



KAP II TA - TOR 4.1, 4.2, 4.3

MAKIN

Community Consultation, Risk Assessment & Adaptation, and Training



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Executive Summary

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

The five-man team comprised Dr. Temakei Tebano (TheEcoCare 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), Miss Erimeta Barako (Participatory Planning Officer, MISA) and Ms Titeem Auatabu (Resource Information Officer, Mineral Unit, MFMRD). Also assisting were the IPO, ICW and Social Welfare officers of Makin Island Council. The key areas discussed fell under water, coastal erosion, seawater seepage into *babai* pits, reduction in natural resources, overcrowding 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.

The relocation issue in light of overcrowding and 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 Makin people. Details on project funding and how they can be accessed were provided by Miss Barako. Miss Auatabu presented comprehensive information on protecting and looking after and managing our coastal areas through limiting the amount of aggregate mining to ensure surge storms have minimal impact on coastlines.

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), fishermen, and other significant groups within each village set up. The selection was done through village councilors who then consulted village elders to witness the selection process. There were 40 participants from Makin Village and 20 from Kiebu Village making 60 in all from the island.

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. Areas and issues related to island profiling were dealt with by a MISA staff accompanying the team.

Seepage of seawater into *babai* pits appeared to be the major concern of the Makin and Kiebu residents. Much of the erosion problems on Makin, which appears to be a second concern, to a large extent is linked to aggregate mining and land reclamation. The major local contributors identified are the Island Council and the communities of two major churches on the island, KPC and RC, to a lesser extent is household activities. The impact of sea level rise is questionable while natural beach movement is evident in some areas. Scarceness of marine resources is a third concern as Makin had lost some of its readily available resources through the construction of a causeway across an inland lagoon in late 1980s. The causeway has recently been turned into a bridge but by calculation the damages initially caused will remain and both entrances of the lagoon connecting it to the windward and leeward reefs will soon be clogged up with sand accretion. Thousands of dollars may be required to reduce coastal erosion and seawater seepage into *babai* pits at both villages.

Water is not a major issue on Makin village at the time of the consultation as there is plenty of portable fresh water from ground wells used for all household purposes. Makin Island receives more rain than any other islands in the Gilbert Group. However, prolonged droughts will first affect vegetation and fruit trees, ground water resources will definitely be affected, hence plans need to be made for future uncertainties. Rainwater is available in homes with houses and sheds made of concrete material and aluminum roofing. The number of catchments is small. Quite a number of them are with the Island Council and Government housing.

Kiebu Village requires immediate water enhancement in terms of more permanent water catchments such as concrete cisterns to ensure there is rainwater for drinking for all residents as long as they can provide. Ground well water is scarce on the islet and sources are quite a distant from village settlements. A water system had existed that was provided by several agencies but spare parts and proper maintenance to the system had not been made available causing the collapse of the system. This subsequently gave way to the destruction of the system where parts of it were looted. An overhead tank and solar pump had outlived their life-span needing

maintenance and replacement, the piping system in particular was unearthed and looted. Ground water has to be carted once again.

There is little agricultural activity in terms of vegetable and swine/poultry home farming. Similarly, fisheries activities are few and both officers are not on the island except an ice plant care taker. There were no fish in the plant at the time of the visit but occasional catches of tuna were carted on the main road of Makin village for sale.

The Makin people are aware of CC and SLR after village consultations made by the Tiibi Kauntira, IPO, and ICW in early February. However, distrust by residents did not help advance the scope of the consultation. Adaptation measures have not been thought of seriously since then but need to be enhanced. It was seen that intensifying training and consultation on CC and SLR complimented with media training in its various forms and with contributions from 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 to Makin situation. 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	Tiibi Kauntira (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 Makin 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 Tamana Report by Tebano, *et al.*, 2008). KAP II senior management presented them in early May to the KCCSC and was approved unanimously in the July meeting.

1.3 Rationale of the Makin Visit

A visit to Makin 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. Makin is the sixth island visited under this assignment.

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Itinerary

22nd July:

Left Tarawa for Makin at 2.30pm arrive Makin 3.45pm. Met Clerk and Tiibi Kauntira; discussed workshop plan, catering, participants, etc.

23rd July:

First day of consultation for Makin village participants. 9am – 4-30pm (Temakei, Titeem, Erimeta and Ereata).

24th July:

8am – 2pm. Session taken by Rosalind (media training). 2.30pm – 4pm (Temakei and Ereata). Field trip from 10 am – 1.30 pm - TK, Ereata, Temakei, Erimeta, Titeem, eroded and accreted areas at Makin.

25th July:

9am -4.30pm Kiebu- travelled by skiff from Makin to Kiebu at 7am, arrived Kiebu at 8am. Consultation began at 9.30 am and finished at 4.30 pm.

26th July:

8am -2.30 pm media training led by Miss Rosalind Kiata. Field trip between 9 am and 12.30 pm led by Kauntira Erene. 3pm closing of workshop by participants. Left Kiebu for Makin at 4.30pm.

27th July: Rest (Sunday)

28th July:

Monday – field trip 9 am – 1 pm led by TK Taratoba, visited Kii-ni-Makin, eroded areas estimate of size , inspection of Catholic chapel for body cracks caused by building on *babai* pit filled with stones and gravel – compressed over time causing multiple cracks at one end of concrete block. Inspection of eroded areas close to KPC compound.

29th July: Left Makin for Butaritari.

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).

Makin is one of the small islands in the northern Gilbert Group and is the seventh island visited in this KAP II outer island consultation exercise.

