



KAP II TA - TOR 4.1, 4.2, 4.3

Marakei

**Community Consultation, Risk Assessment
and Training**



compiled by

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Executive Summary

A visit to Marakei was carried out for the same purposes as in previous islands, Tamana, Beru, Kuria, Makin and others. Similar activities were carried out as part of the consultation process.

The team that visited Marakei comprised Dr. Temakei Tebano (The EcoCare Group and current National Consultant to KAP II for Components 4.1 and 4.2 and 4.3), Miss Rosalind Kiata (Media Consultant, KAP II), Mr. Tion K. Uriam (Resource Information Officer, Mineral Unit, MFMRD) and Mr. Tierata (Civil Engineering Unit, MWPU), Mr. Martin (Water Section of MWPU), Miss Erimeta Barako (MISA) and Ms Makin (MELAD). Also assisting were the IPO, ICW officers of Marakei Island Council. The key areas discussed fell under water, coastal erosion, reduction in natural resources, and sea level rise. Adaptation strategies to overcome or reduce risks and vulnerabilities related to climate change and sea level rise were discussed during all sessions and enacted through poster presentations, song composition, a drama and radio programs.

The relocation issue in light of reduction in landmass due to accelerated coastal erosion, as the last resort, was discussed but the emphasis was on adapting to risks and vulnerabilities at an island level and finding solutions to those being faced by the Marakei people. Briefings on project funding and how they can be accessed were provided by Miss Barako. Mr. Uriam presented comprehensive information on how beaches and aggregates are formed, the need to protect and look after our coastal areas through limiting the amount of aggregate mining and enhancing mangrove and coastal vegetation planting to ensure surge storms have minimal impact. Ms Makin presented the climate change and sea level rise slides, while Martin and Tierata presented facts on water and construction designs, respectively.

Miss Kiata trained participants on information gathering and dissemination on all issues discussed in the consultation. The exercise provided participants with a feeling of satisfaction in that they heard and enacted issues of concern to our existence in light of climate change and sea level rise. A recorded drama by the Catholic Youth Group in Tarawa on all aspects of CC and SLR was screened at end of day 1 to give participants an overall view of the consultation and the issues most pertinent that they will enact as part of the participatory, risk assessment, awareness and adaptation process.

The bulk of the four-day consultation was spent on explaining the causes and factors contributing to global warming with subsequent events such as climate change and sea level rise and potential adaptation measures to reduce or counter their impact at a village and island level. Documentaries on CC and SLR and other relevant videos were screened.

A review on contributions to the 2007 consultation from various government and private sectors were summarized by Dr. Tebano. Dr. Tebano also presented his factual lectures on linkages between and among systems (on power point) and emphasized that all systems are linked in many ways most of which are not understood. Destroying one system will eventually affect other immediate or farther systems sooner or later. The connectivity between and among them is through air, energy, water currents and waves, food chain, and many more. He also strongly supported biblical writings in relation to man's responsibility to care for the Earth.

Each presentation by team members was followed by open discussion on risks and vulnerabilities, including problems related to CC and SLR, and potential strategies taking into account of traditional

knowledge and workable measures in light of the increased intensity of drought, storm surges and unpredicted bad weather.

Village representations comprised youth groups(s), women interest group(s), church groups and other significant groups within each village set up. There were cases where those over 50 years and above participated. The selection was done through village councilors who then consulted village elders to witness the selection process. There were 72 participants with at least 6 representatives from each ward within a village. Risk assessment and island profiling were partly done through consulting participants on the affected sites followed by site visits, filming and recording exact positions with a GPS. Issues related to island profiling were gathered by the MISA staff accompanying the team.

Water is not a critical issue on Marakei at the time of the consultation. The rains fell occasionally hence there was enough rainwater for almost the overcrowding guest house with no ground water for most of the day. It was reported that the latest drought had severe impact on ground water in wells close to the coastline, plant resources and people in general. Rainwater is available in homes with corrugated iron or aluminum roofing. Council and Government housing have some plastic water tanks but no concrete cisterns.

There is little agricultural activity in terms of vegetable and swine/poultry home farming. The village is busy with sorts of fishing activities. The most exploited marine resources are juvenile bonefish and goatfish. Tunas and other reef fish are rarely caught. An ice plant has few fish and some ice cubes for sale.

The Marakei people are not aware of CC and SLR as a follow up from the December 2007 consultation had not been carried out due to lack of support from the Island Council. There was no money for transport and material costs. Potential risks and adaptation measures have not been thought of seriously either. It was seen that intensifying training and consultation on CC and SLR complimented with media training in its various forms and with contributions from island councils and government ministries in their respective areas related to CC and SLR will boost the awareness level that should slowly lead to determining appropriate adaptation measures most appropriate for Marakei and other islands. The training and participation of IPOs, ICWs and village representatives is an important integral part of capacity building to ensure public awareness continues after the conclusion of the project.

ACRONYMS

ACP	Asia-Caribbean-Pacific
AG	Attorney General
CCA	Climate Change Adaptation
CPUE	Catch per unit effort
DRCS	Digital radio concentrator system
EC	European Commission
ECD	Environment Conservation Unit
EDF	European Development Fund
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
IC	Island Council
ICT	Information Communication Technology
ICW	Island Community Worker
IPO	Island Project Officer
JSS	Junior Secondary School
KAP II	Kiribati Adaptation Project II
KCCSC	Kiribati Climate Change Steering Committee
KPC	Kiribati Protestant Church
LDC	Least developed countries
MDGs	Millenium Development Goals
MELAD	Ministry of Environment, Lands and Agricultural Development
MFMRD	Ministry of Fisheries and Marine Resources Development
MISA	Ministry of Internal and Social Affairs
MPWU	Ministry of Public Works and Utilities
MTR	Medium Term Range
RC	Roman Catholic
SEC	Solar Energy Company
SLR	Sea Level Rise
SPC	Secretariat of Pacific Communities (formerly South Pacific Commission)
SWO	Social Welfare Officer
TCH	Tungaru Central Hospital
TK	TiibiKauntira (Chief Council)
TOR	Terms of Reference
UNCDF	United Nations Conservation Development Fund
UNDP	United Nations Development Program
USA	United States of America
WHO	World Health Organization

Chapter 1: INTRODUCTION

1.1 Scope of the Report

This report focuses on the status of terrestrial physical environments, marine physical environment, marine and terrestrial resources (living and non-living), communication and transport, the general discussion and recommendations on issues needing immediate action to counter or reduce risks and vulnerabilities that are affecting the lives of Marakei residents on a daily basis. The island profiling aspect is compiled by MISA staff accompanying the team.

1.2 Selection Criteria

The selection criteria are discussed fully in the Tamanareport by Tebano, *et al.*, 2008). KAP II senior management presented them in early May to the National Steering Committee (NSC) and was approved unanimously in the July meeting.

1.3 Rationale of the Marakei Visit

A visit to Marakei is similar to previous visits that aim to assess, record and report potential risks and vulnerabilities related to CC and SLR. This exercise falls under public awareness and consultation, TOR Component 4.2 of the Consultant (Dr. Temakei Tebano) and Training Component 4.3 now under the same TOR. Marakei is the ninth island visited under this assignment.

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Itinerary

Sunday 28th Sept., 2008

Left Tarawa at 0600 for Marakei, arrived Marakei 0630. Were not met on arrival, words said no announcement sent to Clerk to Marakei Island Council. Were kindly met by Catechist Buraun, boys taken to Priest's House, girls were accommodated at Island Council's guest house. Were later in the day met by the TiibiKauntira.

Monday 29th

Met with TiibiKauntira and Clerk at 0900 discussing the logistics for the consultation, composition of participation, cost of food and transportation, program. Met with IPO and Social Welfare and discussed their involvement in the consultation. Site visits to eroded coastlines and public properties at risk.

Tuesday 30th

Day 1 of Consultation: 27 participants from villages of Norauea, Tekuanga, Antaai and three wards from Rawannawi village. TK opened the consultation, IPO chaired.

