Manihiki Henua

Climate Change and Vulnerability and Adaptation Assessment

September 11th to 16th 2012

Introduction

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

Manihiki 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 Mayoress, Manihiki Island Council members, the Island Secretary, Member of Parliament, leaders and people of Tongareva for their time and contributions to making this program a success.

Meitaki korereka.

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PART ONE
Background

Manihiki

Manihiki Island or *Te Fuinga o Niva* as it is traditionally known in the Cook Islands and is the second largest island in the Northern Group. It is. A low lying coral atoll, Manihiki is over 1200 kilometers north of Rarotonga. Its nearest neighbour, Rakahanga, is located just 44 km away. The atoll consists of some forty islets with a total land area of 5.4 square kilometers surrounding a deep central lagoon.

Characteristics of the island of Manihiki	
Type of island	Atoll
Location	11°S, 161°W.
Population(2011 Census)	481[1]
Distance from Rarotonga (km)	1204
Land area (km²)	5.4km²
Highest Point (m)	Approx 4m
Area used for Agriculture (acres)	n/a
Lagoon size (sq. km) and reef length (km)	Lagoon Size, 40km² Fringing reef, 32km

Figure 1: Map of the Island of Manihiki

[1] Census 2011 Figures

Farming of black pearls is the major industry for the people of Manihiki. However, since then, the economic returns from black pearl farming has declined considerably to just $2.2 million NZD in 2007, due to disease associated with over-stocking in the Manihiki lagoon and the reduction of the international price of pearls on the market.

Lagoon health is slowing recovering and other measures have been taken by both farmers and central government to revive the pearl farming industry including through significant changes to branding and marketing of Manihiki black pearls. There remains great potential for the Manihiki black pearl industry. Our efforts in this planning period hopes to not only improve economic returns from pearl farming but also to build the capacity of our people in all aspects related to pearl farming.

Rainwater is the main source of drinking water for the island. Rain is captured by each household for storage and there are also community water tanks that cater for peoples needs.

Manihiki's hospital is situated on Tauhunu with a doctor, nurse and public health officer, while Tukao has a clinic with a nurse practitioner.

Manihiki has two power stations for each village, Tauhunu with two 68kW diesel generator and one 68kW generator for Tukao. There are plans in the future for Manihiki to have a solar PV mini grid system with battery storage and a diesel generator as back up[2], however it is unclear when this grid may eventuate.

Transport to and from the island is both by air and sea. Manihiki has fortnightly flights landing at Tukao airport. This flight also carries with it passengers that will travel on to Rakahanga via an inter-island ferry. Return flights to Manihiki costs roughly about $3,000 NZD return. Shipping to the island runs on a schedule of one ship every three to four months. Freight costs for both modes of transportation is expensive and so people on Manihiki tend to bulk buy and import goods to last two to three months per household.

Environment

Manihiki is surrounded by thick lush coconuts and pandanus trees. Its lagoon is well known for its pearl production and one of key industry for the Cook Islands. It has extensive sea bird nesting especially on the islets.

The Manihiki lagoon is the backbone of the Cook Islands black pearl industry and its health is vital for the industry to thrive. A healthy environment is vital for Manihiki's survival and also future development. Of critical importance is the protection of Manihiki's foreshore not only from the effects of climate change and sea level rise but also importantly from human actions that may worsen the condition of our foreshore.

There are dedicated dump sites for waste disposal on both villages. Waste taken to the dump includes cans, bottles, old fridges and even old television sets.

[2] Government of the Cook Islands, 2012: Cook Islands Renewable Energy Chart Implementation Plan: Island Specific. pg 8

Climate

Currently there is no weather station for Manihiki. The Northern Cook Islands (Northern Group) position being so close to the equator results in fairly constant temperatures throughout the year. There is limited data on island specific climate trends and projections. 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 conditions[3].

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 results[4]:

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 (0–40ºS, 170ºE–130ºW)			√	
Ocean acidification is projected to continue	√			
Mean sea-level rise is projected to continue	√			

At present the average daily temperature in slowly rising. This is creating the onset of unpredictability in weather patterns around the world. The following events are expected to occur as direct result of this; Expected increased incidences of dry spells and drought; Increase bush fire incidences; Increased threat to bio-diversity on the islands, Expected increase incidences of heavier than normal rainfalls and occasional occurrence of rise in sea levels leading to flooding and damage to lowland or low islands.