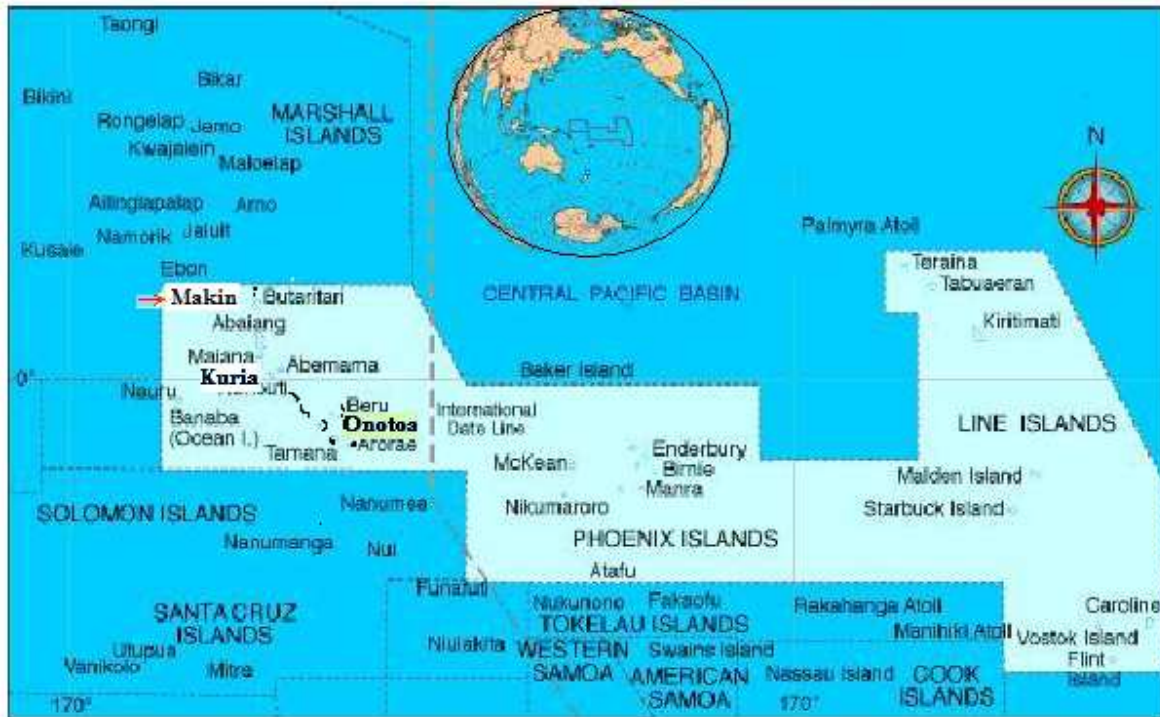


Figure 1a: Islands in the Gilbert Group, Kiribati.

1.5 History and Background

Makin is an island in the Northern Gilbert Group. It has an area of 6.7 square kilometres and a population of 2,385 (Census 2005). It was settled perhaps simultaneously with the rest of the islands in the Gilbert Group beginning more than two millenia ago by successive waves of migrants from Southeast Asia, Tonga, and Fiji. The area now called Kiribati has been inhabited by Micronesians speaking the same Oceanic language since sometime between 3000 BC and 1300 AD. The area was not isolated; invaders from Tonga and Fiji later introduced Polynesian and Melanesian cultural aspects, respectively. Inter-marriage tended to blur cultural differences and resulted in a significant degree of cultural homogenisation.

Colonial era

From the early 19th century, Western whalers, merchant vessels and slave traders visited the islands, introducing diseases and firearms. The first British settlers arrived in 1837. In 1892 the Gilbert Islands consented to become a British protectorate together with the nearby Ellice Islands. Together they became the crown colony of the Gilbert and Ellice Islands in 1916. Kiritimati (Christmas Island) became part of the colony in 1919 and the Phoenix Islands were added in 1937. They gained self-rule in 1971, and, after the Ellice Islands gained (1978) independence as Tuvalu, the remaining islands were granted independence (1979) as Kiribati (Wikipedia, 2008).

In most of the northern islands, there are several district leaders, each of whom leads a group of *kainga* (family and immediate members). On Makin and Butaritari one chief was recognised as paramount. The chiefly dynasty of Makin and Butaritari was consolidated under one Uea, the latest being Nauraura Nakoriri, before and after the arrival of the British rule. The heads of the *kainga* were always consulted on matters affecting the community and could initiate action, but always they were obliged to seek the approval of the chief, who provided overall leadership and regulated relationships amongst the *kainga*.

Independence to present day

The Gilbert and Ellice Islands gained self-rule in 1971, and were separated in 1975 and granted internal self-government by Britain. In 1978 the Ellice Islands became the independent nation of Tuvalu. The Gilbert Islands became independent as Kiribati on July 12, 1979. Although the indigenous Gilbertese language name for the Gilbert Islands proper is "Tungaru", the new state chose the name "Kiribati", the Gilbertese rendition of "Gilberts", as an equivalent of the former colony to acknowledge the inclusion of Banaba, the Line Islands, and the Phoenix Islands, which were never considered part of the Gilberts chain. In the Treaty of Tarawa, signed shortly after independence and ratified in 1983, the United States relinquished all claims to the sparsely inhabited Phoenix Islands and those of the Line Islands that are part of Kiribati territory.

1.6 Geography

Makin is the northernmost island in the Gilbert Group in the Pacific and is part of the Republic of Kiribati. It is approximately 6.7 square kilometers and lies north of the Equator at 03°24.74'N, 172°56.3418' E and 03°20.364'N and 173° 40.24'E (Fig. 1a). It was formerly known as Little Makin to distinguish it from Big Makin (now known as Butaritari). The island is a reef island with a small inland lagoon at Makin Islet. Makin receives highest rainfall than any other islands in the group. Its population as of 2005 Census exceeded 2,000. Copra is the main money earner. The main villages are Makin and Kiebu. The climate is hot and humid all year round. The people of Makin are a mixture of Polynesia and Austral Micronesians making their dialect distinct from other islands.