Wednesday 1st Oct.

Day 2 of Consultation: Rosalind took charge of the day with a wrap up toward end by Dr. Tebano.

Thursday 2nd Oct.

Day 3 of Consultation: Same program as for Day 1.

Friday 3rd Oct.

Day 4 of Consultation: Rosalind took charge of whole day with a wrap up toward the end by Dr. Tebano.

Saturday 4th Oct.

More site visits and revisits to areas identified as having problems. Quantification of costs that may be required.

Sunday 5th Oct.

Back to Tarawa at 0700.

1.4 Location of Kiribati

The full text on this topic can be cited in previous similar reports on Tamana (Tebano, *et. al*, 2008), Beru (Tebano and Abeta, 2008), Onotoa (Tebano, 2008) and Tarawaieta (Tebano, 2008). Other similar reports by the same author are on Makin, Butaritari, Kuria and Marakei. There are numerous sources on the internet that provide comprehensive updated backgrounds on Kiribati. However, Marakei is one of the islands in the central Gilbert Group and is the ninth island visited in this KAP II outer island consultation exercise.



Figure 1a: Islands in the Gilbert Group, Kiribati.

1.5 History and Background

Marakei is an island in the northern part of the Kiribati Group (Fig. 1a). Most historians consider that the crew of Hernando de Grijalva's vessel *San Juan* probably discovered Marakei and Abaiang or alternatively either Butaritari, Marakei, Abaiang or Tarawa in 1587. This island is in the Northern Gilbert Group with Makin, Butaritari and Abaiang. Marakei has an area of 13.5 square kilometers and a population of 2,741 (2005 Census).

Blackbirding in the form of labor recruitment to work on the Guatamala(Latin America) sugar plantations had been ongoing before the first British flag was hoisted on the island. A few foreign traders had also been on the island trading overseas items (including tobacco, alcohol, guns and pistols) in return for copra, coconut oil, turtle sell and others artifacts of value.

The Marakeipeople are kind and friendly. One will find himself acquainted within hours of arrival on the soils of Marakei.Inquisitiveness is rife on Marakei that within minutes one can describe a visitor from toe to head. The dances on the island are some of the best in Kiribati where all movements of a gracious frigate bird flying overhead are enacted to match the singing accompaniment.

1.6 Geography

Marakei is an excellent example of a true atoll. It encircles a shallow lagoon that connects to the oceanic waters via Baretoa and Raweta inter-islet passages. Marakei is amedium sized island in the Gilbert chain of the Republic of Kiribati (Fig. 1a), located north of the Equator at 2°00'N and 173°17'E.The land area is approximately 13.5 km² while the lagoon has 19.6 km². Marine vessels visiting the island anchor off the reef at the leeward side. Small traditional canoes or dinghies are used mainly by the eastern villages as a form of transportation from one part of the island to another other. The lagoon water is stagnant as there is not much water exchange due to the narrowing of both inter-islet passages (Tebano, 2004; Fig. 1b).

The vegetation on Marakeiconsists of coconut, pandanus and shrubs occupying most of the arable land area. *Babai*– a giant taro,is plentiful on the island and so pits occupy a substantial amount of family land. The landmass is wide in some areas exceeding 400 meters while quite narrow in others.The climate is typically tropical and humid with average annual rainfall of 20.5 meters. The estimated daily yield per person is around 1,000 l/p/d. Droughts are becoming more frequent and the latest one had much impact on fruit trees and all forms of terrestrial life.

Marakeipopulation is predominantly I-Kiribati comprising about 99.7% of the island's total population of about 2,800 individuals with over 194 persons per km² and making up 2.1% of Kiribati total population of around 90,000 (2005 Census). The Roman Catholic is predominant with about 60% of total population, the remaining is made up of Kiribati Protestant Church, SDA, Bahai, Church of God and Mormons (Census, 2005).

Within the lagoon perimeter are luxuriant mangrove and ironwood (*Pemphisacidula*) bushes. The main economic activities are copra cutting, fishing and *babai* cultivation. Shark fin and bech-der-mer (boiled and sun-dried sea cucumber) are traded. Handicrafts are also made on a small scale and sent to outlets at Tarawa.



Fig. 1b: Map of Marakei Island

1.7 Myths and Legends of Marakei Island

Details of the myths and legends related to Marakei can be cited from the writings of Sir Arthur Grimble (*Legends from the Gilbert Islands*) and Sir Harry Maude.

This is one of the versions on how Kiribati came into being. “Nareau the Wise was in Samoa, procreating with the spirits there. One day, he decided to trace the whereabouts of his two children who left Te Kaintikuaba. He left Samoa, heading north, and on his way he created a resting place by trampling the sea and uttering powerful magic. Behold, land was formed with spirits inhabitants on it. This land is now called South Tabiteuea. Feeling satisfied with his marvellous work, he left and went further north. At last, he sighted Tarawa. He stayed on Tarawa and started his work of creating new lands. He used his power to create Makin, Butaritari, **Marakei**, Abaiang, Maiana, Kuria, Abemama and Aranuka. These are now referred to as the

islands of North Kiribati”. Geographically these islands lie north of the Equator and according to Kiribati Government’s district allocation Marakei belongs to Northern Gilbert.

Marakeipeople believe that the northern and central islands were createdat the time when the earth and the sky were separated. They also say that Samoa, Tabiteuea, Tarawa and later the rest of the Gilbert Islands, were originally clouds transformed into islands when they came into contact with the plant called Terenga, which spouted from Awaiki the core of the earth. This tree became Te Kaintikuaba which the spirits of Te Bomatemaki saw emerging in Samoan soil. They were said to have rushed to it and remained there. The inhabitants of the islands were those spirits who dispersed from Te Kaintikuaba when it was destroyed by Teuribaba, another inhabitant. The dispersals were believed to have been to the north of the Gilberts. Their descendants later returned to the Gilberts and travelled throughout the group.

1.8 Information Collection Templates

The templates below reflect on the approaches described above as a result of consulting with appropriate ministries, and the advice of international and regional advisors, a list of problems and vulnerabilities provided by island representatives of the first National Consultation of 2007, ranking and prioritizing them by seriousness by participants. Some modifications were made as appropriate to suit the current consultation and risk assessment on the outer islands. Risk assessment focuses on water, coastal erosion and marine resources. Physical environment and structures, and human resources are added for additional information on island profiling.

Below are the form templates to guide the recording of information in a systematic and uniform manner for all islands visited. They contain information collected from Marakei Island in the areas of potential risks and vulnerabilities (brackish water, coastal erosion, declining food resources, the physical environment and infrastructure, and human resources). Similar information for other islands will also be recorded.

Risk Assessment

- Island Risk Assessment (*form 1.1*)
- Ranking Risks - Island Level (*form 1.2*)
- Ranking islands for risk response – National Level (*form 1.3*)

Island profiling

- Island Profiling - Natural Resources (*form 2a*)
- Island Profiling – Physical Environment and Infrastructure (*form 2b*)
- Island Profiling – Human Resources (*form 2c*)
- Ranking Resources, Environment and Infrastructure –Island Level (*form 2d*)
- Ranking Resources, Environment and Infrastructure – National Level (*form 2e*)

