperatures **reduce dissolved oxygen levels**, which can affect aquatic life. Increased intensity of rainfall will produce **more pollution and sedimentation** due to runoff. Flooding and large volumes of water can affect water quality by transporting **contaminants** into water bodies, and overload storm water and waste water systems.

Sea level rise may also affect water quality through the movement of **saline water into fresh groundwater resources and freshwater lenses**.

Water resources compromised: Kabara village, Fiji

Kabara village, located on a small island in Fiji is experiencing stronger storms, drought and rising sea levels — making it very difficult for people to sustain their livelihoods (WWF, 2004).

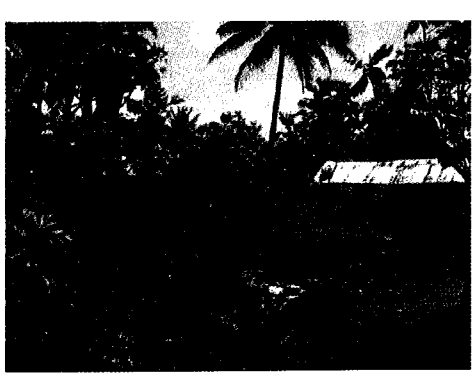


Image of Kabara village, Fiji (Source: Francis Areki)

Situated in a dry belt in the Lau Group of Islands in Fiji, droughts are becoming increasingly common in Kabara. There are no sources of surface water and no rivers or streams. The local community are reliant on rainfall to provide all their water needs, and this water is captured in either shared household or community tanks. If used wisely, these tanks of 5,000 litres can last for more than three months. However, during the dry, winter months, this becomes a very difficult challenge. With changing rainfall patterns projected as a result of climate change, and based on Kabara's location, longer drier periods may become a reality.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

Reference
WWF (2004) *Climate Witness*, WWF, Suva, Fiji.

HUMAN HEALTH AND CLIMATE CHANGE

PACE-SD Factsheet Series: No 7

The impacts of climate change on human health

As **basic human requirements**, we depend on safe drinking water, sufficient food, secure shelter and good social conditions. Unfortunately, climate change is set to affect all of the above requirements in some way. The health impacts of climate variability and change are likely to be overwhelmingly negative, particularly in the poorest communities. This applies to us here in the Pacific as well.

Rising temperatures and humidity are likely to impact health in the following various ways:

- Contribute to physiological heat stress;
- Increase the incidence of heat rashes, heat exhaustion and heat stroke;
- Escalate the number of respiratory problems including asthma;
- Increase the rates of diseases such as bacterial diarrhoea;
- Increase the number of mosquito-borne diseases such as malaria; and
- Decrease the production of staple foods in many of our farming communities therefore increasing the risk of malnutrition.

More variable rainfall patterns are likely to impact on health by increasing the:

- Risk of injury due to more rain in the monsoon season or flash flooding;
- Spread of infectious enteric diseases that cause diarrhoea in young children; and
- Risks of water-borne diseases.

Rising sea levels are likely to impact on health in the following ways:

- Increase the risk of coastal flooding;
- Necessitate population displacements amongst low-lying island communities and hence potentially cause psychological distress;
- Threaten vital infrastructure and settlements; and
- Increase the frequency of inundation incidents.

Extreme weather can cause potentially fatal illnesses (see Figure 1) and also impact on health in the following ways:

- Heat waves will substantially increase the risk of heat rashes, heat exhaustion and even heat stroke, which can lead to death—those with poor cardiovascular health and low physical fitness, along with the elderly, are at highest risk;
- Extreme weather and higher temperatures will increase respiratory problems and asthma;
- In cities, stagnant weather conditions can trap both warm air and gaseous pollutants, leading to smog episodes with major health impacts, most notably respiratory diseases; and
- There will be a higher incidence of water-borne diseases, such as diarrhoea, typhoid and cholera.

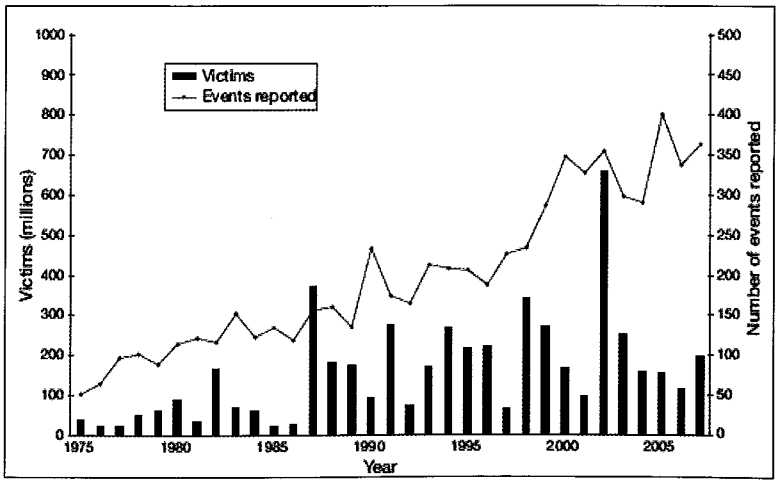


Figure 1: Number of weather-related disasters and victims during 1975-2007, reported to the International Disaster Database (Source: WHO, 2009)

Given these many linkages, the changes in the Earth's climate present many serious challenges for protecting public health.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/

HUMAN HEALTH AND CLIMATE CHANGE

PACE-SD Factsheet Series: No 7

Human health concerns in relation to climate change in the Pacific

Alongside the impacts associated with higher temperatures, climate change will increase people's risk to suffering from allergies and infectious diseases, and illness and injury from floods, storms, droughts and cyclones.