Fig. 1b: Map of Makin Island, airstrip visible from above.

1.7 Myths and Legends of Kuria Island

Details of the myths and legends related to Makin 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”

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 (see Appendix i) to guide the recording of information in a systematic and uniform manner for all islands visited. They contain information collected from Makin Island in the areas of risks (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
<p>Refers to islands in the Gilbert Group</p> <p>[reef/raised or atoll – needs to be specified].</p> <p>Number of villages to be visited, number of participants, sex, age and occupation.</p>	<p>Island residents identify the vulnerabilities and risks they are experiencing in light of climate change and sea level rise.</p> <p>A list given during the 2007 consultation is checked against this new listing.</p>	<p>Causative hazard type identified</p>	<p>Extent and impact of disaster, who are affected, how are they affected</p>	<p>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.</p>	<p>Implication on urgency of response</p>	<p>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;</p> <p>Preventive – includes warning systems, planning and regulatory measures.</p>	<p>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.</p>
<p><i>Makin Island, reef island, central Gilberts; 2 main villages 10 workshop participants from each village representing all village sectors..</i></p>	<p><i>Coastal erosion</i></p>	<p><i>King tides, storm surge and sea level rise.</i></p> <p><i>[aggregate mining on the rise for more permanent structures]</i></p>	<p><i>Coastline at 4 sites identified at Makin village and north-eastern site of Kiebu village. More serious at Makin village, rows of coconut trees have fallen down, coastal vegetation affected making beach vulnerable to more erosion.</i></p>	<p><i>Makin:Kangitano, Mwanou,Tabukinb eira, KPC-RC</i></p>	<p><i>3 very serious</i></p>	<p><i>Law to regulate aggregate mining on the island; properly designed seawall along currently affected areas- reactive.</i></p>	<p><i>Ministry of Works and Public Utilities; MELAD, MISA.</i></p>

<i>Makin Island, reef island, central Gilberts; 2 main villages 10 workshop participants from each village representing all village sectors.</i>	<i>Babai plants die from saltwater</i>	<i>Water intrusion to babai pits and the central part of a village</i>	<i>Related to sea level rise and the destructive work of man removing earth and soil barrier causing extreme high tides to overtop; the original idea was to let fresh water run into the sea – TeKii-ni-Makin</i>	<i>The middle of Makin village</i>	<i>3 – very serious and needs urgent attention</i>	<i>Construction of proper channel gate to allow fresh water run-off during heavy rains and stopping salt water entering through the same channel.</i>	<i>Ministry of Works and Public Utilities; MELAD, MISA</i>
<i>Makin Island, reef island, central Gilberts; 2 main villages 10 workshop participants from each village representing all village sectors.</i>	<i>Fresh water becoming brackish day by day.</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>All villages along the western coastline and on the windward side at Makin village.</i>	<i>1 not very serious right now.</i>	<i>Proper care by covering top and seal sides at ground level</i>	<i>Ministry of Works and Public Utilities – Public Utilities Board’ Ministry of Internal and Social Affairs; Ministry of Health and Medical Services.</i>

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.
	<i>Terrestrial resources</i>	<i>3</i>	<i>MELAD, MISA, MWPU</i>	<i>Some effort made – a board gate put in the channel, needs improvement;</i>	
	<i>Coastal erosion</i>	<i>3</i>	<i>MISA, MWPU/PWD</i>	<i>None</i>	
	<i>Water</i>	<i>2</i>	<i>MWPU/PUB, MISA</i>	<i>None</i>	
	<i>Marine resources</i>	<i>2</i>	<i>MFMRD, MELAD</i>	<i>None</i>	
	<i>Private and public assets</i>	<i>1</i>	<i>MISA, MWPU, MELAD</i>	<i>none</i>	

Ranking islands for responses to risks – National Level (form 1.3)

Island	Type of risk	Ranking score (forms 1 and 2)	Implementing agency/ministry	Partners	Start-up date
Provide island name (and district – Gilbert	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

northern, central, southern					
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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>Terrestrial – babai infiltrated with seawater</i>	<i>Many babai pits are not cultivated after the latest intrusion</i>	<i>Human mistake in leaving artificial channel open for freshwater run-off hence causing seawater overtopping during extreme high tides and bad storms</i>	<i>Construction of proper and long term channel to allow fresh water run-off only – a one way system</i>	<i>MISA, MELAD, MWPU/PWD</i>	<i>To be determined after inspection and EIA</i>	<i>To be identified</i>
<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>Sharks depleted, others declining.</i>	<i>Overfishing, unregulated fishing, heavy harvest during spawning runs.</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, OAG</i>		
<i>Fruit trees (terrestrial)</i>	<i>Dying and scarce Rows of coconut trees and vegetation fall into the sea, Natural and human destruction in terms of aggregate mining.</i>	<i>No replanting scheme, drought</i>	<i>Replanting scheme encouraged, home gardening encouraged- high priority.</i>	<i>MELAD</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>Makin Island Council – TeKii-ni-Makin causeway/bridge</i>	<i>Bridge too narrow</i>	<i>Bad design and unplanned closure of the lagoon with no EIA.</i>	<i>Not urgent</i>	<i>MISA, PWD, KPC</i>		
<i>Eroded coastlines at Makin and Kiebu villages(See Table 1.</i>	<i>Storm surge and king high tide over-wash</i>	<i>Unpredicted impact of CC and SLR on coastline; infiltration of seawater into babai pits;human destructive activities and careless mistakes.</i>	<i>Very urgent response to areas mostly affected by natural events.</i>	<i>MISA,MWPU,Makin Island Council</i>		

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
Makin, northern Gilbert Group	Coconut trees and coastal vegetation being lost; babai dying	3	MISA, MWPU, MELAD	MWPU	na
Makin/Kiebu	water	2	MWPU, MISA	MWPU	na
<i>Makin</i>	<i>Marine</i>	<i>3</i>	<i>Fisheries</i>	<i>MFMRD</i>	<i>Not available</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

Makin Island is being regarded as a reef island but with a tiny inlet lagoon. Its fringing barrier reef surrounds the island all around forming protection from enormous wind and wave actions. The shoreline slightly rises from sea level to over a meter at the highest point. Ruderal vegetation is common along the coastal area with more defined vegetation into the bushland (Thaman and Tebano, 1995). 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 and eastern shoreline is protected with rocky shores while the leeward western portion is mainly made up of sandy beach that gently slopes down to a reef flat that in turn connects to a reef crest and a back reef, and finally leading to a drop off and deep ocean. There are *babai* pits along the main road running through main villages but more pits can be found further inland accessible by bush tracks.

