

Rakahanga Enuua

Climate Change and Vulnerability and Adaptation Assessment

September 11th to 16th 2012



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Introduction

This report is a reflection of the impact of Climate Change on the island of Rakahanga. The information acquired in this report was mainly acquired through a survey of questionnaires and other outside contributions. This purpose of this exercise was also to collect and collate information to formulate policy statements that would enable us to come up with strategic recommendations that can be implemented at the national and as well at island level.

Rakahanga is one of the five islands identified by the Climate Change Country Team and National Environment Service to complete the collation of baseline data for the Climate Change Vulnerability & Adaptation Assessment (V&A) program. The V&A Team for Manihiki consisted of staff from the National Environment Service and Cook Islands Red Cross.

Other outer islands whereby Climate Change Vulnerability and Adaptation assessment have been carried out, through various projects and organisations, are as follows:

Aitutaki	2003
Mauke	2008
Mangaia	2008
Mitiaro	2008
Pukapuka	2008
Atiu	2012
Rakahanga	2012
Manihiki	2012
Penrhyn	2013
Palmerston Island	2013

These assessments will require regular review, preferably every five years as changes to our daily living environment is always occurring as a result of climate change.

This work would not have been possible without funding assistance from the Pacific Adaptation Strategy Assistance Program (PASAP) under the Government of Australia and the Asian Development Bank Small Grants Activity (ADB SGA), as well as support from the Government of the Cook Islands.

The V&A team would like to thank the Mayor, Rakahanga Island Council members, the Island Secretary, Member of Parliament, leaders and people of Rakahanga for their time and contributions to making this program a success.

Meitaki korereka.

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PART ONE

Background

Rakahanga

The Island of Rakahanga; traditionally called *Tapuahua*, lies approximately 162 degrees west and 10 degrees South of the Equator. It is the second farthest island; 674 nautical miles from Rarotonga, the main island of the Cook Islands group. Rakahanga is an atoll island, located close to the island of Manihiki where the famous black pearl is cultivated.

The population in 1996 was 249 men, women and children. This number has now dwindled to 77¹. The island residents are self-reliant and depend largely on what the land and ocean/lagoon to provide for their sustenance².

Characteristics of the island of Rakahanga*	
Type of island	Atoll Island
Location	10°02'30"S, 161°05'30"W.
Population	1966: 323 1971: 339 1975: 365 2011: 77
Distance from Rarotonga (km)	1248
Land area (km ²)	4.04 km ²
Highest Point (m)	4.2m
Area used for Agriculture (acres)	n/a
Lagoon size (sq. km) and reef length (km)	Lagoon Size, 12km ² Fringing reef, 14km



Figure 1 Map of Rakahanga

¹ Census Figures 2011

² Rakahanga Community Development Plan 2012 - 2017



Figure 2: Important places on Rakahanga.

Figure 2 shows critical infrastructure such as the roads, power station, hospital and the administration office where the police, Telecom and the Bank of the Cook Islands offices are located.

The island is heavily reliant on imported supplies such as food, fuel and building materials. Their remoteness is a predicament as air transport is not available to the island. However there is a ferry run by the Rakahanga Island Administration that travels to and from Manihiki when there are passengers travelling to the island. This is an extra cost that members of the Rakahanga community just have to bear. Shipping, like with most of the northern group islands, is irregular sometimes having a three to four months delay. Community members therefore bulk buy goods to last for at least till the next shipment. Freight costs are also costly for the people for both air and sea transport. Sometimes when goods are shipped to Rarotonga for family members on the main islands, costs are transferred to the receiving families to cover upon collecting the items from the harbour in Avatiu.

The main source of drinking water for the island of Rakahanga is rain water. Each household has some water storage capacity and there are also community water tanks that are also in use. There is a hospital in Rakahanga with a nurse practitioner and also a public health officer.

Rakahanga has a 27 KVA Generator that supports the islands needs. Electricity is supplied with 18 hours a day³. There are plans in place to have a solar PV mini grid system for the island having battery storage and with a new diesel generator as backup.

Environment

The environment on Rakahanga is largely untouched and is generally in a pristine state. The island is covered with thick lush coconut trees. It is the expectation of the Island Government for this to continue and they have programs in place to manage solid waste which are collected and transported to a number of disposal sites around the back of the settlement areas. Most of the waste generated by the residents is mainly vegetation followed by materials imported to the island, especially aluminum cans and plastic materials. These are burnt together with the vegetative materials to keep the fly population low.

The island lagoon which once produced black pearls is also in a pristine state. The council continues to be concerned about its state given its past conditions. The council now wants the lagoon monitored to ensure it continues to be in a healthy in order to provide sustenance to the island population. Part of the lagoon has been closed off by a causeway constructed in 2005. This has now turned into a natural breeding area for a number of fish species especially, Milkfish (Ava), Tilapia, Fresh water eels and Trevally.

Climate

In the Northern Group Islands, temperature is fairly constant throughout the year while in the Southern Cook Islands, there is a difference of around 4°C between the warmest and the coolest months. Annual maximum and minimum temperatures have increased in both Rarotonga for the southern group and Penrhyn for the north Cook Islands since 1950. These temperature increases are part of the global pattern of warming.

Rakahanga currently has no weather station that records climate and weather information. When assessing climate, the Cook Islands are divided into Northern and Southern groups (using Rarotonga and Tongareva (Penrhyn) data stations) because their climates differ substantially due to the large distance between the island clusters and their positions relative to the equator. The El Niño-Southern Oscillation has opposite effects on the Northern and Southern groups. In Rarotonga or the Southern group, El Niño events tend to bring drier and cooler conditions than normal, while in the north El Niño usually brings wetter conditions⁴.

Climate trends assessed through recent work under the Pacific Climate Change Science Programme (PCCSP) 2011 indicates a cause for serious concern with increasing temperatures and rainfall, rising sea levels, and increases in the frequency, intensity and duration of extreme events. Here are some of the results⁵:

³ Government of the Cook Islands, 2012: Cook Islands Renewable Energy Chart Implementation Plan: Island Specific. pg 5

⁴ Government of the Cook Islands, 2011, *Cook Islands Second National Communication under the United Nations Framework Convention for Climate Change*.