Pacific countries are in the front line. People are at risk from severe tropical storms, and salinisation of water resources and agricultural land from sea level rise.

1. Over the last 60 years, **human activities have affected the global climate** through the release of carbon dioxide and other greenhouse gases into the atmosphere. The resulting changes in the global climate bring a range of risks to health, from deaths in extreme high temperatures to changing patterns of infectious diseases.

2. **Weather extremes**, such as heavy rains, floods and disasters, endanger health as well as destroy property and livelihoods. Approximately **600,000 deaths** occurred worldwide as a result of weather-related natural disasters in the 1990s, some 95% of which took place in developing countries.

The damaging wind force of a tropical cyclone (Source: Lyndon Mechielsen)

3. Intense **short-term fluctuations in temperature** can seriously affect health by causing **heat stress** (hyperthermia) or **extreme cold** (hypothermia), and lead to increased death rates from heart and respiratory diseases.

4. **Pollen and other aeroallergen levels** are also higher in extreme heat. These can trigger respiratory problems and **asthma**, which affects around 300 million people. Rising average temperature is expected to increase this burden.

5. **Rising sea levels** are another outcome of climate change and increase the risk of coastal flooding, and damage to settlements and infrastructure on the coastal fringe. Floods can directly cause **injury and death**, and increase the risks of **infection from water and vector-borne diseases**. Possible relocation of communities could cause psychological effects, **mental distress**, and increase tensions and potentially the risks of **conflict**.

Young locals carrying water and food in Timor Leste (Source: Marcus Bleasdale)

6. More **variable rainfall patterns** are likely to compromise the supply of fresh water. **Lack of water and poor water quality** can compromise hygiene and health. Water scarcity (which affects four out of every 10 people) forces people to transport water long distances and store supplies in their homes, increasing the risk of **household water contamination**. This leaves people susceptible to the risk of **diarrhoea**, which kills approximately 2.2 million people every year, as well as **trachoma** (an eye infection that can lead to blindness) and other illnesses.

7. Climatic conditions (**temperature, humidity and rainfall**) influence the ability of diseases to be transmitted through water and vectors such as mosquitoes. **Climate-sensitive diseases** are among the largest global killers, such as diarrhoea and malaria.

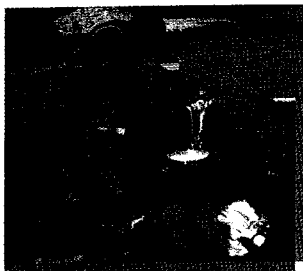
8. Malnutrition causes millions of deaths each year, from a lack of sufficient nutrients to sustain life and a resulting vulnerability to infectious diseases. **Increasing global temperature** and more **variable rainfall** is expected to **reduce crop yields** in many tropical developing regions, where food security is already a challenge.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

Reference
World Health Organization (2009) *Protecting Health from Climate Change: Connecting Science, Policy and People*, WHO, Geneva.



CLIMATE CHANGE AND ROOT CROPS IN THE PACIFIC

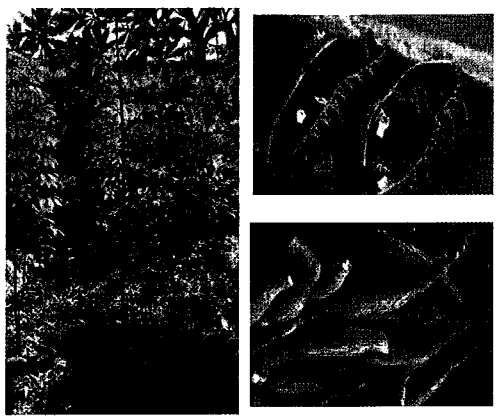
PACE-SD Factsheet Series: No 8

Both historically and at present, root crops are an essential component of Pacific Islanders' diets. Most of these crops are grown for subsistence in local gardens for household consumption and sale at market

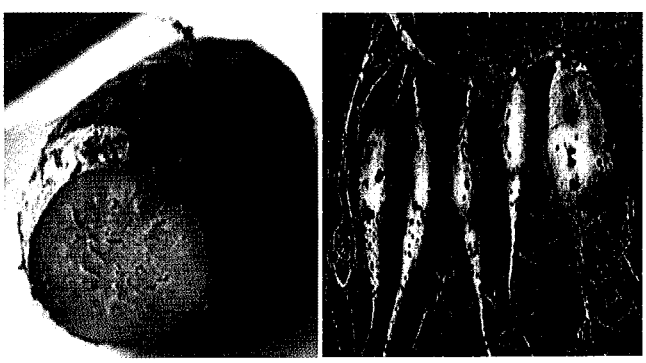
Importance of root crops to Pacific Island countries

Throughout the tropical and subtropical regions of the world, root crops are a staple food source for over 400 million people. For Pacific communities, particularly for rural dwellers, root crops are critically important for peoples' diets and nutrition. These crops include taro, giant swamp taro, giant taro, tannia, cassava, sweet potato and yam.

For instance, in Tonga and the Solomon Islands, tubers (such as taro) present 40-50% of the total energy intake of people. Moreover, the yellow and orange varieties of the sweet potato contain a high amount of vitamins A and C, and yams provide significant quantities of vitamin B1, C and iron. Some of the leaves of these root crops are also edible, for example, taro leaves provide a good source of protein, dietary fibre and a host of vitamins.