1.10 Main Settlements

Figure 1c below shows the approximate location of the main villages. The northern village is Makin situated on the islet of Makin. The southern village is situated on the islet of Kiebu. The southernmost islet is Onne and islets between Makin and Kiebu are Aonibike and Tebuatarawa (Fig. 1c). Makin is the administrative headquarter of Makin Island Council.



Fig. 1c: Map of Makin showing main villages and airstrip.

Chapter 2: CONSULTATION FINDINGS

The findings of the Makin 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 five 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 prior to the closure of the semi-inner lagoon at the airstrip site. Finfish species such as milkfish, mullet, trevally and others have vanished. Shellfish species such as *te koikoi* (*Barbatia* sp.) and a mud worm, *te ibo* (Sipunculid) have also disappeared. Mangrove crab, *te mwanai* (*Cardissoma* sp.) has disappeared from the lagoon. The cause of the problem squarely falls on the closure of the lagoon from the ocean with the construction of a causeway in the late 1980s with subsequent replacement and narrowing of the lagoon with a bridge made of concrete material.

Prior to the construction of a causeway, participants claimed that food resources were plentiful there. Finfish, shellfish species and a mud worm provided adequate protein for Makin village residents. Several months after the completion of the causeway mangrove crab populations declined, mud worm and shellfish were dead and mangrove bushes started disappearing. The loss of such resources was felt. Accretion along both sides of the lagoon caused the narrowing of the inlet channel from the ocean side. The volume of oxygenated seawater reaching the inner parts of the lagoon had reduced considerably, the volume of fresh water from *babai* pits and the land increased proportionally. These resulted in oxygen starvation, reduced flushing of the lagoon, reduced food particles in the water column and loss of salt from the organisms. Mass mortality of organisms and a fast shrinkage and disappearance of mangrove forests were witnessed.

The replacement of a solid causeway with a solid bridge had not reversed any loss of resources from the said lagoon. The negative and detrimental impacts of such a man-made structure on the coastline and marine resources will remain as long as the structure exists. The re-opening of the

lagoon to reverse the current impacts will be too costly in terms of funding and social economic aspects.

Reef fish species are scarce and overfished. Juveniles are being fished with small mesh size nets (half to one inch) to compliment crab meat and pelagic species such as flying fish and tunas. The use of traditional canoes is slowly being overtaken by motorized canoes and skiff boats. The use of monofilament gill nets is on the rise and the gillnetting of flying fish is an additional method recently being introduced to the island. Over a hundred fishing nets were recorded in 2005 and it is assumed that number must have increased since then. Trolling and dip netting at night for flying fish are fading away as they are time consuming and less efficient. Shark is rarely landed, could be associated with a decline in their population due to overfishing for shark fin trade. Other reef resources such as octopus - *te kiika* or *kao* (*Octopus* sp.) and lobsters – *te nnewe* (*Panulirus* sp.) are unheard of if they are ever being fished.

Moray eel traps are few (Fig. 2a) and stone fish traps are a thing of the past as most existing ones are no longer maintained. Makin had about twenty skiff and motorized boats and less than one hundred traditional canoes (Census, 2005), the numbers are unlikely to change much as the number of people living on Makin is pretty much stable except for the year 2005 when over a thousand residents went back to their homeland for the opening of the Makin Island Council maneaba; this inflated the exact number of more permanent residents resulting in one more house of representative being added to the Makin constituency. An ice plant is providing ice for the fishermen but not much fish goes to the plant itself, most of it is sold on the road side or at fishermen's residents. There are no obvious fishery activities enhancing the fishermen's skills or conservation strategies for resource management purposes.

Ciguateric moray eels and other carnivorous fish such as *te ingo* (*Lutjanus bohar*) are common in well known reefs. History told of no such problem prior to the blasting of a boat channel. Since the late 1980s ciguatera occurred around the boat channel. Repeated requests through the House of Parliament to rectify the problem only resulted in offering explanations that nothing can be done to solve the problem. The consultation participants also raised concerns over the issue. A response from the team advised that ciguatera is no longer a problem but a 'blessing in disguise' in that the toxic areas and fishes therein are the conservation areas and breeding stocks, respectively, for the sustainable fish stocks on Makin Island reefs.



Fig. 2a: Moray eel traps (photo by Bwe Temakei, 6-9-08)

Fish species brought to land by fishermen during the one week stay on Makin comprised the trevally species of *te kuia-n-rereba* (*Caranx* sp.), flying fish - *onauti* (*Cypselurus* sp.) and a goatfish – *te maebo* (*Upeneus* sp.) Skip jack – *te ati* (*Katsuwonus pelamis*) and yellow-fin tuna – *te baibo* (*Thunnus albacore*) are caught in numbers mainly via trolling. Giant clams such as *te were* (*Tridacna maxima*) and *te werematai* (*T. squamosa*) are consumed but are rare while *te kima* (*Tridacna gigas*) is depleted.