⁵ Australian Bureau of Meteorology and CSIRO, 2011. *Climate Change in the Pacific; Scientific Assessment and New Research. Volume 2: Country Reports*.

Conditions	Confidence Level			
	Very High	High	Moderate	Low
Surface air temperature and sea surface temperature are projected to continue to increase	√			
Annual and seasonal mean rainfall is projected to increase				√
The intensity and frequency of days of extreme heat are projected to increase	√			
The intensity and frequency of days of extreme rainfall are projected to increase		√		
The incidence of drought is projected to decrease			√	
Tropical cyclone numbers are projected to decline in the south-east Pacific Ocean basin (0–40°S, 170°E–130°W)			√	
Ocean acidification is projected to continue	√			
Mean sea-level rise is projected to continue	√			

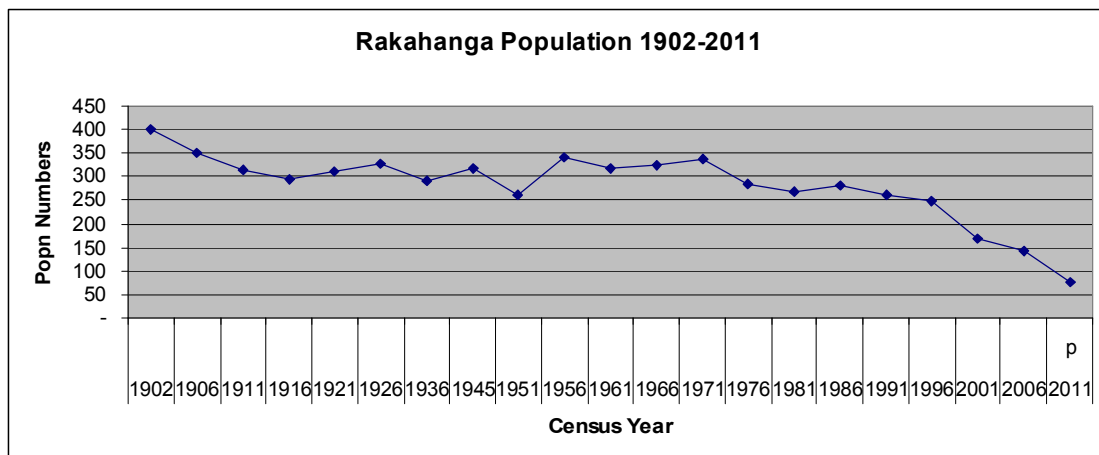
In 2011, the whole of the northern group experienced months without rain. Coconut trees dried out and this was visible when the team visited the island with evidence of topless/leafless coconut trees although the trees seem to have recovered now.

The island of Rakahanga, like Manihiki, was also affected by tropical cyclone Martin in 1997. This was one of the worst disasters that happened to the island as homes were destroyed, and waves and storm surges damage then are still visible today. Surge from the lagoon was reported to come onto the island for about 150 to 200 meters along the settlement areas. The Rakahanga site of their airport was badly damaged. The CICC church was one of the places that still stand today.

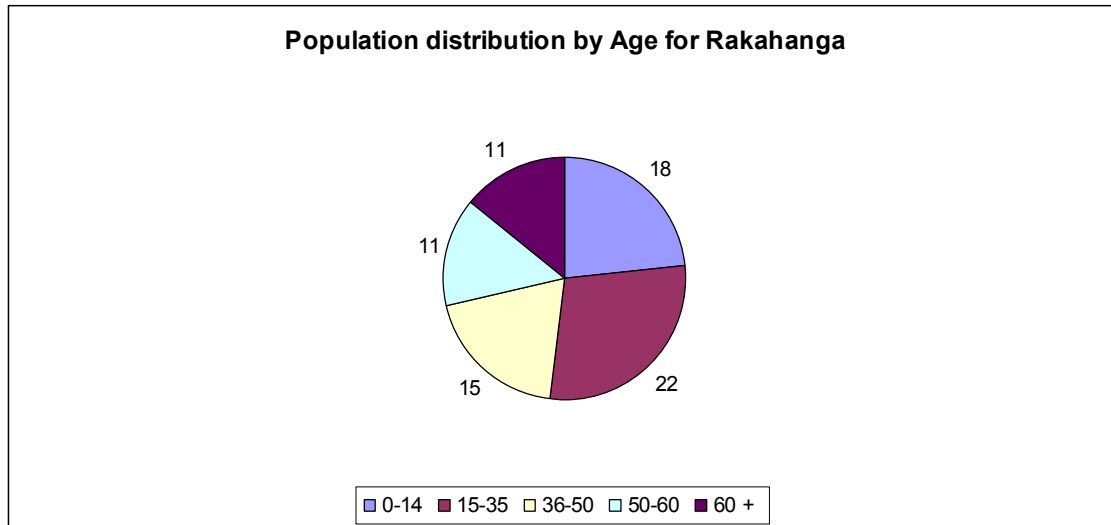
Social

Population

The population of Rakahanga has been on the decline since 1971. This is shown by the graph below. Rakahanga has five villages – Matara, Purapoto, Niteiri, Numahanga and Teruakiore. In the 2011 census the preliminary results shows that the population of Rakahanga in total is 77 with 38 male and 39 female.



For the household survey that was done by the team, a number of 21 occupied homes were surveyed. Total population surveyed was recorded at 71, 38 females and 33 males. During the 2011 Census, there were 77 people on the island. The pie graph shows the population distribution during that time⁶.



The majority of the population is of working age with 11 adults (6 males and 5 females) 60 years plus. During the household survey, one home had an elderly man that haven't left his house in years and was characterized as infirm. He is being cared for by family members.