Images of a young cassava plant, and cassava



Images of a taro and sweet potatoes

Pacific root crops are largely for domestic consumption; both in households and for sale at market. However, some international trade does occur with Australia and New Zealand (and to a lesser extent, USA) and there is good scope for this to be expanded. Of particular interest though is the potential to establish an intra-regional trade of root crops between Pacific countries – to secure regional food security and create diverse livelihood options (FAO, 2010).

Generations of traditional knowledge have provided detailed information on cropping and harvesting times, in relation to seasonal variations of rainfall, temperature, winds and pollination. However, the projected rates of climate change and associated impacts in the Pacific could severely impact on this knowledge and subsequently, the security of this valuable food source.

Image of a giant swamp taro

THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/

CLIMATE CHANGE AND ROOT CROPS IN THE PACIFIC

PACE-SD Factsheet Series: No 8

Projected impacts of climate change on root crops

Projected climate change presents a number of challenges for Pacific Island countries (see Table 1). These impacts and hence challenges include: crop damage and even failure; infrastructure damage; soil erosion; soil nutrient depletion; saltwater inundation of land and crops; soil salinisation; increase in new diseases and pests; and increase in drought and flooding. Pacific Island countries are particularly vulnerable to these impacts of climate change given their heavy reliance on ecosystem services such as soil fertility, insect pollination, and rainfall to maintain soil moisture levels.

Enhanced inter-annual and intra-seasonal climate variability is also a concern for Pacific Island countries. These variabilities could see an increased frequency and intensity of extreme weather, such as heavy rainfall episodes, prolonged droughts and flooding events.

Table 1: Impacts of climate change on the production of crops and soil resources in the Pacific (Source: FAO, 2010: 22)

Possible intensified cyclones and storm surges	→	Soil erosion and nutrient depletion, crop and infrastructural damage
Rising sea levels and increasing salt spray	→	Seawater inundation of land and soil salinization
Rapidly changing environmental parameters and ecosystems	→	Proliferation of new and existing invasive pests and diseases
Changing rainfall patterns	→	Increased incidences of drought and/or flooding

What can we do to minimise the impacts of climate change

Using drought and salt tolerant crop varieties, along with crop diversification could reduce the risks of crop failure. The following three steps, outlined by FAO (2010), provide a basic guide to building resilient farmers and agricultural systems in Pacific Island countries.

Yam and taro leaves (Source: Karen McNamara)

I. Grow multiple crops and diversify crop mixes to include drought, salt and water resistant varieties. This helps in maintaining food security during the dry season, prolonged droughts and heavy rainfall episodes. Such an adaptation initiative, providing diverse varieties, also protects farmers when the market is in surplus and hence the demand drops.

II. Build awareness amongst stakeholders, particularly farmers, of the impacts of climate change on root crops and agriculture more generally. Those people most affected by these changes and variability need to be aware of steps they can take to maintain their livelihood.

Pumpkin crop, Soso village, Fiji (Source: Karen McNamara)

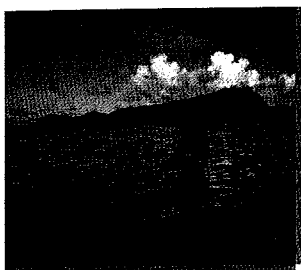
III. Monitor and evaluate agricultural cropping systems to assess the success of any implemented adaptation initiatives. This is especially important so that farmers can learn what did and did not work, and then share this information with others.

THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

Reference
Food and Agriculture Organization (2010) *Pacific Food Security Toolkit. Building Resilience to Climate Change: Root Crop and Fishery Production,* FAO, Rome.



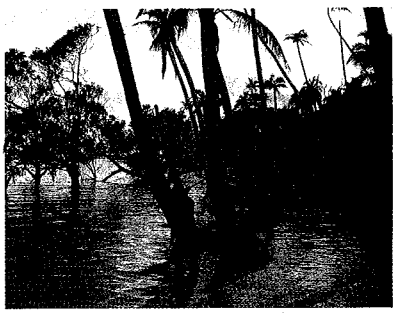
FISHERIES AND CLIMATE CHANGE

PACE-SD Factsheet Series: No 9

The fisheries industry

From 1950 to 1988, the world fish catch climbed from 19 million to 89 million tons. However, since the late 1980s it has fluctuated between 85 million and 95 million tons. A startling 90% of the world's large predatory fish, including tuna, have disappeared in the past 50 years.

Some 75% of oceanic fisheries are being fished today at or beyond their sustainable yields. Preservation of nursery habitats like coral reefs, kelp forests, and coastal wetlands is integral to keeping fish in the sea for generations to come.



Spear fishing in Vanuatu (Source: Taito Nakalevu)

Ocean warming and acidification, changes to rainfall patterns and an increasing frequency of cyclones are all projected to have a negative impact on the food sector.

Threats due to climate change

Projected sea level rise and warming sea surface temperature will likely cause a decline in the productivity of fisheries in some areas of the Tropical Pacific. For instance, a key impact of climate change will be a loss of coral reefs and mangrove forests, which many fish depend on. Figure 1 presents some of the key impacts of climate change on fisheries and aquaculture.