The most common preservation method practised on Makin is salting, those who have dip-freezers powered by gasoline generators keep their catches fresh. Baking and sun-drying are unheard of. Overall, marine resources on Makin are being heavily exploited to feed the exploding population but there is no protein shortage as far as the Makin people are concerned. However, 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 also 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. Adaptive measures in terms of food security must be carefully planned at a village and island level.

2.1.2 Terrestrial Living Resources

Like most other islands in Kiribati, Makin has few terrestrial living resources. These include fruit trees, fruit plants and garden plants. Of particular importance for the sustenance of the island's population coconut, *babai*, breadfruit and pandanus, like fish, are the main staples. The most

recent drought had a drastic impact not only on plants and trees but on other terrestrial animal resources as well. Of particular interest are crabs *te mwanai* (*Cardissoma* sp.) that provides protein almost on a daily basis. Pigs and chickens are reared for special family and village occasions.

On Makin *babai* (giant taro – *Cyrtosperma chamissionis*) is cultivated and utilized almost on a daily basis and particularly on special and important occasions, so as *te mai* (breadfruit – *Artocarpus* varieties). Pandanus - *te tou* (*Pandanus tectorius*) compliment the main staples when in season. Banana varieties (*Musa*) grow on the island and papaya (*Carica papaya*) varieties and citrus fruits such as lemon and lime are also grown. Vegetable gardening for Chinese cabbage is practised but on a small scale. *Te karewe* – fresh toddy is popularly drunk but the impact of drought on coconut trees is significant. Toddy provides a daily intake of Vitamin C.

The cultivation of *babai* by gang workers known as *te karoronga* or *kawawa* is popular. The burning of coconut leaf compost and dead shrubs is practiced but to a small extent. These activities were witnessed during the one week stay. Bush fires deliberately set or by careless deeds are dealt with by *kaainga* members as most land plots are shared amongst related *kaainga* members. The thick bushes have been cleared and replanted with coconut seedling. Pandanus is more common in villages but appeared not to be doing well away from dwellings.

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 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 are not devised soon.

In terms of land-based protein sources, pigs and chickens (Figs. 2b, 2c) are reared and raised 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* (*Portulaca samoensis*), *wao* (*Boerhavia repens*) and *booi* (*Portulaca lutea*) may not be available in times of drought. While pigs are commonly roped on one of the hind or fore arms chickens are domesticated and run wild 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 the day.



Fig. 2b: Roaming chicken (photo by Erimeta Barako); Fig. 2c: Pig feeding (photo by Erimeta Barako)

The avifauna resource of Makin is insignificant however there are nesting black noddies and white terns around the island but in particular at Onne islet at the southernmost end of Makin. The birds, although small in size, may provide some protein source when marine and terrestrial proteins are scarce. Their habitat must be protected by law. The birds also aid fishermen in locating schooling tuna and trevally.

It appears from information collected that the marine living resources of Makin is scarce but can sustain the current human population, however, there is a need to enhance finfish species popularly fished by putting in place management plans to meet the need of future generations. More importantly is a need to re-look at best options that may bring back those resources that are already lost as a result of some activities that are detrimental to the environment and marine resources. This refers to reopening and widening the inland lagoon to its original width. This will also reduce coastal erosion which is a chronic environmental problem on Makin islet. Observations on the current status of the existing bridge is that in five years time, if the estimates are correct, both mouths of the channel will be clogged up with sand and gravel and vegetated with mangrove and coastal shrubs (Fig. d). The valuable resources will be gone for ever.



Fig. 2d: The lagoon and ocean channels of the existing bridge, Makin (03°22.741'N; 172°59.72') (photo by Temakei Tebano)

2.1.3 Non-living resources

Ground well water is the main source of water for many purposes. Community rainwater tanks and reservoirs are few and not adequate to cater for the need of large numbers of people over a lengthy period of time. There are also few concrete private homes with aluminum roofing, the Makin Island Council owns about a dozen buildings built of more long term imported material. Those in dire need for drinking water are the Kiebu communities who rely almost entirely on rainwater for their daily domestic chores. Ground water on this islet is limited to some areas away from the main settlement. Most of the islet is built on porous coral debris and sand that allows seawater infiltrate into the fresh water lens. The Kiebu communities have no choice but to embark on increasing the number of water catchments, particularly water cisterns that are more sustainable than plastic tanks, the latter 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 open (Figs: e and f). The concrete blocks or coral boulders surrounding the outer rim are either too low or broken to stop seepage of dirty water from the surrounding. The 2005 Census showed that over one hundred families are dependent on rainwater and over three hundred households depend on well water. Most wells were not covered and remain so till these days.

There is a need to improve a water system on Makin, particularly on Kiebu islet, in terms of more permanent water catchments and upgrading the current ground water system by providing solar pumps with overhead tanks and piping to carry water to a village. Alternative well sites must be identified and reserved for future need. To a lesser extent, water system improvement on Makin islet is also required to ensure plenty of rain water is stored for domestic use by members

of communities; this can only be improved with the construction of concrete water catchments at public places such as church compounds that have huge chapels and meeting houses, *maneaba*, with aluminum roofing. Wells need to be properly secured from surface water flooding and potential pollutants.



Fig. e: A public well near a community babai pit at Kiebu; Fig. f: another community well at Kiebu, Makin (photo by Temakei Tebano)

Sanitation cannot be separated from a water system as is the main cause of water pollution and contamination. While there is a substantial number of land-based toilets recorded on Makin how well are they functioning or used is any body's guess. There is a need to properly determine the current status of the system to ensure the safety of ground water. In addition, potential ground water sites must be identified and reserved for future use as an adaptation measure in light of more frequent droughts and sea level rise.