History

(Excerpt from Mr Iakimo Temu File, Police Officer of Rakahanga, kimokopu@oyster.net.ck)

A Brief Geological History Of Rakahanga

A research group consisting of the late Mr. Tony Utanga along with other Researchers from Germany in 1987 gave the following records kept by Mr Iakimo Temu, Police Officer of Rakahanga. Here is an excerpt of the finding:

About 110 million years ago in the area of the Manihiki Plateau a huge field of volcanic was much much further to the southeast, at a latitude of about 40° South. But it started wandering in a northwesterly direction until 110 million years later, reached its present position.

When the volcanoes erupted, some of them reached a height of more than 3000 meters. Besides lava, as molten rocks is called, during the eruptions rock fragments from the underlying basement were blown several kilometers high into the air and transported over great distances in some cases.

In others they fell back onto the area of eruptions helping to build up the volcano.

This all happened above sea-level.

⁶ Government of the Cook Islands, 2012: Cook Islands 2011, Census of Population and Dwelling – Main Report

One of those huge volcanoes once was Rakahanga. After volcanic activity ceased, the earth crust became cooler and started subsiding several kilometers. The high volcanoes subsided as well. Today the earth crust of the Manihiki Plateau is now 3.5 kilometers below sea level.

While the earth crust sank, it also moved to the northwest. When it reached tropical waters, most of it was drowned, only a few high volcanoes still kept their heads above sea level – they were islands.

In the tropical waters the islands had reefs around its volcanic core. While the earth crust and the volcanic islands continued sinking, the reefs kept pace with subsidence and finally, when the summit of the volcanoes went under reef growth continued until the fringe reef was made an atoll.

The research vessel SONNE from Germany proved the high age of Rakahanga by sampling the rocks as old as 50 million years from the southern slope of the atoll.

Local Governance

On Rakahanga, the Island Secretary oversees the delivery of services by public servants. At the time of writing this report, the Government is in the process of reviewing the local government act to empower the Mayor and the local council to take charge of the island administration. The Mayor also becomes the point of contact for communicating disaster information from Rarotonga to the people of Rakahanga.

The Island also has a Member of Parliament who is currently based in Rarotonga.

The island is heavily dependent on public sector employment as a means of supplementing family welfare. Where there are two or more in a household working as public servants, the home income generated would fare much more favorably than those with only one working for the government.

Economy

Marine Resources

Rakahanga has a very productive fisheries sector. This needs to be developed to provide food security as well as in creating an alternative revenue stream for the island community which may include harvesting of ocean and lagoon fisheries for the market in Rarotonga.

Pearls have previously been farmed on the island in which two pearl farms, one owned and run by the Island Council, and one by the Church were established. The industry however collapsed due to high population of pearl shells in the small lagoon leading to the onset of disease in the pearl crops. Administration and management issues and conflicts also contributed to the demise of both ventures.

Fishing

Fish in Rakahanga is a staple diet for its people. In June 2012, a workshop was held in New Caledonia where scientist predicted that by the year 2050, the northern group waters would

be very ideal for ocean fish.⁷ From the survey, there was mixed responses whether there is a huge impact of climate change on fishing on Rakahanga. Whilst some of the respondents are saying that there is reduction of Tuna on Rakahanga, some respondents are saying otherwise. Ministry of Marine Resource's future plans for Rakahanga's fishing sector has concentrated mainly on food security initiatives. They have engaged the services of a technical assistant to teach the local fishermen how to prepare tuna jerky. This exercise is further improved through the introduction of different spices and flavors. It is apparent that government future investment will be focused in the oceanic and coastal fisheries. The question remains as to what should be undertaken by the Local Council and community to sustain the rich resources in this sector.

Agriculture

Copra was once a regular income-earner for the island, but low market prices in the earlier years and irregular shipping caused the collapse of the industry. Coconut remains an important food crop for the island community. The recent increase in use of young coconut sprout as an organic drink has now created an opportunity for the islanders to enter the high value organic drink markets.

The drop in population of the island has also brought about some benefits including availability and abundance of more natural resources to support revenue generating ventures on the island. Young coconut leaves are also plentiful on the island which could form the basis for "rito" production on the island

As far back as 2005, attempts has been made to develop a 'hydroponic' garden for the people of Rakahanga but this did not take off as supporting mechanisms such as chemicals, seeds and other materials for the project did not come through.

The need to promote home gardening to provide a much more balanced diet is encouraged.

Handicraft

Women are an economic resource but are not utilized at full capacity on the island. This is caused by little opportunity being given to women. Handy craft activities on the island are also limited. This is because market potential has not been fully developed.

The island women's currently have issues with handicrafts from their island been taken to Rarotonga on credit basis. To stimulate production and improve the participation of women in economic development initiatives, there is a need to re- look at this arrangement to come up with a more producer friendly system. A number of grants funding scheme could be looked at to start this off on Rakahanga.

Tourism

At present, there is no Tourism on the island of Rakahanga. Whilst Rakahanga Island has enjoyed air traffic services in the early 90s, this was completely destroyed during Cyclone Martin.

⁷ Bell JD, Johnson JE, Ganchaud AS, Gehrke PC, Hobday AJ, Hoegh-Guldberg O, Le Borgne R, Lehodey P, Lough JM, Pickering T, Pratchett MS and Waycott M (2011) Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change: Summary for Pacific Island Copuntries and Territories. Secretariat of the Pacific Community, Noumea, New Caledonia.

Given the sandy beaches, the abundance of tuna and other ocean fish, the potential for Tourism on the island of Rakahanga remains an attractive option but huge infrastructure investment is necessary.

Local market

There is no local market in Rakahanga however during our survey, some of the respondents suggested for a stall at the Punanga Nui Market in Avatiu to sell some of the local catch, dried fish and handicrafts.

Rakahanga is well known for their Rito woven hat that is surmountable to those produced by its near neighbours. With abundance of tuna fish, processing tuna jerkys would also be an ideal way to earn a side income. MMR has been undertaking tuna jerky preparation in Rakahanga to promote this type of opportunity.