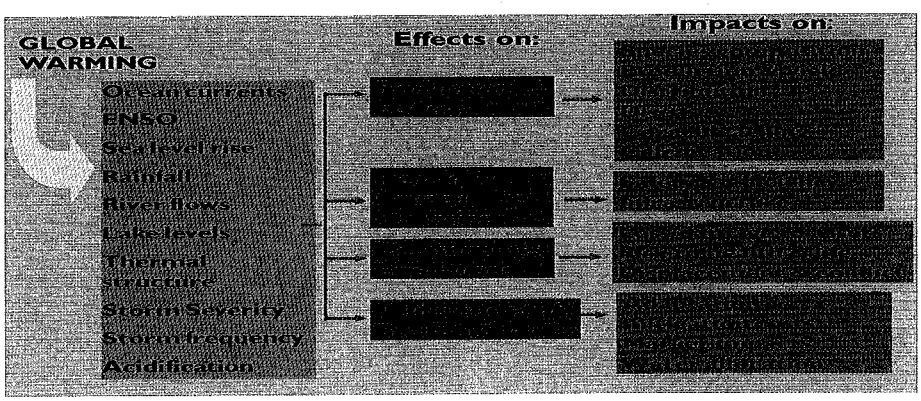


Figure 1: Impacts of climate change on fisheries, including aquaculture

Figure 2 highlights the projected changes in fisheries catch potential by 2055 under a 'business as usual' climate change scenario. It shows that high latitude regions are projected to gain in catch potential while regions in the tropics, including the western Pacific ocean, may suffer from losses.

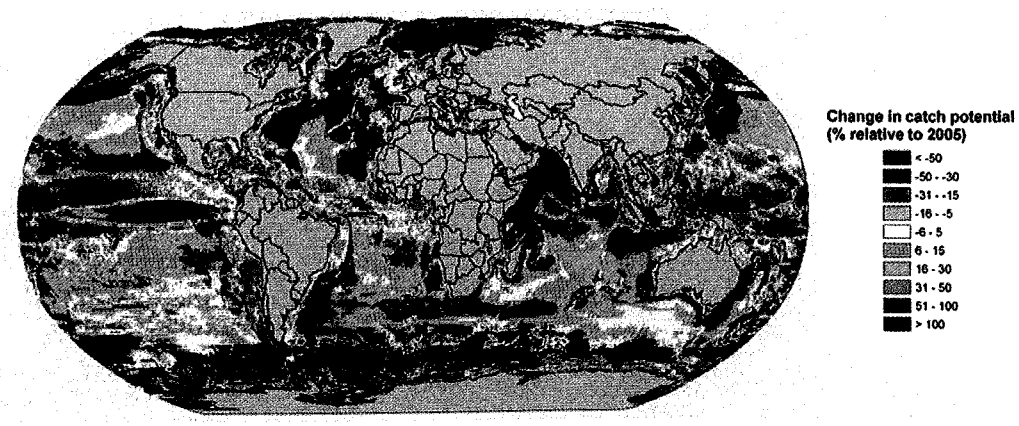
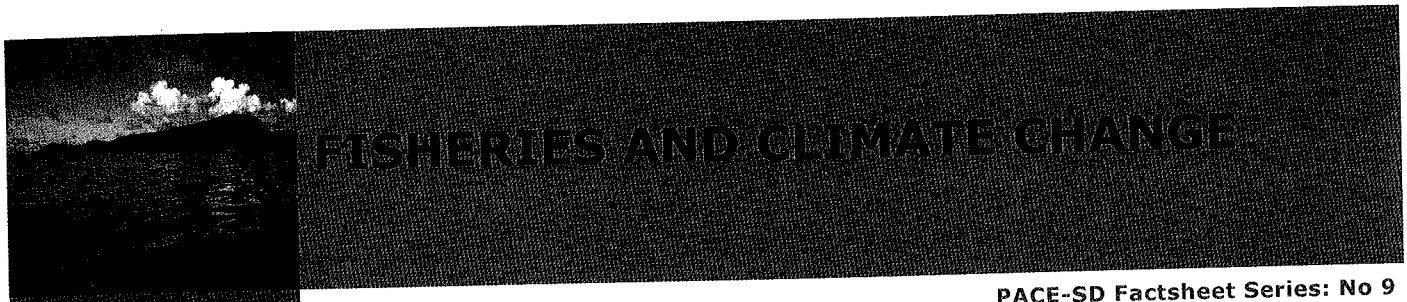


Figure 2: Projected change in fisheries catch potential by 2055, using a 'business as usual' scenario (Source: Cheung et al, 2010)

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/



FISHERIES AND CLIMATE CHANGE

PACE-SD Factsheet Series: No 9

Fisheries: their importance & on-going changes in the Pacific

Fisheries (including aquaculture) is an important and crucial industry in the Pacific for three main reasons: food security; livelihoods; and an economic source for government revenue. Many communities depend on coastal fisheries for their livelihood (see Figure 3). In the Pacific, fish consumption is very high (compared internationally), averaged at 70 kilograms per person per year (FAO, 2008). Moreover, the export of fish accounts for up to 73% of the total exports for some countries.

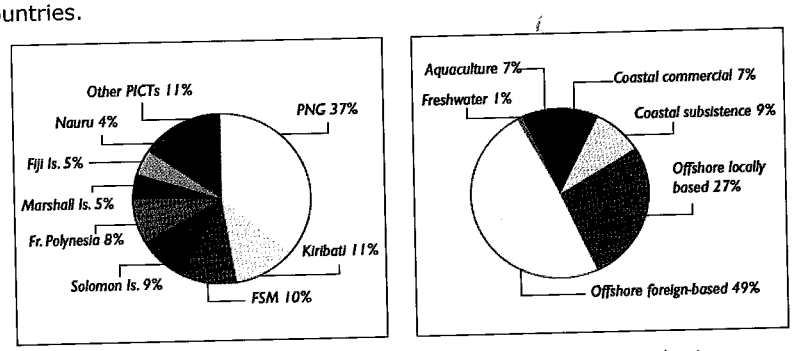


Figure 3: Production from fishers and aquaculture by country and category (Source: Gillett and Cartwright, 2010)

According to FAO (2008), key drivers of change for fisheries in the Pacific region include: climate change and rising sea surface temperature; coastal water pollution due to population growth and urbanisation; governance and political stability; global economic conditions; status of fisheries in other oceans; markets and trade; fuel costs; technology and innovation; and foreign aid. Many of the fisheries in the Pacific face collapse over the next 25 years (Gillett and Cartwright, 2010).