Island Risk Assessment *(form 1.1)*

Island [Makin]	Vulnerability/ Risk	Hazard/ danger	Nature of disaster	Location/Site	Ranking [1=not serious; 2=serious; 3=very serious]	Proposed Adaptation measures [reactive/ preventive]	Responsible agency/ministry
Refers to islands in the Gilbert Group [reef/raised or atoll – needs to be specified]. Number of villages to be visited, number of participants, sex, age and occupation.	Island residents identify the vulnerabilities and risks they are experiencing in light of climate change and sea level rise. A list given during the 2007 consultation is checked against this new listing.	Causative hazard type identified	Extent and impact of disaster, who are affected, how are they affected	Identify area(s) on the island where the problem occurs – name of district or village is recorded and marked on a map. Pictures of these sites are videotaped or shot with digital camera.	Implication on urgency of response	Measures and strategies must be proposed by the communities themselves with the assistance of a consultant or members of the visiting team; reactive implies immediate practical actions to mitigate impacts (e.g. planting mangrove, seawall construction, construction of wooden embankments). These strategies are <i>reactive</i> in that they are actions taken to mitigate the effects of erosion for example; Preventive –includes warning systems, planning and regulatory measures.	Government ministries or other agencies that are involved or have similar interest in the programs/issues are identified, results of similar activities from other ministries are put together with the recent findings of KAP II outer islands reports.
<i>Marakei Atoll, northern Gilbert; 9 main villages 6 workshop participants from each village representing all village sectors..</i>	<i>Coastal erosion</i>	<i>King tides, storm surge and sea level rise. [aggregate mining on the rise for more permanent structures]</i>	<i>Coastline at Rawannawi Village, houses and properties, rows of coconut trees and coastal vegetation are sitting on the eroded beaches</i>	<i>Rawannawi</i>	<i>3 very serious</i>	<i>Law to regulate aggregate mining on the island; properly designed seawall along currently affected areas- reactive.</i>	<i>Ministry of Works and Public Utilities; MELAD, MISA.</i>
<i>Marakei Atoll</i>	<i>Fresh water becoming brackish day by day.during drought period</i>	<i>Drought</i>	<i>Prolonged drought with no rain for more than ten months, people are fetching water from wells further inland, fruit trees within village compound (breadfruit, fig tree, etc) are turning yellow and dying.</i>	<i>Most villages along the western coastline</i>	<i>2 serious</i>	<i>More water catchments such as plastic tanks, cisterns should be encouraged. Ground water must be enhanced, wells must be well looked after, covered with board and properly secured with concrete around it.</i>	<i>Ministry of Works and Public Utilities – Public Utilities Board; Ministry of Internal and Social Affairs; Ministry of Health and Medical Services.</i>

<i>Marakei Atoll</i>	<i>Terrestrial resources</i>	<i>Drought</i>	<i>Fruit trees (main in particular for fruit disease); general vegetation affected.</i>	<i>All villages</i>	<i>I not very serious</i>	<i>Replanting and research into cause of breadfruit problem.</i>	<i>MELAD, MISA</i>
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Ranking Risks for Action – Island Level (*form 1.2*)

Island	Risk	Ranking score as in form 1.1; 3 highest, 1 lowest	Responsible ministry/agency	Current status of activities	Timing and estimated duration of response (months)
Name of village and area be stated, map of site provided	List of risks.	Risk with highest score appears first, those with lowest score come last	Name of agency or government ministry specifies	Describes whether there had been similar activities carried out before or a new issues; if risk has been responded to describe status of the activities and future direction (contact MISA and other relevant ministries)	This needs to be factored in with the budget or obtained from relevant agency/ministry.
Rawannawi Village	<i>Coastal erosion, public road Coastal erosion Water</i>	<i>3 3 2</i>	<i>MELAD, MISA, MWPU MISA, MWPU/PWD MWPU/PUB, MISA</i>	<i>Concrete walls and relocation to mainland. None None</i>	

Ranking islands for responses to risks – National Level (*form1.3*)

Island	Type of risk	Ranking score (<i>forms 1 and 2</i>)	Implementing agency/ministry	Partners	Start-up date
Provide island name (and district – Gilbert northern, central, southern)	List of risks identified for island	Provide corresponding ranking score	Provide name of agency tasked to carry out the required job	Provide names of agencies and funding donors in the project	Supply exact date of the start-up date for implementation

Island Profiling – Natural Resources (*form 2a*)

Terrestrial/Marine Resource	Current Status	Potential cause(s) of problem	Action needed [low/high priority]	Partners	Cost of activity [AU\$]	Source of funding identified
Specifies type of resource – terrestrial or marine; specifies whether fauna or flora; name resource	Refers to observed status by residents whether dying, declining, extinct, etc. Verification needed if can be done during a visit – photos and site visits	Residents’ list of causes, verification needed – survey or research may be required; examine existing reports and relevant information.	Consultation, cooperation, team work, regulation, etc. Specify urgency for action	Identify partners who can assist or who are responsible [government or private]	To be determined by agency	To be identified by agency
<i>Water</i>	<i>Becoming brackish and contaminated with sea water – in particular in villages close to the shoreline.</i>	<i>Drought for many months, closeness of villages to coast, increasing population.</i>	<i>Inspection and island visit; low priority</i>	<i>Government, PUB</i>		
<i>Finfish and non-finfish resources</i>	<i>All finfish are declining.</i>	<i>Overfishing, unregulated fishing</i>	<i>Byelaws to be set up to regulate fishing activities and protect spawning seasons; quota limits and off-seasons – high priority</i>	<i>MFMRD, MISA, OAG</i>		
<i>Fruit trees (terrestrial)</i>	<i>Just recovering after the latest drought</i>	<i>No replanting scheme, drought</i>	<i>Replanting scheme encouraged, home gardening encouraged- high priority.</i>	<i>MELAD, MISA</i>		

Island Profiling – Physical Environment and Infrastructures *(form 2b)*

Terrestrial/Marine Environment or infrastructures; public or private	Current Status and site/location	Potential cause(s) of problem	Response type required [urgent or not urgent]	Partners	Costs	Source of funding
Specifies type of environment or structure in question – eg. Reef, lagoon, coastline, mudflat, marshland, buildings, causeways, seawalls, land reclamation, etc.	Refers to observed status by residents – damaged, dead, lost, wave over wash, etc. Verification needed if can be done during a visit – photos and site visits	Residents’ list of causes, verification needed – survey or research may be required; examine existing reports and relevant information.	Consultation, Cooperation, team work, etc. Specify urgency for action	Identify partners who can assist or who are responsible [government or private]	To be determined by agency	To be identified by
<i>Eroded coastline at Rawannawi</i>	<i>Storm search and king high tide over-wash</i>	<i>Unpredicted impact of CC and SLR on coastline;</i>	<i>Very urgent response to areas mostly affected by man-made structure and natural events.</i>	<i>MISA, MWPU, Makin Island Council</i>	Approx. \$200,000 (material, labour and administration)	tbi
<i>Eroded coastlines on either sides of land reclamation</i>	<i>Storm search and king high tide over-wash</i>	<i>Unpredicted impact of CC and SLR on coastline</i>	<i>Very urgent</i>	<i>MELAD, MISA, MWPU, Makin Island Council</i>	na	tbi

Island Profiling – Human Resources *(form 2c)*

Population by sex	Age groups	Schools/Public utilities	Government/non-government paid workers	Major occupation	Production/export	Imports
Number of males and females (2005 Census)	Schooling, non schooling, over 50 years old	Name of school (primary, secondary, jss) and number of children; name of public utilities. Types of buildings (concrete or local) within each establishment	Number belonging to each group, level of education	Apart from paid jobs	List	List
<i>see MISA report and Kiribati Census 2005</i>	<i>see 2005 Census</i>	<i>refer to Education Digest 2005</i>	<i>refer to Education Digest 2005</i>	<i>refer to Education Digest 2005</i>	<i>refer to Kiribati Balance of Trade, 2005 (MFED)</i>	<i>refer to Kiribati Balance of Trade 2005 (MFED)</i>

Ranking Resources, Environment and Infrastructure for Action – Island Level *(form 2d)*

Island	Type of resource, environment and infrastructure	Ranking score <i>(Forms 2a and 2b)</i>	Agency/ministry for further observation and research	Partners	Start-up date
Provide island name (and district – Gilbert northern, central, southern)	List of resources identified for island	Provide corresponding ranking score	Provide name of agency tasked to carry out the required job	Provide names of agencies or ministries who may be involved in the process	Supply exact date of the start-up date for the task
<i>Marakei</i>	<i>Properties, wells and land affected</i>	<i>3</i>	<i>MISA, MWPU, MELAD</i>	<i>MWPU</i>	<i>na</i>
<i>Marakei</i>	<i>water</i>	<i>1</i>	<i>MWPU, MISA</i>	<i>MWPU</i>	<i>na</i>
<i>Marakei</i>	<i>Marine</i>	<i>1</i>	<i>Fisheries</i>	<i>MFMRD</i>	<i>Not available</i>
<i>Marakei</i>	<i>Terrestrial</i>	<i>1</i>	<i>MELAD</i>	<i>MELAD</i>	<i>NA</i>