It is therefore important that communities living on the atolls are aware of the risks/threats and are prepared and ready to face these when it occurs. Tropical cyclone Martin in 1997 was one extreme event that is still haunts the people of Manihiki. It was reported that waves

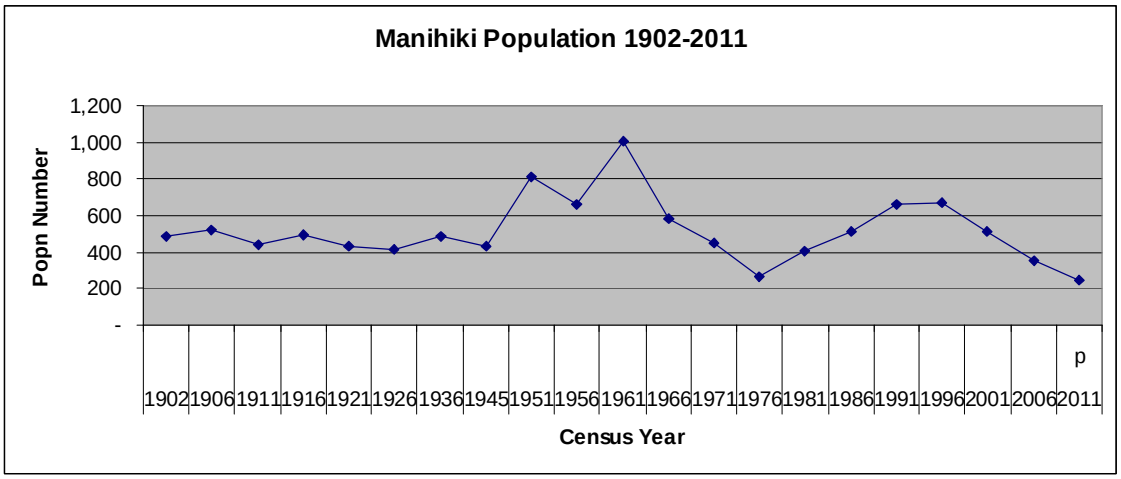
[3] Government of the Cook Islands, 2011, *Cook Islands Second National Communication under the United Nations Framework Convention for Climate Change*.
[4] Australian Bureau of Meteorology and CSIRO, 2011. *Climate Change in the Pacific; Scientific Assessment and New Research. Volume 2: Country Reports.*

reached to 14metres in height and several people was swept to sea. It is still an emotional topic for Manihikians and had a psychological impact on some that chose to leave the island.

Social

Population

Manihiki has two populated villages – Tauhunu and Tukao. The total number of occupied dwellings in 1996 was 198, but by 2001 the number had declined to 161, with an average size of 4 persons per household. In the 2011 census the preliminary results shows that the population of Manihiki in total is 481 with 233 male and 248 female. For the household survey that was done, the number of occupied dwellings 125 and 86 unoccupied.



Furthermore, the 2011 census shows a distribution of age groups in the pie graph. Over fifty percent of the population is under the age of 35 and ten percent are pensioners.

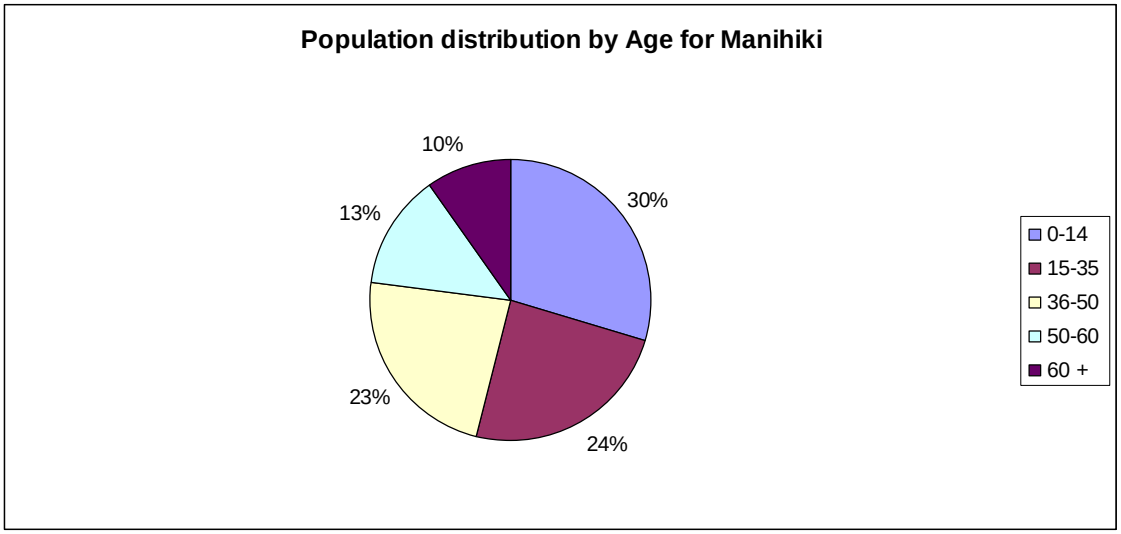


Figure 2: Tauhunu Village

Figure 3: Tukao Village

Local Governance

On Manihiki, the Island Secretary oversees the delivery of services by public servants. At the time of the undertaking of the assessment, the Government was in the process of amending? the local government act to empower the Mayor and the local council to take charge of the island administration.

The island also has a Member of Parliament who is currently based in Rarotonga as he is also the Prime Minister of the Cook Islands, Honorable Mr Henry Puna;

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.