The sales of ‘koperu’ as bait fish for fishermen in Rarotonga is currently being practiced with a good income in return. At present, there is also a sale of reef fish to Rarotonga in one of Rarotonga’s main outlets.

According to a respondent during the survey, the Women’s Federation has submitted proposals to seek funding to acquire equipment for producing coconut virgin oil. More effort is required to establish and run such an initiative on a small scale.

PART TWO

Vulnerability Assessment

Methodology:

In compiling the data for this report, the following activities were undertaken.

1. Mini Workshop

In the Mini workshop, invites were extended to the Mayor, Island Council, Aronga Mana and Island Secretary. The Mini workshop was held on Tuesday 12th September in the Island Council Chamber. This workshop was mainly conducted and lead by Ms Mii Matamaki, Senior Environment Officer. She was ably supported by Charles Numanga. The mini workshop was aptly disrupted by power shutdown. The mini workshop was postponed to Thursday night.

The workshop went through the event and outcome risk related to climate change and disaster risk assessment and identified priorities as set out under the **Recommended Policy Actions**. A notable comment from the community leaders was the ‘dark shadow’ that was seen in the lagoon at a certain depth in 2012. The result of this is unsure at this stage, but it is possibly linked to the drought times and lack of circulation of lagoon water.

It was also mentioned that there is a certain type of seaweed that is found at the harbour area that helps with individuals with asthma. The inhaling of the smell of this seaweed has healing properties.

2. Public Awareness;

The public awareness was held on Thursday night 14th September at 7pm in the Community Hall. It was well attended by the whole of Rakahanga community where again Ms Mii Matamaki was able to make a presentation on defining what Climate Change is? Questions and answers were opened to the public. Some of the more notable feedback was as follows:

“We have been experiencing water shortage in the past drought and we would like our community water tanks to be upgraded”

During Cyclone Martin, it was evident that there was nowhere for anyone to run to – perhaps, it is timely that the cyclone shelter be revisited⁸;

Can you please explain as to where exactly are we going to run when a Tsunami comes our way? A Tsunami travels at a speed of a jet, how much time is available for the people of Rakahanga to run to? And where do we run to?

After Cyclone Martin, the people planted coconut trees along the coast and even on the other motu – the purpose of the coconut trees planted is to help slow down the force of the cyclone waves;

We noticed that after Cyclone Martin, some of the sea shells disappeared and a new pinkish sea shell suddenly appeared in huge numbers;

The public meeting was ended with a closing prayer and refreshment was provided for all that attended.

⁸ In the public meeting, Mrs Munokoatini offered a piece of her family land to the Mayor and the Island Council to see if it is viable to build as a Cyclone Shelter. In her offer, she does not want this piece of land to be leased but to be taken to be used for the Safety Centre. Also note that in the past, the CICC Hall was seriously considered as an Evacuation centre.

3. Household Survey

The household survey was conducted by the team. The survey revealed some interesting and gripping lessons learnt and even traditional methods of preserving food.

The survey also revealed certain aspects of changes impacted by changing patterns of climate change. There was also strong inclination towards the building of a cyclone safety center where people living along the coast line can move further inland to be sheltered. The need to promote water conservation during drought periods was also highlighted as a practical activity that the people must put in place.

Risks and Vulnerabilities – *the impact of Climate Change and Disaster*

Step 1 - Summarize the Risks – With reference to each of the relevant climate change and disaster risk reports, (and other relevant documents collected during the stocktaking), the Climate Change Adaptation and Disaster Risk Rakahanga Community Leaders will summarize the nature of the risks from climate change and natural disasters to the relevant sector. The initial step is to identify **event risk** (i.e. the “risk of occurrence of any particular hazard or extreme event” for example flood, drought, increased hurricane intensity) and **outcome risk** (i.e. “the risk of a particular outcome” for example loss of life, loss of income, loss of property, increase in pests/disease, increase in water/vector borne disease).

Event Risk	Outcome Risk
NOTE: Following outcome risks listed in SNC and JNAP DRM CCA	
Climate Change	
<p>1. Sea level rise and storm surge- A rise in sea level of 1 meter by 2100 Increase in storm surge events inundating up to 4.5 meters above mean sea level.</p>	<p>1. Increased incidents of coastal erosion, flooding and inundation of low lying areas, agricultural and planting areas affected.</p> <p>2. Impacts on traditional livelihood and culture – loss of access to fishing areas – impact on ground water springs/wells</p> <p>3. Damage to coastal infrastructure – airport/harbour</p> <p>4. Impact on economy and loss of investments especially on coastal infrastructures</p>
<p>2. Changes/variations and increase in local and national temperatures regimes increase of between 1.5 and 3.5 degrees, more hot days and warm nights particularly in Southern Group Cooler in the northern group</p>	<p>1. Impact on ecosystems (marine, terrestrial and aquatic) – corals, food productivity, planting areas</p> <p>2. Increasing energy demand (cooling, refrigeration) – cost of electricity</p> <p>3. Impacts on marine and terrestrial biodiversity - migratory and distribution changes</p> <p>4. Impact on vector borne disease (water quantity, demand, quality) Increase in diarrhea related illness especially for babies.</p> <p>5. Increased prevalence of invasive species (productivity,</p>