Ranking for Action and Implementation – National Level *(form 2e)*

Island	Type of resource, environment and infrastructure	Ranking score <i>(Forms 2a and 2b)</i>	Implementing agency/ministry	Partners	Start-up date
Provide island name (and district – Gilbert northern, central, southern)	List of risks identified for island	Provide corresponding ranking score	Provide name of agency tasked to carry out the required job	Provide names of agencies and funding donors in the project	Supply exact date of the start-up date for implementation
Na	na	na	Na	Na	Na

1.9 Topography

Marakei is a lagoon island. Its fringing barrier reef surrounds the island with a shallow lagoon in the middle of the island. The windward reef is broader than the leeward reef. An excellent anchorage is outside of the western reef. The shoreline slightly rises from sea level to over two meters at the highest points. Ruderal vegetation is common along the coastal area with more defined vegetation into the bushland (Thaman and Tebano, 1995). Most of the landmass is flat with lots of *babai* pits occupying family land. The midland may be slightly higher than the coastal areas by a few centimeters while the ocean beach front is even higher as the waves keep building up the shoreline with more sand and coral debris.

The windward shoreline is protected with rocky shores (Fig. 1c) while the leeward western portion is mainly made up of sandy beach that gently slopes down to a reef flat.



Fig. 1c: A rocky shoreline at the ocean side (photo by TionUriam)

1.10 Main Settlements

Figure 1d below shows the approximate location of the main eight villages. On the eastern side of the island from north along the lagoon side are Antai, Tekuanga, Norauea and Bainuna. Teraereke and Terokea villages were abandoned, however residents of Terokea are being absorbed by Bainuna village. Rawannawi is the biggest village (7.9 km) and is where the Island Council headquarter is located (Fig. 1d). Tekarakan is the second largest with two wards and relatively similar in size with Rawannawi. There are three wards in this village and within each ward are sub-wards, nine in all.

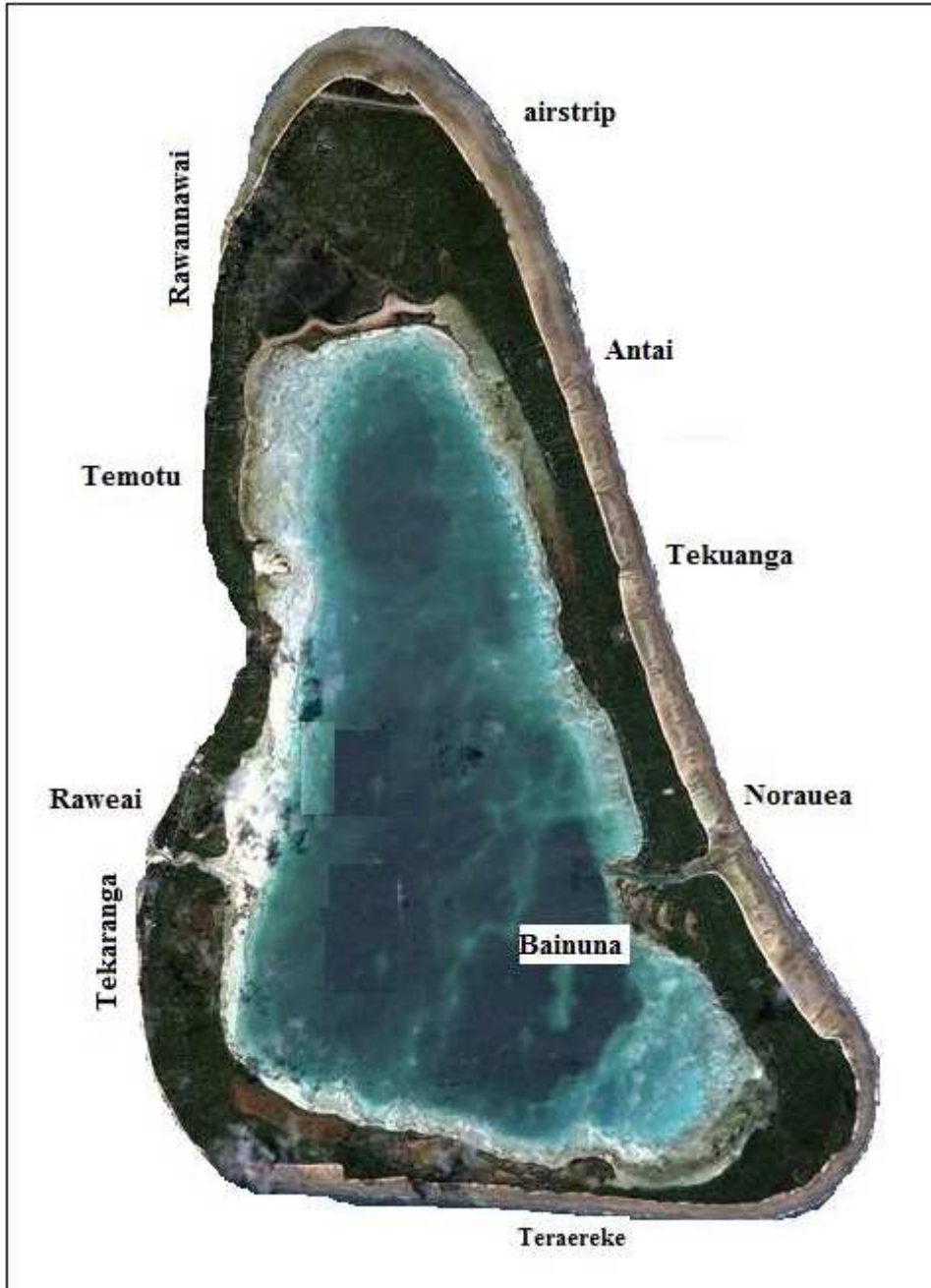


Fig. 1d: Map of

Marakei showing main villages.

Chapter 2: CONSULTATION FINDINGS

The findings of the Marakei consultation on the status of natural resources, coastal erosion, water resources and the marine and physical environments is a combination of data and information gathered during the six days of consultation, field observations and interviews with people of different backgrounds. Interviews were kept as informal as possible.

2.1 Status of Natural Resources

2.1.1 Marine Living Resources

Participants claimed that the marine resources, fin-fish in particular, is not as used to be. The lagoon is contributing little to the daily intake of protein in terms of tilapia, milkfish fry and a shellfish – *tekoikoi-n-anti* (*Spodylus sp.*). *Te bun* (*Anadara holoserica*) was once abundant throughout in the lagoon but is disappearing presumably because of the stagnant water in the lagoon. Filamentous green algae and urchins flourish, both are signs of polluted water (Tebano, 2004).

Pelagic species such as flying fish and tunas (skip jack – *teati* (*Katsuwonus pelamis*), yellow-fin tuna – *tebaibo* (*Thunnus albacore*) provide protein almost on a daily basis. Flying fish is fished day and night and is the most popular fish on any dish. Because of ciguatera fish poisoning which is a prominent problem on the western reef stretching from Tabonteora – Rawannawi village (northern village) right to Tekarakan village (southern village), most reef fish are not eaten. However, during the visit the western reef is full of people doing purse seining with small mesh size nets; participants and the fishers spoken to said that they know which species are toxic and those not toxic. On examining the names given it became apparent that most species are non reef dwellers such as *teninmwai* – silver biddy (*Gerres sp.*), *tetewe* – goatfish (*Mulloidess sp.*), *terereba* – trevally (*Caranx sp.*), *teikarii* – bonefish (*Albulaglossodonta*) and others. Juveniles of other toxic species were also mentioned.