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 Makin Island Council. Construction works at a household and church community levels in terms of land reclamation and more permanent housing also have negative impacts on the coastal environment. Reducing or controlling aggregate mining remains with the Island Council itself and its peoples. A bylaw, specific for Makin that regulates this activity and compliments the 2007 Revised Environment Act needs to be put in place soonest. Alternative sources need to be identified and devised to ensure Makin's 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 sea surrounding Makin Island, a reef and intertidal reef zone, marine fauna and flora, traditional navigation skills in relation to weather forecasting and current patterns. Other relevant issues are also discussed.

Makin by definition is a reef island like Kuria. However, a semi-enclosed inland lagoon puts it in question mark meaning the island is still undergoing land formation process. The current physical status and the low lying areas which are still inundated with seawater during extreme high tides and which have been barricaded with earthwork to save arable land are testimony of what Makin would look like in the years to come (Fig. 1c).

The two islets of Makin and Kiebu are the main settlement areas. Aonibike, Tebuatarawa and Onne islets are inhabited but support coconut plantations important for the livelihood of Makin residents. Species of massive *Porites* are ubiquitous in shallow reef flat pools and over reef crests. Branching and brain coral species are also found in pools and at buttress zone beyond a reef crest.

Finfish are abundant among corals and in the open sea beyond the reefs. Sea shells and other micro-organisms, although not significant in terms of food source occupy a range of ecological micro habitats within the entire reef system. In between islets are passes completely dry during low tide at spring tides and swift currents that are hazardous at high tides. Cases of people swept away and drowned have been reported.

The quality of water could not be assessed but the daily flushing and turn over from oceanic water must contribute substantially. At the leeward side the width of the reef platform is about hundred meters at the narrowest points; the windward side is wider and is about three hundred meters at the narrowest points.

The experience of fishermen over changes in weather patterns is confirmed over the lessening usefulness of traditional navigation skills in terms of travelling and fishing seasons. The weather pattern has changed, that is, 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 Makin. 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 comprising erosion, the beach, the rocky shores, aggregates and mining, the coastal strands, bushes and shrubs, rock splicing and coral boulder removal.

Observations and assessments from this visit consider coastal erosion on Makin as a serious problem and a threat to properties and people's lives. The seriousness is measured in terms of rows of coconut trees disappearing. The claimed eroded areas at both Makin and Kiebu were visited and inspected. Exact locations were recorded using a GPS (Table 1). Approximate lengths of affected areas were taken for cost estimate should funding is requested for. Pictures were also taken as proof of what is happening on the island.

At Makin there were four sites examined for erosion and two for accretion. The most serious areas are Kangitano, Mwanou and Tabukinibeira at the windward side. These eroded areas are associated with aggregate mining that still continue, the Makin Island Council is the main culprit and to a lesser extent the KPC and RC communities. The fourth affected area is at the western side of Makin village between KPC and RC compounds; these eroded areas are the result of land reclamation by both KPC and Roman Catholic communities on Makin. Approximate costs are shown in Table 1 below.

Table 1: Eroded areas, location and approximate costs (provided by Ereata Kakau, Civil Engineering Section, MWPU).

Island	District/Area	Location	Cost (\$)	Total (\$)
Makin	Kangitano	03°22.225'N, 172°59.421'E	88,410	
	Tabukinbeira	03°22.809'N, 170°00.091'E	85,820	
	Mwanou	03°22.541'N, 172°59.755'E	73,000	
	KPC - RC		151,830	
				221,820

The impact of sea level rise is obscured by human destruction. 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).



Fig. 2g: Eroded beach at Kangitano (03°22.225'N, 172°59.421'E) and Mwanou (03°22.541'N, 172°59.755'E), Makin
(photo by Temakei Tebano)

As for Kiebu the northern end of the islet (Tabonkiebu meang – 03°19.818'N, 172°55.716E) has accreted over the last years. At the north eastern side of the same islet (Tabontebuki – 03°19.726N, 172°58.726E) is an eroded area. The sizes of both areas are similar. The two cases can be assumed

to be part and parcel of a natural beach movement and shifting along the northern portion of Kiebu shoreline.

Seawater intrusion into *babai* pits at both Makin and Kiebu is becoming more frequent and severe. Affected areas were inspected and assessed. As far as Makin is concerned, what is termed as Tekiinimakin (03°22.444'N, 172°59.290'E) has been an issue since the colonial era (Fig. h). Reliable sources told of a tragic mistake made by prisoners at the time. During and after heavy rains prisoners used to dig a channel to drain out fresh water from *babai* pits into a lsemi-enlosed lagoon to avoid the drowning and loss of *babai* plants. This had to be done again and again. To the frustration of prisoners and the wardens the drainage was left open and seawater seeped in during high tides instead of rainwater going out. The problem remained for many years and just recently PWD had tried to stop seawater seeping in by putting in a one-way cage that will only allow fresh water drain out and reducing the amount of seawater going in. It is felt that a longer term solution be invented to ensure the livelihood of the Makin people in terms of food source is not put at stake. The impact of sea level rise is not yet felt as far as the consultation finding is concerned.



Fig. h: Teki-ni-makin (photo by Temakei Tebano)

At Kiebu *namo-n-rua* or community *babai* pit at Tabareiauea area (03° 19.354'N, 172° 58.675'E), less than one hundred meters away from the ocean side (Fig. i), salt water intrusion has been reported several times in the past and the latest was last year during the extreme tide that affected many coastlines throughout the Gilbert Group. The main causes can be categorized into two – natural and human-induced. A natural cause is associated with the composition of

ground sediment on which Kiebu village sits. About 90% of Kiebu sits on brackish water and the remaining 10% sits on fresh water where the *babai* pit is situated. This is also where wells were dug out providing the Kiebu communities with ground water during drought periods. The ground sediment is composed mainly of coral rubble, coral sand, carbonate rock and coral boulders thus making the underground sediment porous allowing seawater seep through easily.