	<p>species distribution or migration)</p> <p>6. Changes in migration and breeding patterns of birds and fish, especially tuna.</p>
<p>3. Changes in rainfall patterns - an increase in precipitation especially during the wet season in Southern group incidents of extreme rainfall are likely to occur more often and be more intense.</p>	<ol style="list-style-type: none"> 1. <i>The availability of water in general for drinking and bathing</i> 2. <i>Increased prevalence of invasive species (white fly now found on the island)</i> 3. Increased incidents of crop diseases affecting food security – the livelihoods of pigs 4. Impact on human health from water and vector borne diseases 5. Reduced tourism attractiveness, and economic losses from productive sectors, food insecurity, natural resources for handicrafts etc.
<p>4. Increased climate variability – Changes in seasonal temperatures, timing of rainfall,</p>	<ol style="list-style-type: none"> 1. <i>Impact on terrestrial and marine biodiversity (pollenators-bees etc., migratory species, growing cycle, food chain)</i> 2. Impact on agricultural productivity and food security – seasonal changes and also its quality is not as good as it used to be. 3. Impacts on tourist arrivals and duration of stay – travel between Manihiki and Rakahanga
<p>5. More severe weather events (droughts, rainstorms, heat waves, and category 4/5 cyclones) -</p> <p>Increase in frequency, intensity and duration of extreme events (floods, droughts and storm surges)</p> <p>Increase in intensity of cyclones (i.e. more category 4 and 5 cyclones) in annual average of 1.6 cyclones in the Southern group, and annual average of 6 cyclones in the Northern group</p> <p>Increase in wind intensities between 5-10% by 2050</p>	<ol style="list-style-type: none"> 1. <i>Impact on coastal ecosystems (wave damage, erosion)</i> 2. <i>Loss and damage to agricultural infrastructure and crops affecting food security</i> 3. Increased incidents of damage to infrastructure, fishing boats 4. Increased incidents of water pollution and damage to water storage, not enough water. 5. Increased incidents of loss of human life and injuries 6. Increased damage to terrestrial (e.g. tamanu, kuru) and aquatic living things 7. Stress and social disruption – family members leave for income earning activities, stress on family members 8. Disruption of education and social services, affecting already vulnerable groups like disabled, youth, and women 9. Increased costs for recovery, impact on economy and reduced ability to attract foreign investment – delayed response by response agencies especially for remote islands 10. Increase internal migration - 11. Increase demand on emergency shelters
<p>6. Increased incidents of ocean acidification</p>	<ol style="list-style-type: none"> 1. <i>Impact on coral growth and fish nurseries</i> 2. Impact on marine biodiversity and resources including migration of fishery resources
<p>7. Increased levels of Green House Gases (GHGs)</p>	<ol style="list-style-type: none"> 1. Increased incidents of ocean acidification 2. Impacts on human health: respiratory

Disasters	
8. Hazardous substances spillage (oil and petroleum products)	<ol style="list-style-type: none"> 1. Long term impacts on terrestrial and marine biodiversity, food security 2. Impacts on tourist arrivals and attractiveness of tourism product
9. Bush Fire	Not related to Rakahanga
10. Epidemics (Dengue fever, cholera)	<ol style="list-style-type: none"> 1. Impacts on health service delivery – doctors and nurses may become patients as well. Past experience have shown that Dengue is introduced by outsiders. 2. Loss of life 3. Impacts on productivity – people cannot work as they have fallen ill
11. Geo-physical hazards (tsunamis)	<ol style="list-style-type: none"> 1. Loss of life and injury 2. Loss of and damage to property and livestock 3. Impact on terrestrial and marine biodiversity 4. Impact on human health (increase in respiratory illness and stress) 5. Impact on economy

The priority Outcome Risks are in *ITALICS* and List Priority Outcome Risks Identified by Rakahanga Community Leaders:

Step 2 – Estimate Risks - Using the summary of risks to the relevant sector developed under Step 2, the Rakahanga Community Leaders undertook an estimation of the following key elements of risks:

Estimate of the *Severity of the Impact (Event and Outcome Risks)*

- In the context of climate change adaptation, the Rakahanga Community Leaders could choose to include non-financial criteria such as the loss of life, effect on GDP, impact on social capital and quality of basic services, environmental impacts or any other relevant measure that is suited to best expressing the potential impacts in measurable terms.
- The Rakahanga Community Leaders developed an impact severity rating scale appropriate to the risk scenarios (*event* and *outcome*).

TABLE 2 a: Direct Impact Rating Matrix

Event *Sea level rise and storm surge-*
Outcome *Increase incidents of coastal erosion, flooding and inundation of low lying areas, agricultural and planting areas affected 8/11*

<i>Impact</i> <i>Severity</i>	Social			Economic				Environmental			
	Displacement	Health	Cultural aspects	Loss of livelihood	Property loss (house/land)	Financial loss (crop)	GDP loss ??	Air	Water	Land	Biodiversity/ecosystem
Very low											
Low		X						X			
Moderate							X				
High	X		X						X	X	X
Very high				X	X	X					

Number	Outcome Risk	Social	Economic	Environmental
1	<i>Increased incidents of coastal erosion, flooding and inundation of low lying areas, agricultural and planting areas affected.</i>	2	3	3
2	<i>Impacts on traditional livelihood and culture – loss of access to fishing areas – impact on ground water springs/wells</i>	2	2	2
3	<i>Impact on ecosystems (marine, terrestrial and aquatic) – corals, food productivity, planting areas</i>	1	2	2
4	<i>Increasing energy demand (cooling, refrigeration) – cost of electricity</i>	2	1	1
5	<i>The availability of water in general for drinking and bathing</i>	2	2	2
6	<i>Increased prevalence of invasive species (white fly now found on the island)</i>	1	1	3
7	<i>Impact on terrestrial and marine biodiversity (pollenators-bees etc., migratory species, growing cycle, food chain)</i>	1	1	2
8	<i>Impact on coastal ecosystems (wave damage, erosion)</i>	2	2	3
9	<i>Loss and damage to agricultural infrastructure and crops affecting food security</i>	2	2	3
10	<i>Impact on coral growth and fish nurseries</i>	1	1	2
11	<i>Long term impacts on terrestrial and marine biodiversity, food security</i>	2	3	3
12	<i>Impacts on health service delivery – doctors and nurses may become patients as well</i>	2	2	2

Step 3 - Estimate Frequency or Probability of Event

The Rakahanga Community Leaders estimate the frequency or probability of an event identified in the relevant reports based on their expert judgement.