Morays (*Gymnothorax sp.*), huge trevally, large barracudas, large grouper (*Epinephellus sp.*), *Lutjanus bohar* and large parrot fish (*Scarus sp.*) remain toxic. Participants claim that ciguatera was not serious during drought period. Sharks are rare as they have been heavily exploited for shark fin trade. Other reef resources such as octopus -*tekiika* (*Octopus sp.*) and lobsters –

tennewe (*Panulirus* sp.) are rarely caught, the latter is sometimes caught during night fishing with a torch or pressure lamp. Fish protein is available almost on a daily basis complimented with land crab meat whose population appears to be declining as far as participants are concerned.

The use of traditional canoes (Fig. 2a) is gradually overtaken by motorized canoes and skiff boats. The use of monofilament gill nets of small mesh size is on the rise and both the lagoon and reef flats are being gleaned. Over one hundred fishing nets were recorded in 2005 with some households owning more than two units; and it is assumed this number has increased since.



Fig. 2a: A fisherman paddling his canoe (photo by TionUriam)

Higher water temperatures associated with climate variability and climate change may seriously impact the living corals important for reef fish sustainability. Warmer water and a change in current patterns may prevent pelagic fish species such as tunas from coming closer to land hence forcing fishermen to go out to sea farther. The combined effect of all these factors may have a detrimental impact on marine living resources and food security at large. Adaptive measures in terms of the latter must be seriously considered at a village and island level. The only fish preservation method practised on Marakei is salting and sun drying; very few or none have dip-freezers. Fish baking in dug-out earthen ovens is rarely done these days.

2.1.2 Terrestrial Living Resources

Like most other islands in Kiribati, Marakei has few terrestrial living resources but much higher rainfall than the central and southern islands. These include fruit trees, fruit plants and garden plants. Of particular importance for the sustenance of the island's population coconut (*Cocosnucifera*), a giant taro – *babai* (*Cyrtospermachamissionis*), *temai* - breadfruit (*Artocarpus* varieties) and *tekaina* – pandanus (*Pandanustinctoria*), like fish, are the main starch staples. The

most recent drought had a drastic impact not only on plants and trees but on other terrestrial animal resources as well.

The cultivation of *babaion* Marakeihas increased substantially as far as participants are concerned (Fig. 2b). Residents are feeling the pinge of high prices of imported starch items like rice and flour. The lunches brought by participants were dominated by *babai* (*kaatutu*), a smaller variety that needs little cultivation. *Te mai* (breadfruit – *Artocarpus*) varieties and pandanus - *tetou* (*Pandanustectorius*) compliment the main staples when in season. Banana varieties (*Musa*) grow on the island (Fig. 2b); papaya (*Carica papaya*) varieties and citrus fruits such as lemon and lime are also grown but in small numbers. The leading author saw *tebero* (*Ficustinctoria*) fruit only once among the lunches provided; this is a very nutritious berry variety that grows wild in the islands and fruits almost year round. Some participants claimed it is not in fruiting season, others countered saying there are very few wild ones and hardly seen in all villages visited. *Te karewe* – fresh toddy (a sap from coconut flower) is popularly drank but the impact of drought on coconut trees is significant. Toddy provides a daily intake of Vitamin C. Certain pandanus varieties are more common in villages and appeared not to be doing well away from dwellings. Replanting activities are unheard of perhaps only on small scales at family land level.



Fig. 2b: Cultivated *babai* plants (at left); bananas at the background (right) (photo by TionUriam)

The storage of coconut for future needs is not heard of, nor the harvest of pandanus to make *tuae* or *kabubu*, pandanus cake and powder, respectively. The making of *bwiro* from breadfruit for long storage purpose, traditional for the northerners and centralists is rarely if not practised these days. These all mean that none of the plant or tree fruits are processed for safe keeping for future use and food security. The imminent impact of prolonged droughts could be serious enough if

adaptation measures such as mentioned here are not adopted soon. *Tenon* (*Morindacitrifolia*) juice processing for local and overseas market is popular on Tarawa; given the landmass and excellent climate for this plant Marakei could benefit from planting and processing the fruit of *tenon*.

Land-based reared protein sources such as pigs and chickens (Figs. 2b, 2c) are abundant and made available for special occasions. While the local pig breed is fed mainly on coconut and fish, shortage of these may seriously affect the number of animals available on the island. Complimentary grass feed of *mtea* (*Portulacasamoensis*), *wao* (*Boerhaviarepens*) and *booi* (*Portulacalutea*) may not be available in times of drought. While pigs are commonly roped on one of the hind legs or forearms (appearing to be the practice in central and northern groups) chickens are domesticated and roam around in villages. Penning and fencing using local material was the usual practice but the declining availability of them offers no choice but letting chickens roam freely and pigs tied to a bush that provides shade during most of the day. The status of the population of a crab -*temwanai* (*Cardissoma* sp.) on the island has not been assessed; the residents claim they are not plentiful as used to be years ago and mangrove deforestation on the island, particularly at the southern end, will seriously impact the crab's population and affect other resources and organisms as well.

Going around the island several times gave the consulting team members the impression that the practice of clearing land with fire is rife. Of particular interest are Teraereke and Antai areas where some of the fires remained active during the site visits (Fig. c).



Fig. 2c: Bush fires may be caused by careless land clearing or on purpose (photo by Temakei Tebano)

The authors were informed that in many cases the fires were started by copra cutters who lit them to ward off mosquitoes (which is pretty bad on the island) and leaving the fires to take care of themselves when done.

The avifauna resource of Marakei exists throughout the island but is insignificant in numbers as compared with those in the Phoenix Islands. The common local inhabitants are black noddies and white terns; these occupy mostly uninhabited areas (Fig. 2d). The birds, although small in size, may provide some protein source when marine and terrestrial sources are scarce. Their habitats must be protected by law.



Fig. 2d: Black noddies nesting on breadfruit branches (photo by TionUriam)

It appears from information collected that the marine living resources of Marakei are heavily exploited but can sustain the current pressure. However, there is a need to enhance finfish species popularly fished by instituting and enforcing an Island Council's bylaw on gillnetting using small size mesh nets, limiting flyingfish gillnetting hours and imposing fishing season, closing the harvest of all fish species including land crab during mating seasons. Two popularly mating seasons known are *tebwaa* for flyingfish and *tekauangao* for land crab. The exact times must be identified. The mangrove bushes must also be protected to enhance fries and juvenile fish, provide habitats for mud crab and other sessile shellfish.

Milkfish farming is practised on Marakei but is not on an intensive basis. The existing ponds at Teraereke are pretty much underutilized. There is a high potential for milkfish farming on the island and is only a matter of giving it a boost to start it up. Tilapia is a pest but some way of utilizing it must be found.

2.1.3 Non-living resources

Ground well water is the main source of water for many purposes on the island. Rainwater is a supplementary resource collected at homes with aluminum roofing and water catchments. Community rainwater tanks and reservoirs are few and not adequate to cater for the need of large numbers of people during prolonged drought periods. There are also few concrete private homes with aluminum roofing, the Marakei Island Council owns about a dozen office buildings and classrooms built of more long term imported material. Properly constructed water cisterns will last a long time and must be encouraged. Plastic water tanks have a short life span given the hot humid environmental condition that degrades the material in a very short time.

Most wells, if not all, seen are not covered (Fig. 2e). The concrete blocks or coral boulders surrounding the outer rim are either too low or broken to effectively stop seepage of dirty water from the surrounding during heavy rains in most cases. The 2005 Census showed only about forty households are dependent on rainwater (Fig. 2e) and the remaining population relies on ground well water. The water lens at the eastern side of the island is only 2 – meters below ground level and is potentially vulnerable to pollution and contamination of all kinds. Their closeness to the lagoon must be a worry (Fig. 2e). Some parts of the island are narrow, for example, Raweai village, and the groundwater is vulnerable to saline intrusion during prolonged drought periods, hence land suitable for water reserve must be identified.