Fig 2i: A dirt track along the ocean side of Kiebu namo-n-rua; Fig.2 j: Affected babai plants viewed through bush on pit side

(photo by Temakei Tebano)

A human-induced cause refers to a deepening of a culture bed by some planters, in some parts of the pit, who dug deep into a salt water layer. High water pressure from the ocean side pushes salt water into a thin fresh water lens, mixes with it forming brackish water that kills off *babai* and fresh water vegetation alike (Fig. j). A legend telling of the ghosts' dwelling in the vicinity of the pit and keeps casting spells when the Kiebu residents do not please them will not help solve the current problem now being faced. Sea level rise will exacerbate the problem even further to the extent the pit will be given up and Kiebu residents have no more source of daily starch intake. Two potential solutions are within reach, one is to bury sections of the pit through which salt water is being forced through fresh water layer, the other is to built a concrete wall in the ground, at the ocean side of the pit, down to below rock level to minimize the amount of seawater seeping through the ground and also to cut down on water pressure reaching the pit. This may be prohibitive in terms of the amount of cash required to make it happen. However, some estimate given by civil engineer Ereata Kakau lies around \$25,000 taking into account of material, labor, machinery and administrator costs could be raised through some fund raising scheme.

It was recommended that a complete review of the policy and design of seawall construction be undertaken, which currently is the case as far as civil engineering is concerned. Possible methods to remedy coastal erosion recommended include re-opening channels closed by causeways, relocation of roads and replanting of mangroves (where appropriate) to stabilize flat areas (Gillie, 1993).

Recommendations in this report are similar to those made by SOPAC for islands with causeways. In the case for Makin a specific focus should be on widening the lagoon to its original width, deepening the shallow bed and replanting mangroves along the edge of the lagoon. This will enhance two purposes – restores eroded coastlines and brings back the lost marine and terrestrial animal species the Makin people once enjoyed in the past decades.

2.2.3 The Land Environment

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

Before the British colonial era individual *kaainga* (family and immediate members) lived in hamlets built on their own plot of land. When the British Crown learnt of tribal warfare between *kaingas*, mainly for the purpose of grabbing land from others as was the main wealth, all isolated hamlets were moved and erected in a chosen area which is called *te kaawa* or village. The move was to foster harmony between and among warring tribes hence creating a long and ever lasting peace among all island populations. 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. Rarely villages are close to the sea at the windward side. But in the case of Makin, a small island by Kiribati standard, it is already overcrowded. This problem was reported during the 2007 National Consultation. Overcrowding will no doubt exacerbate the potential risks and vulnerabilities in terms of much needed drinking water, scarce terrestrial and marine food, sanitation affecting sea water and drinking water, and other related 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.

The increase in human population requires more dwellings and homes, hence the expansion of villages. Development projects, communal or private, in the form of construction work that require aggregate mining and timber material, certainly contribute to the destruction of the environment and the land at large. Productive land shrinks as villages expand. Marine and terrestrial resources are constantly 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 climate change scenarios.

The current water status on Makin is not a serious matter as Makin receives more rain than any island in the group. However, prolonged droughts will mostly affect Kiebu village as it has limited ground water reserve. The storage of rainwater with tanks and concrete cisterns must be encouraged at both villages. The current capacity to hold rainwater is insignificant on Makin as compared to Kiebu with quite a number of plastic tanks holding 5,000 litres of rainwater. Concrete water cisterns that last longer and require little maintenance are not constructed. During the Christian Missionaries era concrete water cisterns made of local lime cement obtained from burned coral were popular.

They have been abandoned and not maintained. While the Makin 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.

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 be bailed out but pumped out from a properly covered source. Potential ground water sites must be identified and protected from activities such as animal husbandry and gardening, the digging of *babai* pits and cemeteries.

House gardening on Makin is insignificant in that only less than a dozen households 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 arrangement with Air Kiribati to provide a special airfreight for the produce may encourage farmers to mass produce Chinese cabbage, lemons and limes, papaya and banana.

The planting of a variety of breadfruit trees 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 AMAK or other women groups must be involved.

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 Makin population in times of food shortage.

Land clearing in the form of clearing bushes and burning compost leaving the land bare must be discouraged. Bush fires are a disaster most of which were caused by unattended fires. Others were deliberately set or unintended. Community effort to put out bush fires is the best option as used to be prior to and post colonial times. These days bush fires are ignored and much land is being wasted.

A law dictating burial sites is weakening or non-existent. Village communal cemeteries were common but religion has demanded that the dead from one denomination must be buried at their own distinct cemetery. This arises from different beliefs about dead members that in some denominations those people can still be prayed for eternal salvation, hence any religious function performed for the dead by one denomination must only focus on their own church members who have passed away and not others. This results in family cemeteries near homes or on their own land. These practices may affect the quality of ground water. It is imperative that a law is strengthened to ensure potential ground water sources are not unnecessarily contaminated or polluted with such activities.



Fig. 2k: Burning compost and vegetation to clear land (photo by Titeem Auatabu)

Similarly, the dumping of rubbish (compost and plastic) on the beach is detrimental to the marine and coastal environments. Kuria was reported in 2005 that solid waste management is weak leading to environmental disaster. Proper disposal sites must be identified by the Kuria Island Council to ensure waste 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. The notable ones are reclaimed lands on which major church groups such as KPC and RC are sitting. On those reclaimed lands are community *maneabas* and residents. The impact on the neighboring coastlines is significant. This may lead to loss of homes and flooding. Which structures and properties are to be protected or in need of protection? This will be left to the people of Makin and their Island Council.