TABLE 4: Frequency/Probability Rating (based on climate change risks that are likely to occur during the next 5 years)

Climate Change Risk	Very Unlikely to Happen 1	Occasional Occurrence 2	Moderate Frequent 3	Likely to Occur Often 4	Likely to Occur Regularly 5
CC risks from risk scenario – Step 2 (deal with each separately)	Not likely to occur during next 5yr period	May occur sometime but not during next 5 yr period	Likely to occur at least once during next 5yr period	Likely to occur several times during next 5 yr period	Happened often and will happen again during next 5yr period

Once the top 12 priority risks were identified by the community leaders, the frequency and probability rating was then identified. Below are the results from the leaders.

Event + Outcome Risk	Frequency/Probability Rating
<i>Sea level rise and storm surge + Increased incidents of coastal erosion, flooding and inundation of low lying areas, agricultural and planting areas affected.</i>	3
<i>Sea level rise and storm surge + Impacts on traditional livelihood and culture – loss of access to fishing areas – impact on ground water springs/wells</i>	3
<i>Changes/variations and increase in local and national temperatures regimes + Impact on ecosystems (marine, terrestrial and aquatic) – corals, food productivity, planting areas</i>	4
<i>Changes/variations and increase in local and national temperatures regimes + Increasing energy demand (cooling, refrigeration) – cost of electricity</i>	4
<i>Changes in rainfall patterns + The availability of water in general for drinking and bathing</i>	4
<i>Changes in rainfall patterns + Increased prevalence of invasive species (white fly now found on the island)</i>	3
<i>Increased climate variability + Impact on terrestrial and marine biodiversity (pollenators-bees etc., migratory species, growing cycle, food chain)</i>	2
<i>More severe weather events + Impact on coastal ecosystems (wave damage, erosion)</i>	3
<i>More severe weather events + Loss and damage to agricultural infrastructure and crops affecting food security</i>	3
<i>Increased incidents of ocean acidification +</i>	2

<i>Impact on coral growth and fish nurseries</i>	
<i>Epidemics + Impacts on health service delivery – doctors and nurses may become patients as well</i>	3

Evaluate the Risk - Based on their own expert judgement as the people living on the island, identified risks were examined by the Community Leaders in terms of costs, benefits and acceptability, considering the needs, issues and concerns of stakeholders.

The purpose of this evaluation was to give consideration to:

- ranking the risks from “least severe” to “most severe” from the analyses completed earlier and the perceptions of the stakeholders – see *Table 5* and *Table 6*;
- estimating the costs of potential losses;
- Assessing the acceptability of the risks.

- The Rakahanga Community Leaders **also compared levels of risk and acceptability of risk scenarios** by reviewing the data that has been recorded during the risk estimation process.

Step 4 – Identify Priority Risks and Vulnerable Communities - based on the outcomes from step 1-3 above the Rakahanga Community Leaders identified the top ten priority risks, and identified the whole island as vulnerable as the island is very small to separate different communities.

Event + Outcome Risk	Three Most Vulnerable Communities - areas
•	

For the purpose of this exercise, the leaders felt that the whole island would be vulnerable and not specific areas as required to be undertaken under Step 4. The other islets surrounding the lagoon would also be vulnerable.

Step 5 – Identify possible intervention options to address priority risks

Once it was confirmed that the whole island was at risk, the methodology moved on to look at some adaptation options.

PART THREE

Community Adaptation Plan

<i>PRIORITY AREAS -</i>	<i>RESPONSE OPTIONS</i>
<i>ENVIRONMENT</i>	
<i>1 – COASTAL EROSION</i>	
Increased incidents of coastal erosion, flooding and inundation of low lying areas, agricultural and planting areas affected.	There is a very high probability that this event will occur within the next 5 years <i>Options:</i> 1. Replanting activities to hold soil to minimize coastal erosion; 2. Put in place control measures/systems to monitor/minimize the mining of sand and coral stones for concreting/building purposes
<i>2 – IMPACT OF LIVELIHOOD</i>	
Impacts on traditional livelihood and culture – loss of access to fishing areas – impact on ground water springs/wells as a result of storm surge	This is a very high probability that this event will always occur once in every 5 years for the whole of the Cook Islands <i>Options:</i> 1. Find alternative Fishing methods and spots to sustain livelihood; 2. Maintain, preserve and monitor the use of water wells and springs; 3. Conduct regular water testing to ensure its salinity and fit for human consumption; 4. Explore options to introduce aquaculture.
<i>3 – IMPACT ON ECOSYSTEMS</i>	
Impact on ecosystems (marine, terrestrial and aquatic) – corals, food productivity, planting areas as a result of changing temperature	This is a slow onslaught event/incident that will take several years for the impact to be evident.
Increased prevalence of invasive species (white fly now found on the island) Impact on terrestrial and marine biodiversity (pollenators-bees etc., migratory species, growing cycle, food chain) Loss and damage to agricultural infrastructure and crops affecting food security	There is an increase in invasive species that are affecting the tree/plants on the island. <i>Option</i> 1. Employ an Agriculture Officer/Quarantine officer to help control the introduction of invasive species. 2. Response plan/strategy to control invasive species on the island. 3. Regular replanting program to replace old and fallen trees. 4. Plant trees on the coast to slow the erosion process and lessen the wave impact on the beaches.
Impact on coastal ecosystems (wave damage, erosion)	Conduct a feasibility study to look at a rock wall or wave break that is suitable to the island
Impact on coral growth and fish nurseries	Continue the ‘raui’ system and practice on the island.