The island is managed by the Local Council consisting of the Mayoress and 5 council members. They are the focal point during times of disaster. There are a total of 43 public servants employed by the Island Administration. There are also service providers who are directly responsible to the Secretary of the respective Ministries on Rarotonga namely Marine Resources (3), Environment (1), Internal Affairs (1), Justice (1), and Education (6), Health (4) and Government representatives (2).

Economy

Pearl Farming

Manihiki is well known for its pearl industry, an industry which was booming in the early 90s until 1997. During Cyclone Martin in November 1997, many of the farmers including laborers were evacuated and migrated overseas. There was also reports of the lagoon being contaminated where many critics blamed the debris from Cyclone Martin was starting to affect marine life within the Lagoon.
Today, regular monitoring of the lagoon is carried out by MMR and annual results are published.

Fishing

Like Rakahanga, Manihiki also enjoys a lavish supply of fish. During the teams stay in Manihiki, the people were waiting for the “ti’iti’i” school of fish where when cooked on open fire produces more Omega 3 oil than any other known fish species.
Fishing in Manihiki varies and in the short stay that the team was there, the team accompanied local fishermen to the fish trap to wait for fish in the trap.
Ocean Fishing is an ongoing daily habitual regime for the men subject to good climatic conditions and on some occasions on the phases of the moon.
Manihiki have a productive lagoon and deep sea resources, which includes bivalves like clams, pearls as well as lagoon and deep sea fisheries. These resources however, need to be used, looked after and maintained to provide food security to the island community. Opportunities for development of these marine resources for revenue generation should also be considered by the island communities. However, these developments must be considered only on a sustainable basis.

Tourism

Tourism is slowly developing on the island of Manihiki. There has been a steady increase in tourist accommodation on the island with the major accommodation unit being Manihiki Villas.

Local market

There is no local market but there is drive to export fillet fish to Rarotonga to cater for the local markets. There are also the odd exporters who are exporting dried fish to Rarotonga. This enterprise is hindered because of the lack of regular shipping schedules and the high costs of airfreight.

PART TWO
Vulnerability Assessment

Vulnerability Assessment

Methodology

In compiling data for this report, three activities were undertaken;

1. Mini Workshop

The Mini Workshop was conducted in the Council Chamber in Tauhunu. This was attended by the leaders of the island, including the Deputy Mayor, Local Council Members, community leaders and youths. The exchange was free flowing and interactive with the council members and the presenters.

Presentations were given by Ms Mii Matamaki, Senior Environment Officer from the National Environment Services and Mr Charlie Numanga from the National Red Cross.

One of the discussions revolved around the the 1997 Cyclone Martin which had a negative impact on the island. Comments from participants included that that "evacuation of the people from Manihiki should not have been carried out as it lead to the huge out migration of the people of Manihiki"[5] This resulted in the displacement of the population which eventually lead to the decrease in the labor force. Whilst some may have decided to stay in Rarotonga, the majority have travelled on to New Zealand and Australia.

The Mini Workshop ended up with refreshments.

Figure 4: Participants at the Mini Workshop

[5] Luka Tobia – Deputy Mayor of Manihiki 2012

2. Public Awareness

Two public awareness sessions were held, one in Tauhunu Cyclone Safety Center and the other held at the Tukao Cyclone Safety Center. Both awareness workshops were well attended by members of the Manihiki community and included a good cross section of the resident population, including old and young participants.

After the introductions and presentations pertaining to CC were presented by Mii Matamaki of NES, the participants were grouped into four sectoral areas for discussion and each group to come up with adaptation options.

The four discussion topics were as follows:

1. Impact of CC and Health
2. Impact of CC and Water
3. Impact of CC and Marine
4. Impact of CC and Food Security

There were some reservations at first of the discussion points but as the sessions continued, the lessons learnt from past experiences or practices were revealed by some of the elders.

The breakout sessions also allowed participants to voice their experience or some of the practices that they undertook. Refer to the table for each of the groups presentations in the annex.

Figure 5: Participants at the Community Awareness Sessions both for Tauhunu (L) and Omoka (R)

In terms of the presentation, the presenters spoke in maori to deliver the presentations to the participants. Inter changes amongst the presenters to keep the participants attention was used as the mode of delivery.

Both sessions held in Tauhunu and Tukao ended with a well deserved '*kaikai*' catered by the Youth of Tauhunu and Tukao.

3. HOUSEHOLD SURVEY

The Survey was conducted on both Tauhunu and Tukao using the developed questionnaire amended from the 2008 Vulnerability and Adaptation format. The questionnaire was amended to suit the environment of Manihiki as i is an Atoll Island as opposed to those islands in the Southern Group. The final survey is copied as an appendix.

The survey was first carried out in Tauhunu on the first 3 days from 17th to the 19th. Tukao was surveyed on the last 2 days on the 20th and 21st.

Each of the four enumerators was split into two and conducted house to house survey along identified house numbers.

The survey was carried out through face to face interviews with the respondents. Different responses were received based on the level of knowledge and understanding on the topics covered within the questionnaire.

Risk Assessment – *the impact of Climate Change and Disaster*

Purpose

The purpose of this community vulnerability and adaptation assessment is to determine the applicability, relevance and the urgency of the DRM and CCA JNAP as well as the 2NC. There was also assumption that the people of Manihiki were aware of these two key documents.