There is a need to improve a water system throughout the island with particular note on schools. Bailing is the most common way of collecting water from wells as almost hand pump and solar operated pumps are broken or not repaired. Solar operated water systems need to be encouraged and the hand-operated ones are fixed and maintained. Concrete cisterns or tanks are most ideal for schools and Island Council housing as they last longer and easier to maintain. A school water system costs between \$15,000 to \$17,000. This can be applied to villages and Island Council housing system.



Fig.2e: Sources of water on Marakei (photo by TionUriam)

For all villages on Marakei alternative well sites must be identified and reserved for future needs. The construction of concrete water catchments at public places such as schools, church compounds that have huge chapels and meeting houses, *maneaba*, with aluminum roofing must be encouraged. Wells need to be properly located away from pigsty, toilets and cemeteries, as well as properly secured from surface water flooding and potential pollutants.

Sanitation cannot be separated from a water system as it is one of the main causes of ground water pollution and contamination. In the case of Marakei this is very critical. While there is a substantial number of land-based toilets recorded on Marakei how well are they functioning and managed is any body's guess. There is a need to properly determine the current status of the system(s) to ensure the safety of ground water and the quality of lagoon water are not compromised.

Aggregate mining for construction work is the major contributing factor to coastal erosion. Much of construction work requiring sand and gravel is apparently done by the Marakei Island Council for office, classroom and clinic construction. Construction works at a household and church community levels in terms of land reclamation and more permanent buildings also add to the negative impacts on the coastal environment. Reducing or controlling aggregate mining remains with the Island Council and its peoples. A bylaw, specific for Marakei, that regulates these activities and complimenting the 2007 Revised Environment Act needs to be put in place soonest. Alternative sources need to be identified to ensure Marakei coastline is protected from unprecedented surge and bad storms.

2.2 Status of the Physical Environment

2.2.1 The Marine Environment

In this report the marine environment will include the lagoon, the outer barrier reef, a reef flat, marine fauna and flora, traditional navigation skills in relation to weather forecasting and current patterns. Other relevant issues are also discussed.

Marakeiby definition is a true atoll with a lagoon like most islands in the Group. The physical status of the marine environment can be described in terms of two distinct systems, a semi-enclosed lagoon with little flushing from the oceanic waters and the open sea surrounding the fringing barrier reef.

The lagoon is less than 5 meters deep with a number of patch reef systems throughout. Hardly any living corals are found here hence fish are scarce. Sea urchin and filamentous green algae occupy the vast body of water with salinity of less than 34‰ (normal) and slightly higher temperatures (Tebano, 2004). The TiibiKauntira (TK - Tebau) told the team that when he was a child living in village at Bainuna (eastern side) his relatives used to catch flying fish and other lagoon fish in hundreds. About twenty or more years ago the lagoon started losing fish and other important shellfish like *Anadara holoserica*. He described the lagoon as dead.

The TK even mentioned that the decline in fish stocks in the lagoon is probably linked to the construction of semi-bridge/causeways at Raweta and Baretoa inter-islet passages. The structures had apparently narrowed the passages and caused much of the accretions never experienced before. The western passage had closed up several years back and the Marakei Island Council found it very difficult to reverse the process on its own. The Government aided in re-opening the western passage leaving a small channel with a bridge-crossing. The eastern passage is also closing up; a fish trap constructed under the concrete bridge is interfering with current flow causing much accretion and erosion at both the inner lagoon and ocean side entrances. The cement bridge is weakening day by day and trucks with people or copra are no longer permitted to cross the eastern side bridge. These are examples of human destructive activities destroying a lagoon system with all the resources it contained.

The surrounding barrier reef is healthy with luxuriant live corals of massive, solitary and branching species. The reef flat at the windward side is wider than the leeward side, in some areas it is more than 300 meters wide as compared to less than 100 meters at the leeward side.

Massive coral boulders are ubiquitous at the western reef mainly at both sides of a blasted boat channel at Rawannawi village. The remnants of previous reclaimed land less than 50 meters away from a reef crest was claimed. Proof of the claim needs to be checked with the old maps of Marakei. Rawannawi village had been receding landward as claimed, where have the soils and sand gone to, is a mystery.

Looking briefly at the Marakei map (Figs. 1b and d) it appears that there was another inter-islet passage between the villages of Temotu and Raweai. The physical evidences are there, the coral boulders, a narrow strip of land with a concave shape at the lagoon inner western portion. Old memories talk of a small passageway crossed by foot during time immemorial.

To make the Marakei lagoon functional and productive there are several options, one is to widen the exiting passages to their original width, open another channel between Temotu and Raweai(or on the eastern side) or partition the lagoon for aquaculture activities. These will need money, expertise and hard labor which can be obtained from many sources.



Fig. 2f: Corals in reef pools (photos by TionUriam)

Conservation and management need to be fostered on the island. These cannot be supported without proper bylaws of the Island Council. But the underlying factor is a large number of people living on the island which nears 3,000 according to 2005 Census. Substantial protein supply is required on a daily basis to feed the population. Coupled with this is the increasing number of outboard motors and gillnets that are engaged in the exploitation of marine resources. The west-oceanic water is undoubtedly healthy and clean however the lagoon water is stagnant and may not be suitable for bathing purposes.

There are navigational experts on Marakei who notice the changes in weather patterns confirmed over the lessening usefulness of traditional navigation skills in terms of travelling and fishing

seasons. The weather pattern has changed as participants claimed; the southerlies come at the time of the northerlies and vice versa. The current directions also change, meaning that the timing of the eastward or landward bound current bringing pelagic fish close to the fringing reefs has also changed. This creates confusion among the fishing communities on Marakei. Adjusting and re-inventing fishing seasons is a challenge to the fishermen of today.

2.2.2 The Coastal Environment

This section covers the coastal environment discussing erosion, the beach, the rocky shores, aggregates and mining, the coastal strands, bushes and shrubs, and coral boulder removal.

Observations and assessments from this visit consider coastal erosion on Marakeias a serious problem in certain areas, a threat to properties and people's welfare. The seriousness is measured in terms of rows of coastal vegetation and coconut trees that have disappeared or are standing on the beach (Fig. 2g:), and the flooding of lowlands during extreme high tides. All claimed eroded sites were visited, estimated costs to protect them were determined. Pictures were also taken as proof of their current status (Fig.2g, h), their locations were recorded with a GPS.



Fig. 2g: Eroded coastlines at Marakei(photos by Tion K. Uriam)



Fig. 2h: A protected coastline and a reclaimed land; the affected neighboring coastline (photos by TionUriam)

The most affected area that requires urgent attention is along the entire coastline of Rawannawi village. This is where many destructive activities have taken place to include a boat channel, land reclamation and coral boulder removal. Sooner or later the Island Council's headquarter and other private properties will soon be gone given the fast changes noted by the leading author in a very short period of time of 2005 to 2008. Another area worth of considering as well is at Antai where erosion appears to be serious enough. Whether this coastline has been subjected to aggregate mining it is the residents themselves who know what is happening to it. The approximate cost of protecting the shoreline with concrete seawall is around \$200,000 but this depends on the increasing cost of materials. Other areas affected by land reclamation and aggregate mining are yet to be determined. The impact of sea level rise is obscured by human destructive activities such as those mentioned above. On the other hand, the 2007 revised Environment Act has not made any impact on coastal protection on the outer islands but is making progress on South Tarawa and Betio (Tebano-Farren pers. comm., 2008).

Natural causes include extreme high tides, surge storms, natural shifting of aggregates underpinned by seasonal trade winds, El Niño and La Niña which now control global weather patterns, and to some extent a refutable increase in sea level. Human induced causes of coastal erosion on Marakei include aggregate mining by the Island Council and land reclamation by the dominant churches.

There are not many seawalls or land reclamations on Marakei. Those recorded in the 2005 Census were less than seventy in total and observation on the island has not come across any

newly constructed ones. However the existing ones are doing much damage to the coastal environment.