Long term impacts on terrestrial and marine biodiversity, food security	Experience after cyclone has revealed that certain species of seashells disappeared. At the same time, different species of sea shells took over and was seen growing in the lagoon;
4 - HEALTH	
Impacts on health service delivery – doctors and nurses may become patients as well	Regular training and capacity building of health workers/red cross volunteers and trained first aid practitioners Tutaka program/cleaning areas of mosquito breeding places Plan B – response plans that needs to be trialed or have drills
5 – INFRASTRUCTURE	
Ensure that future developments of essential services (Harbours, Airports, Telecommunication, Hospital) are climate proofed to withstand category 4 cyclones.	<ol style="list-style-type: none"> 1. Build a Cyclone Safety Shelter for Rakahanga – enough feasibility study has been carried out to justify the building of a Cyclone shelter for Rakahanga; 2. Build an alternative airport for Rakahanga – despite the fact that Rakahanga’s old airport was damaged by cyclone, every effort should be made to relocate and build another airport terminal. At the time of the survey, the Mayor has pointed out the new location for the new airport terminal to be build;
There is very high cost in electricity for Rakahanga. Introducing alternative source of energy such as solar system is one avenue to reduce cost.	<p>Options:</p> <ol style="list-style-type: none"> 1. Promote alternative energy – photovoltaic solar system or wind turbine 2. Practice energy conservation practices such as instalments of CFL light bulbs and 4/5 star rating for electrical appliances;
Water remains the most important need for life. The availability of water in general for drinking and bathing	<p>Options:</p> <ol style="list-style-type: none"> 1. Education and awareness on water conservation practices, not to misuse and waste. 2. Community water tanks (built in 1952) to be upgraded/replaced. 3. Increase water storage capacity for each household including households that are vacant.
Promote alternative means of planting to ensure food security and promote healthy eating;	<ol style="list-style-type: none"> 1. Collate, compile and or propagate fruit trees that will withstand and grow in the northern group – more specifically fruit trees that bears fruits 12 months a year; 2. Revive the hydroponic system that is currently defunct; 3. Promote ongoing agricultural program for Rakahanga

6 - WILD PIGS	
Wild pigs – are destroying and eating the “kaveu” and “tupa”. The wild pigs are also eating the taro and puraka.	This incident is currently occurring on the island. Options 1. Introduce a <i>pig eradication</i> ’ program. 2. Island council to ask for support from Rarotonga Police to bring dogs to help catch these wild pigs. NB: Dogs are not allowed on Rakahanga; 3. Seek permit from Police to procure firearms and ammunition for pig eradication operation;
7 – MARINE	
Continue to introduce good practices to ensure sustainable fishing, harvesting and conservation	1. Maintain the contribution of coastal fisheries to food security – the practice of catching reef fish to be sent to Rarotonga needs to be monitored to ensure that it remains within sustainable limits; 2. Use more of the ocean catch as means of revenue making methods; 3. Explore the options of increasing the catch and export from the small fish pond currently in place – export of milkfish, tilapia and prawns; export of fish jerky; 4. Continue with the Raui practice that is already working.

Conclusion and Recommendation - lessons learned

It is apparent that the people of Rakahanga are well aware of the impact of climate change and disaster risk reduction. The general consensus for a cyclone safety center to be built is a clear indication of likely actions that would reduce risks and improve safety of lives.

Rakahanga is a very small tight knit community. Its ability to work together to deliver on some of the required activities to build up its resilience is evident. Simple activities such as replanting of coconut trees along the coast were a start. The vivid experience that they went through past cyclones has left them very little tolerance to be complacent when dealing with future cyclones.

It is evident that continuous review of this vulnerable and adaptation assessment every 5 years to see whether the current needs are addressed or not. These recommendations would need to be incorporated into future island business plans and also aligned to line ministries who are mandated to address relevant sectors within this report.

This exercise has enabled NES, MOIP and Red Cross to further update and consolidate their data for GIS purposes. This will enable such entities to better plan and set programs that would assist with Rakahanga on this climate change activities or disaster risk reduction activities.

This exercise also enables the users of this report to prepare and submit proposals that would be used to implement activities where it will increase its resilience.

There is a need to continue ongoing awareness programs on climate change and disaster risk reduction to build capacity on the island.

As the saying goes “Chances goes to those that are prepared”.

Kia Orana

APPENDIX

1. Copy of the survey form;



**Rakahanga Vulnerability and Adaptation Assessment
In Association with
Cook Islands Red Cross Society and the Office of the Prime Minister**

Questionnaire completed by:Island.....

Date: ___/___/201__

Power Connection: _____

Household Questions

- A. Ingoa; Name of Informant(s): _____ Contact Number:
 i. Landline: _____
 ii. Mobile: _____
 iii. Email: _____

B. Tare Numero Tangata; Number of Occupants _____

C. Household data:

Name	Gender (M, F)	Age	Relationship Ex: father/mother/daughter/grand child	Occupation	Special Needs

D. How many years have you lived on this island? _____ Years Whole Life

Questions about Climate Change

E. Do you understand enough about Climate Change

Fully understand Just enough Not Much Don't Understand

F. Please list what you think how Climate Change going to impact your Island

G. Have you made any changes to adapt or cope with Climate Changes you are experiencing

Questions about Imported Foods

H. What are your main Imported food

I. What are your main Island food

J. Rate Your Food Intake Imported Food % d Food %

K. Have you ever had a food shortage? Fill in the table below the required data for the most recent food shortages

Caused by	Length of shortage	Date	Action taken to cope with Shortage
Shipping Delay			
Rough seas for fishing			
Crops Destroyed			

L. How do you preserve your Food.

Y/N Remarks

Food Preservation

Refrigerator		
Freezer		
Imported Dried/Canned		N/A
Local Preserved		N/A
Sealed Containers		N/A

Questions about Food Preparation

	%	Remarks
Main Cooking Fuel		
Firewood		
Gas		
Electric		
Other		

Questions about Marine Resources

M. Where do you do your fishing? Lagoon Reef Over the reef/Ocean

N. Have you noticed any change in the amount of fish catch in the last ten years?

Increased Catch Drop in some Species Drop Catch Decreasing Catch

O. "Fishing Arapo" have you noticed any changes in the last 15 years Yes No

P. What changes have you noticed with your pearl farm that maybe due to climate change?

Questions about Water Supply

Q. Major source of Drinking Water

Community Tank Only	Own Water Catchment. Tank	Own and Community Tank	Bottled Water	Well/ Borehole	Springs