It also seeks to determine whether these are priority needs for the island people today.

The cost of implementation to bring into reality these initiatives was never addressed. This was an oversight on the part of the team.

Objectives

The objectives of this exercise are to gather some information about the vulnerabilities that that the people of the village of Tauhunu and Tukao are facing with regards to climate change and disaster risk.

Methodology

From the 11th – 16th September 2012, members of the NES and Red Cross undertook a climate change and disaster risk assessment based on information from the Cook Islands *"Second National Communication"* and the "*Joint national action plan for disaster risk management and climate change adaptation (CI JNAP DRM CCA)"*.

A list of priorities highlighting the risks that may impact the lives of the people of Manihiki was produced through collaboration and consultation with the Island Council and other participants. This is the same tool that will be used for all of the risk assessment for Rakahanga, Palmerston, Penrhyn and Atiu.

Furthermore, a mini-workshop was conducted with the Island Councilors and community leaders for both villages of Tauhunu and Tukao.

Climate Change and Disaster Risk Assessment

Step 1 - Summarise the Risks –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). The source of these event risks and outcome risks are the Cook Islands *Second National Communication* and *Joint National Action Plan for Disaster Risk Management and Climate Change Adaptation* (CI JNAP DRM CCA). The marked priority is in italics as identified by the group.

Event Risk	Outcome Risk NOTE: Following outcome risks listed in SNC and JNAP DRM CCA
Climate Change	
1. ***Sea level rise and storm surge-*** Ø A rise in sea level of 1 meter by 2100 Ø Increase in storm surge events inundating up to 4.5 meters above mean sea level.	1. *Increased incidents of coastal erosion, flooding and inundation of low lying areas, access way – school in Tukao, Tauhunu* 2. *Impact on economy and loss of investments (cost of recovery) especially on coastal infrastructures (airport/harbour), te au are i runga i te kaoa;* 3. Damage to coastal infrastructure and areas – road and/or access way/ airport/harbour/micro shelters 4. Impacts on traditional livelihood and culture – loss of access to fishing areas (te titiara kua taui takiri te tuatau e aere mai ana-change of season)
2. ***Changes/variations and increase in local and national temperatures regimes*** Ø increase of between 1.5 and 3.5 degrees, more hot days and warm nights particularly in Southern Group	1. *Impacts on marine and terrestrial biodiversity - migratory and distribution changes/changes in migration and breeding patterns of birds and fish, especially tuna.* 2. *Increasing energy demand (cooling, refrigeration, electrical appliances have increased) – cost of electricity increase*

	3. Impact on ecosystems (marine, terrestrial and aquatic) – corals, food productivity 4. Impact on vector borne disease (water quantity, demand, quality) Increase in diarrhea related illness especially for babies. 5. Increased prevalence of invasive species (productivity, species distribution or migration)
3. ***Changes in rainfall patterns*** - Ø an increase in precipitation especially during the wet season in Southern group Ø incidents of extreme rainfall are likely to occur more often and be more intense	*1. The availability of water in general for drinking and bathing* *2. Impact on human health from water and vector borne diseases* 3. Increased incidents of crop diseases affecting food security – the livelihoods of pigs, bok-choy 4. Increased prevalence of invasive species 5. Reduced tourism attractiveness, and economic losses from productive sectors, food insecurity, natural resources for handicrafts etc
4. ***Increased climate variability*** – Ø Changes in seasonal temperatures, timing of rainfall,	*1. Impact on agricultural productivity and food security – seasonal changes and also its quality is not as good as it used to be.* 2. Impact on terrestrial and marine biodiversity (pollinators-bees etc, migratory species (te titiara, taui te tuatau), growing cycle, food chain) 3. Impacts on tourist arrivals and duration of stay
5. ***More severe weather events*** (droughts, rainstorms, heat waves, and category 4/5 cyclones) - Ø Increase in frequency, intensity and duration of extreme events (floods, droughts and storm	*1. Increased incidents of water pollution and damage to water storage, not enough water, affecting agriculture foodcrops etc* *2. Stress and social disruption, psychological – family members*

surges) Ø 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 Ø Increase in wind intensities between 5-10% by 2050	*leave for income earning activities, stress on family members, shock of what had happened* 3. Impact on coastal ecosystems (wave damage, erosion) 4. Increased incidents of damage to infrastructure, fishing boats 5. Loss and damage to agricultural infrastructure and crops affecting food security 6. Increased incidents of loss of human life and injuries Disruption of education and social services, affecting already vulnerable groups like disabled, youth, and women 7. Increased damage to terrestrial and aquatic living things 8. Increased costs for recovery, impact on economy and reduced ability to attract foreign investment 9. Increase internal migration leave for Rarotonga 10. Increase demand on emergency shelters
6. Increased incidents of ocean acidification	*1. Impact on marine biodiversity and resources including migration of fishery resources* 2. Impact on coral growth and fish nurseries
7. Increased levels of Green House Gases (GHGs)	1. Increased incidents of ocean acidification 2. Impacts on human health: respiratory
Disasters	
8. Hazardous substances spillage (oil and petroleum products)	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 Manihiki and Rakahanga
10. Epidemics (Dengue fever, cholera)	*1. Impacts on productivity – people cannot work as they have fallen ill*