A complete review of the policy and design of seawall construction needs to be undertaken, which currently is the case as far as law and civil engineering is concerned. The reinforcement of the revised 2007 Environment Law to penalize land reclamation done outside law needs to be put in place.

2.2.3 The LandEnvironment

This section discusses the locations or sites of villages in relation to storm surges and overtopping events, water issues, house gardening, land clearing practices, replanting and location of cemeteries.

Like other islands in the group, Marakeivillages were part of the British colonial era arrangement that people live in villages instead of individual *kaainga* (family and immediate members) living in hamlets built on their own plot of land. This was a means of containing tribal wars and land crabbing by stronger *kaaingas*. The preferred village locations were close to the sea at the lagoon side where most fishing activities are carried out; canoes had to be put in and out of the water almost on a daily basis.

Villages were rarely located at the windward side, except in a few cases like Makin where overcrowding is becoming a problem. Marakei is a medium sized island by Kiribati standard and supports over 2,800 people in 8 main villages. All the villages at Marakei Island are situated at the lagoon side. This is where most of the fruit trees and decorating plants are found.

Coconut plantations occupy most of the arable land area. Any increases in population on Marakei will no doubt exacerbate the potential risks and vulnerabilities in terms of portable water, declining terrestrial and marine food sources, sanitation systems affecting sea water and ground water sources, and other related over-population problems. The initial choice of village locations was most appropriate then but in light of the current climate change, climate variability and sea level rise homes and other physical structures are at risk and vulnerable to any unprecedented storm and bad weather events. Villages like Rawannawi and Tekarakan are experiencing population growth and need to expand.

Increase in human population requires more dwellings and homes, hence the expansion of villages is imminent. Development projects, communal or private, in the form of construction work that requires aggregate mining and timber material, certainly contribute to the destruction of the environment and the land plant resources at large. Productive land shrinks as villages expand and marine and terrestrial resources are constantly and increasingly being tapped. Water consumption increases and the drawing of more and more water to meet daily requirements will affect the drinkability of ground water. Compounding these problems is drought that can seriously impact all forms of life. The relocation of many dwellings in the existing villages must be seriously considered at a home, village and Island Council level as an adaptation measure in light of the impending impact of climate change scenarios.

The current water status on Marakei is not as serious as compared to several months ago during the height of the drought period. However, more frequent and prolonged ones will mostly affect all villages on the island in terms of water, food trees and vegetation. The current capacity on Marakei to hold rainwater is insignificant. Concrete water cisterns that last longer than plastic tanks require little maintenance, this must be encouraged. During the Christian Missionaries and European traders' era concrete water cisterns made of local lime cement obtained from burned coral were popular. They have been abandoned and corrugated iron tanks replaced them. Today plastic tanks are most popular.

While the Marakei Island Council owns a number of semi-concrete buildings with aluminum roofing a large number of catchments will suffice to provide government and island council workers with rain water for a long period if the thinking is made a reality. Private and communal water catchments must be encouraged to ensure adequate drinking water is available when required.

Equally important is the improvement of the existing wells to protect them from contamination of all forms. The use of hand and solar pumps to provide village households with portable well water can further improve the standard and quality of water as it will no longer require bailing. Potential ground water sites must be identified and protected from activities such as animal husbandry and gardening, erection of toilet blocks, the digging of *babai* pits and cemeteries.

House gardening on Marakei is insignificant in that only less than a dozen households at Marakei villages are engaged in the activity. Although home gardening can produce a variety of vegetables there is no ready market for it except a home and local consumption. This weakens the desire of many families to produce such items. The planting of a variety of breadfruit trees from around the Pacific will ensure the longer fruiting season hence reducing the consumption of imported rice and flour. Similarly, the planting of pandanus varieties that are good for making *tuae* and *kabubu* must be encouraged. The storing of coconut for future needy times must also be encouraged. These lifestyles do not exist on the island and experts from women groups can be engaged.

Animal husbandry, in terms of swine and poultry, must form the basis of land protein availability when other sources are at stake. The agricultural activities must be strengthened to ensure all local produce can sustain the livelihood of Marakei population in times of food shortage. It is imperative that a bylaw is strengthened to ensure potential ground water sources are not unnecessarily contaminated or polluted with activities discussed above.

Similarly, the dumping of rubbish (compost and plastic) on the beach or the coastal areas is detrimental to the marine and coastal environments. Proper disposal sites must be identified by the Marakei Island Council to ensure waste disposal sites are properly utilized and co-managed.

2.2.4 The Physical Structures

This section looks at public and private structures in the context of their vulnerabilities to climate change and sea rise and how the situations can be improved through the design of appropriate adaptation strategies that can be self-contained or assisted by government.

Public Structures

There are no public structures vulnerable to coastal erosion or other natural/human induced causes except those created by humans. Settlements close to reclaimed lands experience coastal erosion and accretion in most instances (Fig. 2i). Land reclamation interferes with natural beach movement thus causing accretion on one side and erosion on the other (Fig. 2j).



Fig. 2i: Reclaimed lands and eroded neighboring coastlines and properties.



Fig. 2j: Eroded coastline and luxuriant mangrove off the lagoon beach front (photos by TionUriam)

Private Structures

Seawalls and land reclamations are being mixed up in most considerations. The distinction between them is that seawalls are constructed at the highest tide mark while land reclamation extends to below highest tide mark; in some cases reclaimed lands are sitting on a reef or mudflat as in Figure 2i above.

Chapter 3: COMMUNICATION AND TRANSPORT

3.1 Voice Communication, the Media

It is only in recent months that satellite telephones were installed on Marakei as part of improving voice communication on the outer islands. Telephone links with Tarawa and other islands were installed on the island in late 2007. There are seventeen telephone links including those at the Island Council. About fifteen CB radios were reported operational on Marakei, company or privately owned by churches or individuals. There are over 200 transistor radios reported in 2005 (Census, 2005). Radio Kiribati and FM98 provide daily local, regional and world news. Weather forecasts are also broadcasted by Radio Kiribati when made available from the Meteorological Office in Betio. Local newspapers like Uekera, TeMauri, Tarakai, Newstar and Kiribati Times rarely make any impact on the outer islands. Their major markets are Betio and South Tarawa. Daily communication with Marakei via telephone or CB radio can be handy in case of unprecedented disasters caused by storm surges and seawater inundation, as well as other similar events linked to climate change and sea level rise.

2.3 Road, Sea and Air Transportation

Bicycles or push bikes are the most common form of road transportation that serves many purposes including coconut and firewood collection. There were over 300 units recorded in Census 2005. The next most popular are motorcycles nearing 80 in all and are increasing with a most popular made of Honda trailers. Several trucks are owned by individual businessmen, churches, two belong to Marakei Island Council. The latter provide daily transportation for school children but are also made available on a hire basis.

Traditional canoes on Marakei appear to be on a decline. There were approximately 150 recorded in the 2005 Census and this number is likely to decline as motorized crafts are becoming more popular. A demand for faster island sea transportation means and shorter fishing times spent in the open ocean is evident. Motorised skiffs and boats skim in and out of the reef areas during high tides during the day and night despite of the unparalleled increase in fuel cost. More than thirty motorized boats and skiffs are operational on Marakei. There are also huge double hulled

canoes and government marine ships that provide frequent transportation between Marakei and Tarawa.

Inter island sea travel is provided by several private and government vessels serving Marakei on a weekly basis. Food and other required supplies are brought in from Tarawa, local produce in terms of shark fins,bananas, pumpkins, copra and handicrafts are shipped to Tarawa. Regional and privately owned container vessels bring in much needed supplies from outside the South Pacific in terms of fuel, food, machinery, construction material and others.

Air link is provided by Air Kiribati between Marakei, Tarawa and the neighboring central islands. Air Pacific and Our Airline (formerly Air Nauru) and Air Marshall (currently suspended) provide international links between Tarawa and the world. Marakei has both means of evacuation in case of emergency, sea and air. The airstrip on Marakei, like other islands, needs to be upgraded.