Adaptation options in the fisheries sector

Below are some adaptation options that might be useful in maintaining the fisheries (including aquaculture) industry in the Pacific:

* Identify regional ecosystem and fishery sensitivities and vulnerabilities induced by climate variability and change;
* Systematically develop 'plausible futures' for Pacific Island countries' aquatic resources by region, ecosystem and fishery;
* Move towards ecosystem-based management of fisheries resources by incorporating incremental improvements in the understanding of climate change impacts and adaptation responses into day-to-day management advice;
* Identify and effectively communicate advice to policy makers, fisheries managers, industry stakeholders and local communities regarding the implications of climate change impacts and adaptation research findings for the future;
* Restore and sustain coastal and freshwater fisheries; and
* Potentially develop pond aquaculture.

Selling fish products at markets across the Pacific is very common (Source: Johann Bell)

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

References
Cheung, W.W.L., Lam, V.W.Y., Sarmiento, J.L., Kearney, K., Watson, R., Zeller, D. and Pauly, D. (2010) 'Large-scale Redistribution of Maximum Catch Potential in the Global Ocean under Climate Change', *Global Change Biology*, 16: 24-35.
Food and Agriculture Organization (2008) *Climate Change and Food Security in Pacific Island Countries*, FAO, Rome.
Gillett, R. and Cartwright, I. (2010) *The Future of Pacific Island Fisheries*, Secretariat of the Pacific Community, Noumea, New Caledonia.

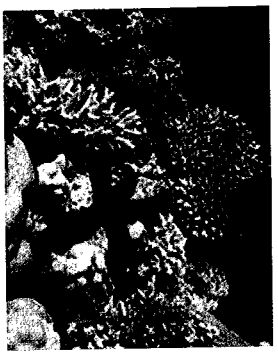
CORAL REEFS AND CLIMATE CHANGE: STRESSES AND FUTURE RESPONSES

PACE-SD Factsheet Series: No 10

Coral reefs have a high level of biodiversity storing many rich genetic resources. Coral reefs are ecologically important ecosystems, a vital source of food and medicine for many people, providing shoreline protection among other ecosystem services.

Importance of coral reefs

Globally, coral reefs are distributed across 101 countries, covering a total area of 284,300 sq km. Coral reefs are particularly vital for the health of people and economic development; supplying direct subsistence for 30-40 million people.



Vibrant coral reef system

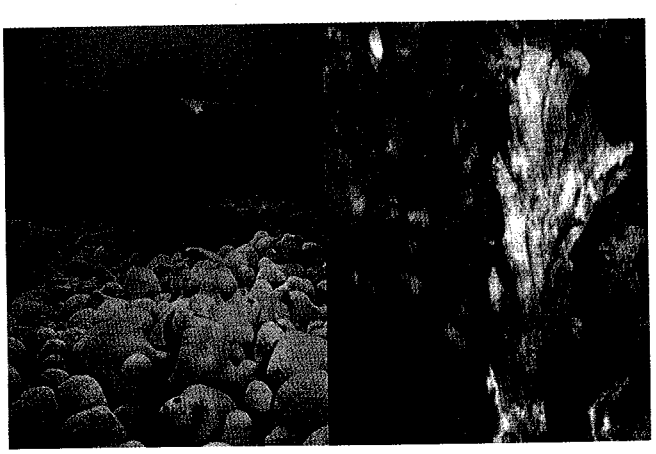
Fishing is also a major industry that benefits from coral reef systems, as does aquaculture and tourism. For instance, 2,500 dive centres are located in 91 countries around that world that take 15 million divers to coral reefs each year. Coral reef systems also provide a series of other benefits, such as coastal protection from cyclones and erosion. In terms of biodiversity, coral reefs are similar to tropical rainforests — holding a vast reservoir of biodiversity.

Stresses on coral reefs

There are a number of negative pressures on coral reefs globally, resulting in their decline. These stresses include:

- Climate variability and change (which increases sea temperatures, ocean acidification, pathogens, frequency of cyclones, and El Niño events such as the 1982-83 and 1997-98 coral bleaching events in some eastern Pacific reefs);
- Agricultural and other pollutant discharges (which produces solid wastes and toxic substances);
- Overfishing (which can use explosives or poisons);
- Uncontrolled tourism (the anchoring and diving equipment can disturb the reef);
- Mining and deforestation in watersheds (as soil erosion and sedimentation can asphyxiate the coral);
- The removal of ocean resources such as coral blocks or sand (as this destabilises the reef system); and
- Mangrove destruction (which limits the provision of nursery areas for a number of reef and lagoon species).

In 2008, coral reefs had lost 20% of their surface area and another 35% was at risk from also being lost. While the Pacific presents as a low-level risk, there remain a number of threats to the sustainability of coral reefs in the region.