	2. Loss of life 3. Impacts on health service delivery – doctors and nurses may become patients as well
11. Geo-physical hazards (tsunamis)	*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

Step 2 – Estimate Risks - Using the summary of risks to the relevant sector developed under, the Manihiki Councilors undertook an estimation of the following key elements of risks (if possible by location), namely:

Estimate the ***Severity of the Impact (Event and Outcome Risks)***
In the context of climate change adaptation, the leaders can 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 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 *Increased incidents of coastal erosion, flooding and inundation of low lying areas, access way – school in Tukao, Tauhunu* 6/11

Impact Severity	**Social**			**Economic**				**Environmental**			
	Displacement	Health	Cultural aspects	Loss of livelihood	Property loss house/land	Fina loss crop/land/ livestock	GDP loss	Air	Water	Land	Biodiversity / ecosystem
Very low											
Low		X						X			
Moderate	X			X			X				
High			X						X	X	X
Very high					X	X					

The following are the top 12 priority risk that was identified by the Community Leaders. The ratings for the "high" and "very high" occurrence of severity were recorded for the purpose of determining areas of high impact.

Number	Outcome Risk	Social	Economic	Environmental
1	*Increased incidents of coastal erosion, flooding and inundation of low lying areas, access way – school in Tukao, Tauhunu*	1	2	3
2	*Impact on economy and loss of investments (cost of recovery) especially on coastal infrastructures (airport/harbour), te au are i runga i te kaoa;*	2	4	2
3	*Impacts on marine and terrestrial biodiversity - migratory and distribution changes/changes in migration and breeding patterns of birds and fish, especially tuna.*	2	2	2
4	*Increasing energy demand (cooling, refrigeration, electrical appliances have increased) – cost of electricity increase*	2	2	0
5	*The availability of water in general for drinking and bathing*	2	2	2
6	*Impact on human health from water and vector borne diseases*	3	2	1
7	*Impact on agricultural productivity and food security – seasonal changes and also its quality is not as good as it used to be.*	1	1	2
8	*Increased incidents of water pollution and damage to water storage, not enough water, affecting agriculture foodcrops etc*	2	3	2
9	*Stress and social disruption, psychological – family members leave for income earning activities, stress on family members, shock of what had happened*	2	3	1
10	*Impact on marine biodiversity and resources including migration of fishery resources*	2	3	2
11	*Impacts on productivity – people cannot work as they have fallen ill*	1	2	1
12	*Loss of life and injury*	3	4	4

Step 3 - Estimate Frequency or Probability of Event

The Group will estimate the frequency or probability of an event identified in the relevant reports based on their expert judgement.

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
Sea level rise and storm surge + Increased incidents of coastal erosion, flooding and inundation of low lying areas, access way – school in Tukao, Tauhunu	3
Sea level rise and storm surge + Impact on economy and loss of investments (cost of recovery) especially on coastal infrastructures (airport/harbour), te au are i runga i te kaoa;	3
Changes/variations and increase in local and national temperatures regimes + Impacts on marine and terrestrial biodiversity - migratory and distribution changes/changes in migration and breeding patterns of birds and fish, especially tuna.	2
Changes/variations and increase in local and national temperatures regimes + Increasing energy demand (cooling, refrigeration, electrical appliances have increased) – cost of electricity increase	4
Changes in rainfall patterns + The availability of water in general for drinking and bathing	4
Changes in rainfall patterns + Impact on human health from water and vector borne diseases	3
Increased climate variability + Impact on agricultural productivity and food security – seasonal changes and also its quality is not as good as it used to be.	3
More severe weather events + Increased	3

incidents of water pollution and damage to water storage, not enough water, affecting agriculture foodcrops etc	
More severe weather events + Stress and social disruption, psychological – family members leave for income earning activities, stress on family members, shock of what had happened	2
Increased incidents of ocean acidification + Impact on marine biodiversity and resources including migration of fishery resources	2
Epidemics + Impacts on productivity – people cannot work as they have fallen ill	2
Geo-physical hazards + Loss of life and injury	1

Evaluate the Risk **-** Based on their own expert judgement as the people living on the island, identified risks are to be examined by the Group in terms of costs (*Note: costs are to be qualified not quantified*), benefits and acceptability, considering the needs, issues and concerns of stakeholders. The purpose of this evaluation is to give consideration to:

- ranking the risks from "least severe" to "most severe" from the analyses completed in previous steps and the perceptions of the stakeholders;
- estimating the costs of potential losses;
- assessing the acceptability of the risks.

Step 4 – Identify Priority Risks and Vulnerable Communities - Based on the outcomes from Steps 1-3, the community leaders identified the priority risks for the different sectors, and identified districts/communities that are vulnerable to these priority risks.
The group found that, rather than select areas, the island as a whole was identified as being vulnerable, and this assessment was used to proceed to the next step.