R. Do you have a water tank(s)? Yes No How many water tanks do you have? ____

S. If yes, what material is it made from

Plastic	Metal	Concrete	Other

- T. How big is it (in litres)? _____
- U. Is your roof suitable for catching rain? Yes No
- V. If yes, how extensive is the guttering to catch the rain?
1. All around the house
 2. Half of the house
 3. A single spout (guttering-piece)
 4. Pump from tank to house
- W. What actions do you take to cope with water shortages?
-

- X. Do you reuse any water e.g. from washing machine, shower, cooking, dish washing etc?
Yes No
- Y. If yes, what do you use this water for? _____

Questions about Energy Use

Z. Appliances that are being used by the household

Appliance	Tick	Number	How often do you use your appliances
Wash machine			
Radio			
Electric Jug			
Electric Pan			
Compressor			
Fridge			
Freezer			

Questions about Transport and Machinery

AA. Transport and machinery used by the household

Tick	Tick	Number	How often do you use your Vehicle
Motorbike			
Boat			
Vaka			
Tractor			
Outboard motors			
Generator			
Battery Charger			
Mower			
Grass cutter			
Chainsaw			

Questions about Waste

BB. What type of toilet (s) do you have

Type	How many	Location In/out
Pour flush		
Flush		

CC. How do you dispose your rubbish?

Waste Disposal	%
Hole	
Collected	

Open Burning	
Other	

Questions about Climate and Vegetation

DD. What changes have you noticed within your surrounding environment over time?

Yes No

EE. What do you think caused these changes?

FF. Have you noticed any changes to the vegetation over time? Yes No

If yes, is it more vegetated now than 10 or 20 years back? _____

Questions about Shoreline Changes

GG. Have you seen any shoreline changes over time?

Yes No

HH. What do you think caused the changes over time that you have seen?

.....

.....

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II. Have you noticed any changes to your livelihood after changes to the shoreline?

What have been these changes? Kua tau ainei toou oraanga ngutuare no tei tau te turanga o te tapataa tai?

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.....

.....

Recommendations for community action? Tetai uatu manako

2. List of Contributors

1. Mii Matamaki
2. Mac Mokoroa
3. Papa Danny Piho
4. Mr Iakimo Temu
5. Nga Takai
6. Papa Temu Hagai
7. Mama Tara Tuteru
8. Ben Ponia
9. Mr Arona Ngari
10. George de Bert Romilly
11. Ms. Rouru Toki
12. Charlie Numanga
13. Reboama Samuel
14. Louisa Karika

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b. Bell JD, Johnson JE, Ganchaud AS, Gehrke PC, Hobday AJ, Hoegh-Guldberg O, Le Borgne R, Lehodey P, Lough JM, Pickering T, Pratchett MS and Waycott M (2011) Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change: Summary for Pacific Island Copuntries and Territories. Secretariat of the Pacific Community, Noumea, New Caledonia.

c. Census Figures 2011

d. Government of the Cook Islands, 2011, *Cook Islands Second National Communication under the United Nations Framework Convention for Climate Change.*

e. Government of the Cook Islands, 2012, *Cook Islands Joint National Action Plan for Disaster Risk Management and Climate Change Adaptation 2011-2015*

f. Government of the Cook Islands, 2012: Cook Islands Renewable Energy Chart Implementation Plan: Island Specific. pg 5

g. Rakahanga Community Development Plan 2012 - 2017

ISLAND FACT SHEET – RAKAHANGA

Physical features	<p>Area: 4.04km² Elevation: <5m above MSL Island Type: Atoll Proximity: 1248 km from Rarotonga 44 km from the nearest island (Manihiki) Settlements: 5 villages: Matara, Purapoto, Niteiri, Mumahanga, Teruakiore located on the southwest end of the atoll</p>
Demographics	<p>Population: (2011) 77 Households: 21 (approx 4 people/household)</p>
Environment	<ul style="list-style-type: none"> • Poor atoll soil • Green turtle nesting site • Lagoon is a crucial marine resource • Extensive sea bird nesting on isolated islets
Health	<ul style="list-style-type: none"> • Health clinic served by a Nurse Practitioner. In case of emergency doctor from Manihiki travels to Rakahanga or patient is referred to Manihiki and then on to Rarotonga. • High levels of NCD's
Local Economy	<ul style="list-style-type: none"> • Dried fish • Handicrafts
Air Transport	<ul style="list-style-type: none"> • Airport destroyed after 1997 Tropical Cyclone Martin • Travelers ferry to Manihiki to catch flight to Rarotonga
Sea transport	<ul style="list-style-type: none"> • 6-8 weekly service • Loading/unloading via barge/ferry
Road transport	<ul style="list-style-type: none"> • No sealed road • Unsealed road length – 2km
Water Supply	<p>Source: Rainfall capture is the only source HH water tanks or Community water tanks 21 HH use rainwater tanks with all having plastic water tanks (approx 12,500 liters per household)</p>
Sanitation	<p>17HH flush toilet; 3 HH pour flush; 1 HH no toilet.</p>
Solid Waste	<ul style="list-style-type: none"> • There is rubbish collection; community rubbish dump is in the form of a landfill hole; wandering and wild pigs is a problem
Electricity supply	<ul style="list-style-type: none"> • During the visit, the island was experiencing shortage of diesel to run the power.
Telecommunications	<ul style="list-style-type: none"> • No newspaper, public notice boards used • FM Radio station that can pick up AM Radio station in Rarotonga, and is able to produce local material • Satellite TV • Email & Internet facilities accessible using broadband. • Mobile service available only at the Telecom Office • Telecom provides prone and fax services
Cyclone shelters	<ul style="list-style-type: none"> • There is no community shelter; there is an offer by a landowner to build the centre on.

KEY ISSUES – RAKAHANGA

Issues	<ul style="list-style-type: none">• Land availability is constrained• Transportation to and from the island
Environment preservation	Raui and conservation is still being practiced
Economic development	Potential in the handicraft industry Potential in the fisheries sector