Images of poor coral reef systems

Globally, at least 60% of all coral reefs are at risk of destruction – populations of fish and freshwater vertebrates have declined by nearly 50% and 40% of ocean fish stocks are overexploited compared to 20% in 1992. These numbers more than anything else show that governments have failed to live up to the provisions of 1992's Rio Declaration and Agenda 21.

Losses in coral reef systems can have various impacts on other species such as seabirds, turtles, sea grasses and mangrove systems. As a consequence of climate change, the key environmental impacts will include changes to coral cover, reef structure and biodiversity. The ecosystem services that will be impacted on, as a result of the impacts of climate change on coral reef systems, will include declining shoreline protection, tourism, fisheries, recreation amenity and cultural value.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/

PACE-SD Factsheet Series: No 10

Impacts of climate change

Of paramount concern are the impacts of climate change on coral reef systems. These impacts include:

- Projected rising sea surface temperature (which could result in coral bleaching and irreversible damage; see Figure 1);
- Ocean acidification (which affects the ability of reef-building marine organisms to form skeletons, due to higher levels of carbon dioxide in the atmosphere that is now dissolving in the world's oceans);
- Increasing pathogen development and disease transmission, largely due to rising sea surface temperature (which could devastate reefs);
- Increasing atmospheric carbon dioxide (which could alter the calcification process for coral skeletons); and
- More severe cyclone regimes (which could severely damage coral reefs).

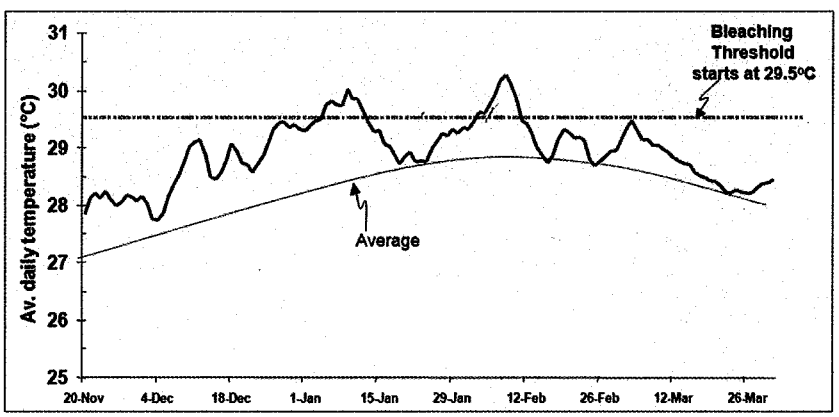


Figure 1: Temperature thresholds for in-situ water temperatures for Agincourt Reef, Great Barrier Reef, Australia in 2002

Adaptation and strategic responses

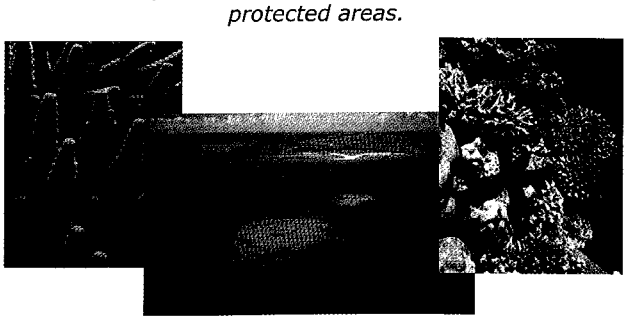
Potential human adaptation and strategic responses for now and into the future to manage and protect coral reefs include the need to:

- Protect biodiversity and connectivity;
- Halt and reverse the impact of pollution, and in particular improve and protect water quality discharges; and
- Prevent over-fishing, for instance through the establishment of marine protected areas.

It is also important to note that the ecological adaptation of corals themselves is important to consider. Historically, coral reef systems have shown that they can cope with changes, thus changing the question from 'can corals adapt' to 'how fast and to what extent can they adapt?'

In the Pacific, what we need to take up as a priority action is EDUCATION.

That is, education about the importance of responsible fishing, sustainable management and protected areas.



...overfishing, the destruction of habitat, destructive practices, and harmful agricultural land-use practices. Given these, new ways of managing and protecting this vital ecosystem is needed.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

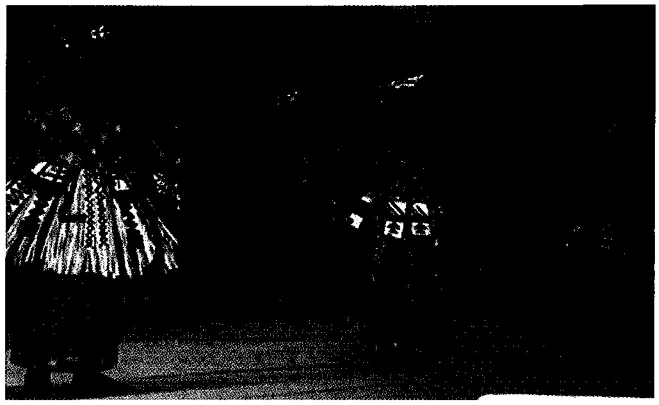
TRADITIONAL KNOWLEDGE IN ADAPTING TO CLIMATE CHANGE

Traditional knowledge represents a unique way of understanding local environments.

This knowledge is important for the world's cultural diversity but also to better understand how to manage our environment.

What is traditional knowledge?

Traditional knowledge is information and beliefs regarding the relationship of living things to one another and their surroundings. Based on a deep understanding of the local environment, it is a way of life and means of survival for many. This knowledge has been passed down from generation to generation through stories, songs, poems, ceremonies and rituals.