Step 5 – Identify possible intervention options to address priority risks
From the prioritised sectors, the leaders considered adaptation measures that could be implemented as proposed policy options. Refer to Part III for adaptation measures.

PART THREE
Community Adaptation Plan

ADAPTATION AND ASSESSMENT – some options to be considered

Identify possible intervention options to address priority risks	
1.Increased incidents of coastal erosion, flooding and inundation of low lying areas, access way – school in Tukao, Tauhunu	- build retaining walls: improve/strengthen retaining walls for berthing of small boats - support and assist the people of the island to refill/reclaim/raise areas that is low lying (e.g. school in Tukao) - encourage/support community works especially in public areas e.g. harbour. (island working bee to be introduced again)
2.Impact on economy and loss of investments (cost of recovery) especially on coastal infrastructures (airport/harbour), te au are i runga i te kaoa;	- strengthen building codes: coastal infrastructure up to standards of cyclone damage -replanting scheme especially tamanu trees
3. Impacts on marine and terrestrial biodiversity – migratory and distribution changes/changes in migration and breeding patterns of birds and fish, especially tuna.	- change of fuel engine from 4-stroke to 2-stroke - encourage raui or reserve areas to allow fish and other species to spawn/grow -promote best practices through local fishing clubs/associations
4.Increasing energy demand (cooling, refrigeration, electrical appliances have increased) – cost of electricity increase	- renewable energy: solar to decrease cost to fuel and decrease cost to power units - training program on how to maintain solar panels - continue energy conservation/efficiency practices and awareness - awareness program on types of appliances that is suitable to the island or 5 stars etc..
5.The availability of water in general for drinking and bathing	- increase water storage and capacity: homes and community tanks - awareness about water conservation - training on regular water tank maintenance - monitoring water safety levels throughout the community (water testing for drinkable standards)
6. Impact on human health from water and vector borne diseases;	- Tutaka programme
7. Impact on agricultural productivity and food security –seasonal changes and also its quality is not as good as it used to be.	- salt tolerant/heat tolerant plants - traditional preservation techniques: ika maro, puraka, kuru, uto - best practise guidelines
8.Increased incidents of water pollution and damage to water storage, not enough water, affecting agriculture foodcrops etc	- increase water storage and capacity: homes and community tanks as well as for agricultural purposes

	- monitoring water safety levels throughout the community (water testing for drinkable standards)
9.Stress and social disruption, psychological – family members leave for income earning activities, stress on family members, shock of what had happened	- training of trainers for counselling services - train people to become counsellors
10.Impact on marine biodiversity and resources including migration of fishery resources	- encourage raui or reserve areas to allow fish and other species to spawn/grow - promote best practices through local fishing clubs/associations
11.EPIDEMIC: Impacts on productivity – people cannot work as they have fallen ill	- Redcross volunteers/retired nurses and doctors to help community (support and upgrade their skills) - Plan : Standard operation procedures in place -Early warning system in place
12.Loss of life and injury	- Early warning in place - people to adhere to the warning - community leaders to know their role in times of disaster (Police) - review and update the island disaster plans - have drills to prepare the community so they know their role, where to go.

Further distinction and separation of adaptation initiatives were classified under the following key Sectors:

Disaster Risks

- Advanced weather warning systems, improved disease surveillance and prevention programs, improved response during drought periods;
- Improved communication among both islands and with Rarotonga;
- Climate proof infrastructure developments;
- Ongoing disaster awareness programs with Red Cross, EMCI and other front-line responding agencies (Ministry of Health, Ministry of Agriculture, Ministry of Marines)

Marine

- Continued encouragement of best practices such as the 'raui' program to conserve and sustain fish stocks;
- Management of coastal fish habitats and fish stocks to ensure that they continue to provide fish for food security;
- Promotion of catch and release' type of fishing for tourism ventures to ensure some growth in tourism

- Reduction in[6] the number of fishing licenses given to foreign vessels to maintain tuna stock within Manihiki fishing waters;

Health

- Improved ability of Manihiki to adapt or respond to climate-induced changes to human health, including through continued investment in public health infrastructure and improved building codes[7] to prevent storm damage,
- Enhanced sanitation systems;
- Improved drinking water systems;
- Monitor and control the exhaust fumes affecting coconut trees that could also lead to affecting the community;
- Improved waste management systems for the island.

Agriculture

- Increased awareness and promotion of home gardening for women to encourage healthy living and diet within the household;
- Improved support for hydroponics operations on Manihiki, including through improved water storage, access to seeds, plant nutrients etc
- Promotion of traditional food preservation methods to the youth and within the school;
- Planting of native trees (such as Pacific Mahogany, Coconut Trees) along coastal areas prone to high seas;
- Introduction and promotion of new hybrid crops that can withstand pests, high salinity weather conditions and even dry spells.