Chapter 4: GENERAL DISCUSSION AND RECOMMENDATIONS

Certain areas on Marakei need urgent attention in light of their vulnerability to erosion. Of particular attention is the entire coastline of Rawannawi village. However, care must be taken to actually look into the causes of erosion in the area. There are claims and counter claims as to the original location and beach front of Rawannawi. A credible proof can only be found through original maps dating back to the 1880s and 1890s. One claim suggested that the original beachfront was only about fifty meters from the reef crest. In such a scenario there are two possibilities, one is that the lost land must have accreted somewhere; the other possibility is that the reef had grown wider over time. It is mentioned earlier of the presumed existence of a third inter-islet passage between Temotu and Raweai. That fits in with the first assumption. If the passage was not there then the same lost land could have contributed to the closing of the western passage. Whichever is the case the Marakei Island Council and its people must find sustainable solutions to the current problem.

An area at the ocean side of Antai village appears to undergo serious erosion problem and needs to be considered in light of the expected increase in intensity of surge storms and accelerated sea level rise. There signs of aggregate mining but an examination in such a short time cannot provide precise explanations, the Marakei Island Council and its people know the inside stories pertaining to the erosion problem occurring here but not in others.

Human destructive activities are contributing to the current erosion problems on Marakei. These need to be examined with caution as the culprits are the major church communities and the Island Council itself. It appears now that seawalls are requested for to protect vulnerable coastlines but in fact damaged reclaimed lands. Supporting such activities with materials and cash are indirectly maintaining the level of problems in the neighborhood coastlines and the problems rolls around in a circle. The Revised Environment Act of 2007 is very clear on seawalls and reclaimed land. The latter is punishable by law and compensation to the affected parties is within the armpit of the law.

Ground water is valuable on Marakei but is vulnerable to pollution and contamination. The eastern side of the island is particularly vulnerable to such water problems as the water lens is pretty close to the ground surface. One of the sources of pollution and contamination is land-

based toilets that are wrongly located at the lagoon or ocean side of a well such that water movement in either direction can affect the quality of water in a well. Compost toilets that do not use much water and hence are environment friendly are recommended. Flush and other types must be properly sealed to ensure waste water does not overflow or sink into the soil. Water run offs may also contaminate wells with no proper concrete walls or too low to stop any animals and debris falling into them. Concrete water cisterns and tanks need to be encouraged more than plastic tanks that do not last long under the current environmental conditions. Water reserves must be identified in cases of retrieving back to the middle of the island. A water policy for the outer islands must be put in place to ensure the safety of drinking water for the people.

Marakeeis known for healthy mangrove forests along the lagoon inner coastline.Hence, the planting of mangroves may help provide natural sanctuaries for fish and other resources more than providing coastal defense. The growing and enhancement of coastal vegetation must be encouraged to keep the coastlines together and minimize the impact of waves and storm surges.

A reactive measure for coastal protection when everything else failed, is a seawall using proper designs provided by the Civil Engineering Unit, Ministry of Works and Public Utilities. Rules and guidelines pertaining tothe construction of such structures must be strictly followed. Of critical importance is the environmental impact assessment (EIA) that should offer advance warnings on any issue to be seriously considered before further steps are taken. There are reported instances where structures are constructed ignoring designs provided resulting in poor resilience and ineffectiveness, meaning the structures do not help solve problems,hence public money has effectively been wasted on unworthy undertakings. Responsible ministries must check the quality of workmanship, identify irresponsible personnel and deal with them accordingly.

The 2007 revised Environmental Act needs to be applied on the outer islands soonest if the coastal areas are to be protected. In the same light, an Island Council bylaw specific for Marakei'scurrent problems needs to be devised and acted on.More awareness programs on protecting the land must be encouraged and embarked on by respective government ministries and non-governmental organization partners.

Marine and terrestrial resources of Marakei Island are just adequate to support the current population density despite of loss of resources via human destructive activities to include coastal vegetation clearing, aggregate mining, land reclamation, waste dumping, marine and terrestrial habitat destruction, to name a few. There is a need to devise management plans to ensure the resources are unnecessarily over-exploited or locked away via destructive ‘development?’ projects. The enhancement of marine protein via milkfish farming or other mari-culture activities must be looked into. Equally important is the encouragement of local farmers to plant more local fruit trees such as pandanus, *tebero*, *babai*, bananas, pumpkins and others to ensure local foods are consumed and stored for future use in times of prolonged droughts and bad weather conditions. Traditional preservation methods must also be encouraged and demonstrated to ensure the local populace and the new generation is familiar with them.

Water and sanitation improvement must be looked into seriously to ensure the health of the people of Marakei. Water catchment must be enhanced, encouraged and potential water reservoirs are identified for future use. Concrete water cisterns in schools and at community facilities must be encouraged. To ensure ground water system is properly maintained and managed residents of Marakei at their respective villages and communities must be involved in all steps of planning, procurement of material and other equipment required. They must be involved in its implementation and management to give them a feel of ownership and responsibility. The Marakei Island Council, in consultation with all communities, must give full support to such a vital undertaking.

Overcrowding, if not yet felt, must be thought of as an inherent problem that compounds potential risks and vulnerabilities related to climate change and sea level rise. Marakei is ranked tenth in population density after South and North Tarawas, Abaiang and Kiritimati. The impact of overcrowding on all resources must be taken seriously. Relocating families to safer grounds within the island now will help reduce the impacts of predicted ground water and storm surge problems.

It is with great care that both communal and private structures are discussed in a manner that does not discourage those concerned to ensure cooperation and realization of the realities of their impact on the environment and the rest of the communities. Structures such as reclaimed land and aggregate mining that contribute to the loss of properties, resources and coastlines must also

be re-considered in light of long term benefits by all. Areas suitable for aggregate mining must be identified and controlled by laws and regulations. Public money must not be committed in unsustainable projects that are undermined by continued human destructive activities. Proper assessment of potential risks and vulnerabilities involving experts in required and related fields must be the first stepping stone before other related processes are carried out.

To ensure Marakei is linked to the rest of the world voice and text communications need to be enhanced and improved further. Break downs in telephone communication causes a lot of problems particularly when it comes to urgent matters such as serious health cases, disaster caused by extreme tides and surge storms, to mention a few. Sea and air transport are vital for emergency purposes in a case of evacuation and emergency services. The current airstrip may need to be extended and properly sealed; similarly the existing boat channel may require widening and dredging depending on environmental impact assessment findings. Cheap sources of energy such as solar and wind must be enhanced to cut down costs on fossil fuel.

The relocation issue, seen as sensitive and complex, must be carefully discussed at household, village and island levels. Should a household be relocated full consultation with the Island Council is necessary to ensure all parties that may be affected in one way or another are aware and supportive to such a move. The reality is that households within a village compound are locked away in their current locations. Relocating to further inland outside a village designated compound will require land owners' consent, hence the Island Council and the whole village must be involved in a full consultation.

Beyond an island level when most of the land is under water relocating to other islands within the Republic may not be a clear option. A more sustainable option is resettlement on high volcanic islands within the Pacific region, an option supported by the Pacific Council of Churches (PCC). However, doors by Australian and New Zealand governments are open; this option will be left to each individual family and *kaainga* to decide on. When will this scenario become a reality instead of a myth, in 30 or 50 years time, no one knows. What is important now is to plan and act at a local level to reduce potential risks and vulnerabilities related to climate change and sea level rise.

For future directions community consultation on CCA and SLR must continue and development projects in light of these must be considered as part of Phase 3 of KAP to focus on the practicalities of mitigation and adaptation strategies. Risk identification and management must be handled through cooperative approach by respective ministries and non-governmental organizations. The Marakei Island Council must strive to continue the consultation process that KAP II is currently undertaking. The level of awareness is low and must be uplifted so that I-Kiribati can appreciate the challenges that they need to think about and the adaptation measures within reach that they can adopt. Beyond that Government will assist and its future plans are being laid out and fed with information gathered from all credible sources. Marakei people will make wise decisions pertaining to their very survival in these unpredictable scenarios.

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