Traditional customs and dances performed in Tuvalu (Source: Karen McNamara)

Traditional knowledge:

- Still exists and stems from local communities who know their surrounding environment;

- Is understood by communities (physically and spiritually), which encourages more community participation and stronger communication networks;

- Is often supported by community Elders and leaders, which gives it more leverage as the community trusts these people; and

- Is more innate to some communities who may at times be distrusting of modern technology.

A tabu leaf indicator is used at Lamen Bay, Vanuatu to signify that an area is closed to fishing, which is crucial in regulating resource use (Source: Francis Hickey)

Using traditional knowledge to understand the climate and climate change

In relation to climate change, Indigenous knowledge may advance scientific understandings, offer **new information about changes and impacts**, and provide **new perspectives on adaptation**. Indigenous observations of changes in their surroundings have the potential to fill gaps in climate data at the local and regional levels, and inform culturally-appropriate adaptation strategies.

Knowledge of climate, seasons and disaster preparedness comes from locals' observations of their lands across generations. Important areas of traditional knowledge that can be used for climate change adaptation and/or disaster preparedness are:

- Food security – having extra food, and preserving and storing food in safe locations.

- Weather events – being able to predict weather events and their impacts.

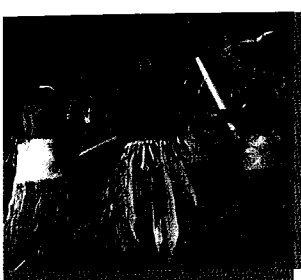
- Infrastructure – building houses and settlements that will withstand extreme events (such as flooding and cyclones).

- Ecosystems – planting native trees to reduce erosion and prevent landslides.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/



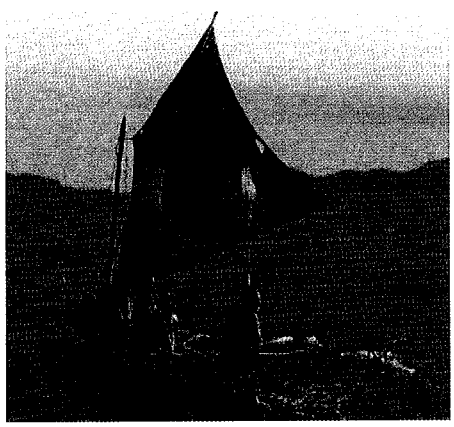
TRADITIONAL KNOWLEDGE IN ADAPTING TO CLIMATE CHANGE

PACE-SD Factsheet Series: No 11

Traditional knowledge in climate change adaptation

Local communities throughout the Pacific have long been coping with and reducing their risks to environmental change and natural disasters. To do so, initiatives have included water harvesting systems, management of land and cropping patterns, seasonal climate forecasts, land use strategies and specific house building techniques.

Singas village in Morobe Province (Papua New Guinea) is a small community situated along the banks of the Markham River, which experiences yearly flooding. To help with flood risk reduction, the community uses their knowledge of the environment to know the right places to build in the dry season and utilises traditional bush materials to build their homes on stilts. After flood events, locals dig out drainage systems and re-plant hazard-resistant crops, trees and other plants not only for food production but also to stabilise the river banks and soil.



A sailing canoe used to travel to food gardens on the mainland, Maskelyne Islands, Vanuatu (Source: Francis Hickey)

There are many practical applications of traditional knowledge, such as:

- **Water:** Rainwater harvesting can be a practical way of attaining a fresh supply of water.

- **Agriculture:** Traditional agricultural crops can be planted in wooden dug-out canoes, particularly as a way of adapting to sea level rise, salinisation and inundation due to king tides.

- **Transportation:** Traditional means of transport can be used as an effective and less polluting way of moving around.

- **Coastline:** Traditional stone walls can be utilised as they are one way of adapting to sea level rise.

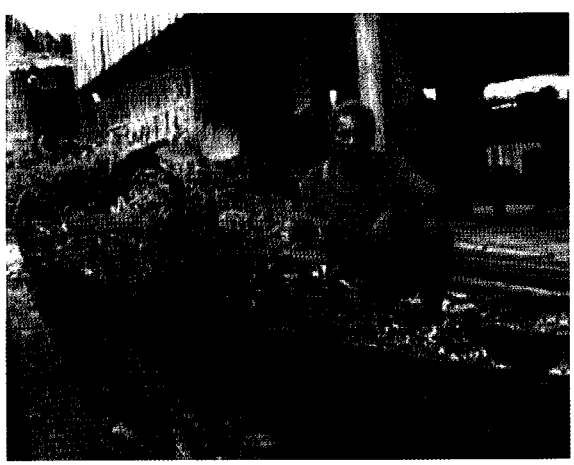
Encouraging the use of traditional knowledge

The **combination of traditional and scientific knowledge** can help lessen the impacts of climate change on local communities. Specific areas of traditional knowledge such as early warning systems, land use, water management and building design are particularly useful for climate change adaptation.

As life becomes more modernised, there is a concern that locals' ability to observe and monitor their environment might weaken. Therefore, as a community, we need to:

- Encourage the use of local knowledge through community exchange programs, workshops, radio programs and other activities; and

- Appoint community leaders as traditional knowledge facilitators.



A wooden dug-out canoe for growing crops (Source: George Baragamu)

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

GENDER PERSPECTIVES OF CLIMATE CHANGE

PACE-SD Factsheet Series: No 12

"Women will be particularly affected by the projected changes in climate - floods, droughts and other climate change-related disasters will hit women the hardest."