Tourism

- Promotion of home stay accommodation for tourism;
- Promotion and introduction of local cuisine and delicacies such as 'uto pancake', baked/raw oyster and others;
- Promotion of bone-fishing as a tourism destination in Manihiki;
- Promotion of scuba diving as an alternative attraction for tourism in Manihiki

[6] We were unable to determine what exactly are we trying to define the nominal number of agreed fishing licences to be issued out to foreign vessels;
[7] There is a Building Regulations and Standards Act 1991 that applies nationally but poorly enforced due to lack of qualified personnel to ensure compliance.

Conclusion and Recommendation - lessons learned

The impact of climate change on Manihiki is nothing new to the people. The direct impact of past cyclones has resulted in the destruction of essential services and domestic housing. The demise of the pearl industry in the early 2000 (which was a booming sector in the mid 80s) has forced the pearl farmers to revisit their farming practices to keep the lagoon pristine and healthy for sustaining pearl oysters. One cannot say that the demise of the pearl industry was a direct result of climate change but could be caused by multiple factors. Unless a proper research is carried out, we will never know. At the time of writing this report, Ministry of Marine Resources and Climate Change Division of OPM were in the process of advertising for a Pearl Biologist to conduct this research.

The people of Manihiki are already practicing some of the adaptation practices to minimize their vulnerability to climate change and its adverse impacts – which means that they are already being proactive by:

- Undertaking tree planting schemes;
- Rebuilding community water tanks to increase water storage;
- Practice water conservation measures;
- Promote 'raui' system in as well as putting in place good policies to sustain fishing on the reef and in the lagoon;
- Recycle rubbish for manure
- Promote Climate Change in school and community activities;
- Rebuild and on-going maintenance of rock walls/wharf within the lagoon
- Plant and introduce hybrid systems that can withstand the high salinity levels, high temperature and limited fresh water;

The V&A conducted in Manihiki has produced some data that has been translated for GIS purposes. The recording of captured historical events, negative social impacts, declining economic livelihood caused by Climate Change and past Cyclones has helped enrich the mixture of lessons learnt. These lessons learnt needs to be replicated as best practices to be adopted by our future generation.

Despite all these undertakings, stronger leadership and direction by the council members and other leaders within the community is required to ensure resilience and adaptation.

In concluding, one of the best responses received was the following:

"we need to change our attitude and perception towards new teachings, new ideas, new knowledge…..knowledge will increase as well as negative impact upon us because of our awareness of what is happening. Our environment is to be preserved and we must take heed of the lessons learnt"

APPENDIX

1. Copy of the survey form;

Manihiki Vulnerability and Adaptation Assessment

In Association with Cook Islands Red Cross Society and the Office of the Prime Minister

Questionnaire completed by: ……..

Date: ___/___/2012__ 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	(M, F)	Age	Relationship e.g. 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 % Island 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.

Food Preservation	Y/N	Remarks
Refrigerator		
Freezer		
Imported Dried/Canned		N/A
Local Preserved		N/A
Sealed Containers		N/A

Questions about Food Preparation

Main Cooking Fuel	%	Remarks
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?
……
……
……
……
……

II. Have you noticed any changes to your livelihood after changes to the shoreline?
What have been these changes? Kua taui ainei toou oraanga ngutuare no tei taui te turanga o te tapataa tai?
……
……
……
……
……

Recommendations for community action? Tetai uatu manako

2. Group Discussions from the Community Awareness meetings

Food security	Marine	Health	Water
Main impacts due to climate change • Shortage in food supplies • Be more self sufficient-store food for *rainy days* • Food security-when in season-dry fish, pahua, korori- preserve them • Takataka coconut, cook & dry ripe kuru/puraka, husk uto & bury, rebury harvested puraka, cook reru bread & store away • Storage of dry foods in freezer eg: flour, rice SOLUTION • Reviving old methods of preserving food • Storage/burying of preserved food for times of need e.g.: post hurricane season • Promote above method within the community, school • Create awareness to prepare for any	**Identify the effects? (Impacts)** • Lagoon visibility eg: clear to murky brown sea changes due to climate changes (no rainfall x7/12) 04/2011 • Changes in weather pattern eg: longer periods of rain/dry lands, increase in sea temperature • High mortality in pearl/oyster: kept at different depths etc; affects the productivity & quality • Fish/marine species: change in catches/species & variety caught • Affects pearl farmers income SOLUTION • Awareness in the community e.g.: increase public awareness/policy in place • Educate & promote: school, community/homes etc, recycle/composting etc to decrease effects to climate	**Te manamanata e kite nei I konei** • Overweight • Kare e angaanga • Kaikai • Makimaki • Toto kake • Toto vene • Maki pukuatu • Namu: tama te au ngutuare SOLUTION • Walk • Tieni te te au kai • Create activity, sport, education • Apii te takainga TEAM 2 • Sickness, poor health, diet resul of water quality,redsoil • Loss of life • Increase of disease. Diarhea etc • Heatwave (temperature increase) • Reduce local food supply SOLUTION • Contact Red Cross, Health, Disaster Management, Island Council • Water tank increased (drought), filter	• Water storage areas were damage • Water pollution • No drinkable water SOLUTION • Assess damage and repair water tanks, spouting, down pipes • Clean out all polluted waters in tanks etc. AWARENESS • Educate the people how to conserve water **Pupu 1-Turanga ote vai inu** • Ravakore ote vai inu • Kare e meitaki an ate turanga ote punu fare kua pe(para) • Kare e putuputu an ate ua • Kare e akameitaki ia te au ngai vairanga anga vai (1997-2012) • Taangaanga ia nei te vain inu ei fangai anga manu (please do not) SOLUTION • Kia akafou ia te au punu fare pe