Why gender?

Image of a woman, Funafuti Atoll, Tuvalu (Source: Karen McNamara)

Climate change impacts will affect all countries, yet its impacts will be differentially distributed among different regions, generations, age classes, income groups and occupations. Crucially, climate change will **not affect women and men in the same way**. As such, impacts will be felt along gender lines.

In some **communities in the Pacific**, men and women have **specific roles** that are defined by their gender. Men are often the builders (construction and maintenance), while women are typically responsible for securing the food and water for their family and livelihoods.

With **declining food and water security** (as a result of climate change impacts), the **strain on women sharply increases**. For instance, rising ocean temperatures and coral bleaching episodes could see a loss of key marine resources that are important resources for the sustainment of women's livelihoods – through consumption, fishing or tourism activities.

Women selling their produce at the fresh market in Port Vila, Vanuatu (Source: Karen McNamara)

Here are some basic facts that reflect the **situation for women globally**:

- Women are the main producers of the world's staple crops.
- Women struggle to cope with year-to-year variability of a variety of crops (such as maize, sorghum and millet).
- Women are more vulnerable to nutritional problems.
- Women's workloads increase as they spend time caring for the sick, which is projected to rise with various human health impacts from climate change.
- More women and children die from natural disasters than men (a function of different economic and social rights).
- Key decision-making institutions (related to climate change) have a largely male-dominated hierarchical structure.

As a result, all aspects of climate change – adaptation, mitigation, policy and decision making – must comprise a gender perspective.

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

For more information please contact:

Director
Pacific Centre for Environment & Sustainable Development (PACE-SD)
The University of the South Pacific
Laucala Bay Campus
Suva, FIJI ISLANDS
Phone: +679 323 2894
Fax: +679 323 2891
Website: www.usp.ac.fj/pace/

GENDER PERSPECTIVES OF CLIMATE CHANGE

PACE-SD Factsheet Series: No 12

Women hold significant knowledge

Women are not just 'helpless victims' of climate change – they hold significant knowledge and skills related to adaptation and mitigation, and hence are important in driving necessary changes. The **leadership of women is critical** in managing the impacts of climate change.

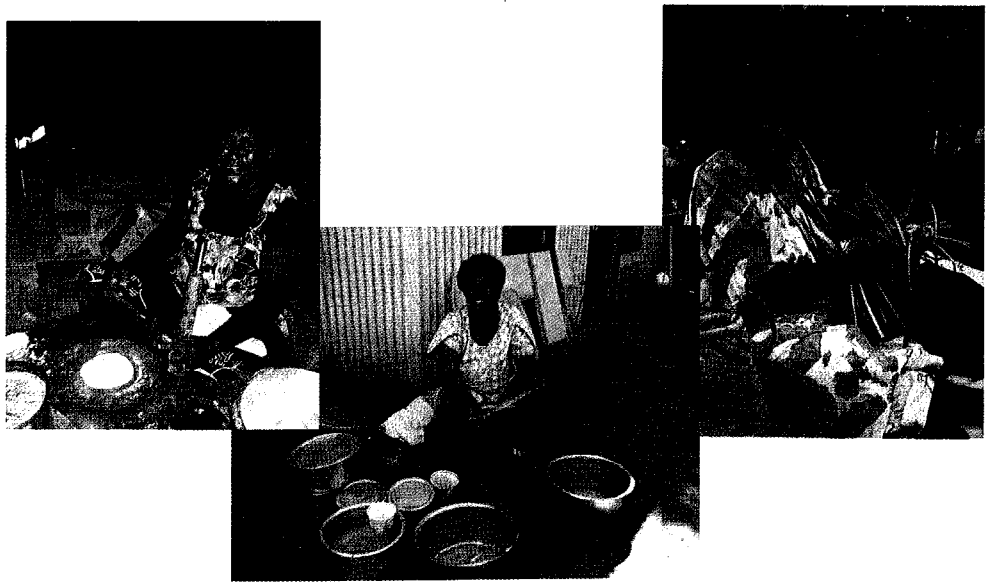
Women can provide different and fresh perspectives on climate change impacts, experiences and appropriate adaptation responses. A recent UNDP (2009: 58, 78) report on gender and equality highlights that women "are not passive, and can become agents of change... and should be active participants and decision makers in mitigating and adapting to climate change".

Women can play a key role in energy consumption, water management, population growth and economic growth. They can also play a vital role in policy development and decision-making.

Importantly, women hold significant knowledge and skills related to adaptation and mitigation.

What can we do to encourage the role of women in climate change adaptation?

- Raise awareness on the value of women's traditional and/or local knowledge.
- Facilitate more equal participation of women in decision-making that concerns climate change adaptation and mitigation at all levels (local, national, regional and international).
- Ensure that any adaptation actions or activities take into account gender perspectives.
- Conduct research into gender-specific: resource patterns; experiences of climate change (among women); adaptation and mitigation responses; and patterns of vulnerability.
- Provide support to women where necessary to enhance their adaptive capacity to the impacts of climate change.



Images of women in Soso village, Fiji (Source: Karen McNamara)

USP
THE UNIVERSITY OF THE SOUTH PACIFIC

This factsheet is produced by PACE-SD under the funding support of the Australian Government's 'Future Climate Leaders Program' (AusAID) and the European Union's 'Global Climate Change Alliance Project'.

AusAID

Reference
United Nations Development Programme (2009) *Resource Guide on Gender and Equality*, UNDP, New York.