thing of need/disaster • Kuru tamiti-stored in tin 3-6 months • Dryed pahua-sun & salt 3years + • Uto buried 6 years + SOLUTIONS-RAVENGA AKAMEITAKI • Educate new generation-television, festival, food stall, home, school, storage Group 4-Impact • Lack of local grown produce-tanutanu • Lack of healthy produce • Soil unstable for growing crops SOLUTIONS • Encourage all types of planting-coconut, kuru trees • Replenish trees/crops • Encourage composting CONTRIBUTION • Start education in schools/community	changes • Introduce healthy living habits How can you help your Island? • Leading by examples e.g.: Councillors • Increase responsibilities with stakeholders e.g.: sponsors • Practice and encourage Effect/Impact • Increase sea surface temperature-fish decrease, decrease catch, corals • Increase cyclone/hurricanes • Change in sea level • Contaminate rubbish • increase sea surface-alage bloom, decrease food sources for shells, production and quality of products, decrease & income SOLUTION • Raui-Routine monitoring and cleaning • Monitoring-set up guidelines or policy for changes	system, medicine, doctor, nurse • Promote food preservation (dry fish, dry banana, etc) • Promote water conservation How can you help your island? • Try self-help, central government, international appeal for assistance • Health awareness, workshop • Implement viable & pertinent solution • More water tanks, health staff, medicine	(para) • Kia tukuia mai tetai au tangika/tura vai fou note au ngutuare katoatoa.(teia openga mataiti 2012) • Akarapurapu ite aka meitaki ite au tura vai tei kino • Taporoporo ite vai meitaki ei inu auraka e kaimoumou kia kore tatou e u kia paki Eaa taau ka rave ite akameitaki I toou iti/oire.tangata? • Ka angaanga taokotai au/matou/tatou kite iti tangata note akameitakianga • Tereni mekre apii ite iti tangata ka akapeea te paruru ite manamanata(iri ir kapua) • Anga me kore akanoo I tetai au ture note paruru ite manamanata • Kia tukuia te au vananga akameitakianga ki runga ite tv, ratio, kia rori ei akamaaraaara, aka matakite ite

• Community exhibition of home garden, trees, crops planted	• Nursery • Hatcheries • Report to community CONTRIBUTION • Follow guidelines/policies being put in place • Increase awareness in the community-climate change policies, water/contaminants • Follow the lagoon management plan • Increase/decrease foverfishing		iti tangata • Kia akapapujia tetai au akanoonooanga (pahi/pahirere note kave mai ite au meitaki note tauturu ite iti tangata: akaraanga tangika vai, punu fare ete vai atu ara.

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ISLAND FACT SHEET – MANIHIKI

Physical features	Area: 5.4km^2 Elevation: <4m above MSL Island Type: Atoll Proximity: 1,204 km from Rarotonga 44 km from the nearest island (Rakahanga) Settlements: 2 villages Tauhunu & Tukao Second largest island in the Northern Group
Demographics	Population: (2011) 481 Households: approx 59 HH
Environment	Think lush coconut and pandanus trees Black pearls 40 tiny islets
Health	Clinic in Tukao with a nurse practitioner, Hospital in Tauhunu with a doctor High levels of NCD's Food: • Local – Fish and "Uto" • Imported – Rice, Flour, Sugar
Local Economy	• Black pearl aquaculture • Handicrafts made from 'rito' sometimes adorned with pearls and pearl shells
Air Transport	• 1,200m long landing strip • Air service, fortnightly flights, occasional chartered flights • Fuel storage facility
Sea transport	Ship cargo reaches the island on average of once a month to once every 2 to 3 months Tourist on yatch visits the island from time to time
Road transport	No sealed road, road is of coral and sand
Water Supply	HH water tanks or Community water tanks
Sanitation	Toilet: Flush or Pour-flush
Solid Waste	There is no proper landfill, rubbish is collected and dump in a hole dug up and covered once it full
Electricity supply	Diesel Generator – 2 x 68kW for Tauhunu and 1x 68kW for Tukao Power in on approx 18 hours a day
Telecommunications	• 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
Cyclone shelters	One cyclone shelter in each village

KEY ISSUES – MANIHIKI

Issues	• Land availability is constrained • Proper pearl farm management for sustainability of economic

	well being • Lagoon health is also a priority
Environment preservation	Raui system in place especially for “paua” Control of the export of paua and coconut crab
Economic development	Strengthen the Pearl Industry Potential in the handicraft industry Potential in the fisheries sector