Private Structures

Seawalls and land reclamations are being mixed up in most. The distinction between them is that seawalls are constructed at the highest tide mark (Fig. l) while land reclamation is constructed below highest tide mark (Fig. m), in some cases are sitting on a reef-flat or mudflat. Makin is a reef island, unlike those islands with lagoons, the leeward coastline in reef islands appear to be

more stable than less protected lagoon shorelines as a barrier reef lies immediately to the shoreline thus breaking the forces of waves and currents. However, the inevitable future impact of rising sea level, compounded with storm surges and unpredictable bad weather, will seriously affect the island's leeward area but the windward side as well. What is required right away is the identification of those vulnerable areas, as done in this exercise, and work closely with experts in the areas of coastal erosion and processes, and civil engineering to ensure appropriate structures to reduce loss of shorelines are demonstrated to the Island Council and the people of Makin for adoption and implementation purposes. Construction designs for causeway, seawalls and other concrete structures can be made available at the MWPU Civil Engineering Unit.



Fig. 2l: Damaged seawall (photo by Temakei Tebano) Fig. 2m: A reclaimed land

Chapter 3: COMMUNICATION AND TRANSPORT

3.1 Voice Communication, the Media

It is only in recent months that satellite telephones were installed on Makin 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. About ten CB radios were reported operational on Makin privately owned by churches or individuals. Makin has more than 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 Makin via telephone or CB radio can be handy in case of unprecedented disasters caused by storm surges and seawater inundation and other similar events linked to climate change and sea level rise.

2.3 Road, Sea and Air Transportation

Traditional canoes on Makin appear to be on a decline, the existing ones are not maintained or left unattended in or outside private canoe sheds. Motorised skiffs and boats are taking over despite of the unparalleled increase in fuel cost. About twenty motorized boats are operational on Makin. These are either owned individually or by companies.

Sea travel is provided by several private and government vessels serving the island almost on a weekly basis. Food and other required supplies are brought in from Tarawa, local produce in terms of shark fins, copra and handicrafts are shipped to Tarawa. Air Kiribati provides air services and links between Tarawa and Makin and other islands. Air Pacific and Our Airline provide international air links while 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.

Motorised boats and skiffs can only bring in goods through a blasted channel from medium to large sized vessels, landing crafts serve the same purpose. Road transport is by bicycles, motor

cycles and trucks. In the case of evacuation exercises Makin has both means, one via sea and the other by air.

Chapter 4: GENERAL DISCUSSION AND RECOMMENDATIONS

The flooding and sea water seepage into *babai* pits on both Makin and Kiebu are the major concerns as far as food security is concerned. Associated with this is the quality of ground water, particularly on Kiebu where a water reserve is limited to a certain portion of the islet. A long term solution to protect *babai* pits from being flooded with sea water needs to be found and acted on as soon as possible. The impact of climate change and sea level rise will exacerbate the current problems even further.

Coastal erosion on Makin appears to become serious year after year as more and more coastlines are being lost. Rows of coconut trees and vegetation are being washed away during extreme tides and bad storms. This is compounded by ongoing aggregate mining with no sign of slowing down. The 2007 revised Environmental Act needs to be applied soon to the outer islands if the coastal areas are to be protected. An Island Council byelaw specific for Makin problems needs to be devised and acted on. And more awareness programs on protecting the land must be encouraged and embarked on by respective government ministries and non-governmental organisation partners.

Both marine and terrestrial resources of Makin Island are just adequate to support the current population density despite of loss of resources via human destructive activities. Yet 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, *te bero*, *babai* and others to ensure local food are eaten 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 is familiar with them.

Water and sanitation improvement must be looked into seriously to ensure the health of the people of Makin. Water catchment must be encouraged and potential water reservoirs are identified for future use when rain water is no longer available. Kiebu needs substantial help to enhance its rain water catchment systems as ground water may turn brackish during prolonged

droughts. A concrete water cistern must be encouraged as plastic water tanks are only short term measures. To ensure ground water system is properly maintained and managed residents of Kiebu and Makin 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 feeling of ownership and responsibility. The Makin Island Council, in consultation with communities, must give full support to such a vital undertaking.

Overcrowding must be thought of as an inherent problem that compounds potential risks and vulnerabilities related to climate change and sea level rise. The impact of overcrowding on all kinds of resources must be taken seriously. Relocating families as earliest as possible through some sustainable scheme may help Makin counter or reduce some of the inevitable risks and vulnerabilities in the years to come.

It is with care that both communal and private structures are discussed in a manner that does not discourage those concerned so that they can cooperate and realize the realities of the impact of their structures and activities on properties of their neighborhood. Structures such as reclaimed land and aggregate mining causing the loss of resources and coastlines must also be re-considered in light of long term benefits by the whole community on Makin. 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 fields must be the first stepping stone before other related procedures are carried out.

To ensure that Makin is linked to the rest of the world voice and text communications need to be enhanced and improved further. Break downs in telephone communication may cause a lot of problems when it comes to urgent matters such as serious health cases, disaster caused by extreme tides and surge storms. 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 tar-sealed, similarly a 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.

For future direction 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 mitigating and adaptation strategies. Makin, being one of the tiniest islands in Kiribati, should be poised to face the inevitable challenges brought by climate variability, climate change and sea level rise in the years to come.

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REFERENCES

Britanica Concise Encyclopedia: Kiribati

Gillie, R.D., 1993. Coastal erosion problems in the Gilbert Islands Group, Republic of Kiribati. SOPAC Technical Report 167. Kiribati Project:KIA

(http://www.fj.emb-japan.go.jp/eco_corporation/eco_kiribati.html).

Moul, E.T., 1959. The Halimeda and Caulerpa of Onotoa, Gilbert Islands. *Bulletin of the Torrey Botanical Club*, Vol. 86, No. 3 (May - Jun., 1959), pp. 159-165

National Statistics Office Ministry of Finance. Volume 1: Basic Information and tables (revised edition).

Republic of Kiribati Ministry of Education, Youth and Sports. Digest of Education Statistics 2005.

Republic of Kiribati and European Commission Joint Annual Report 2004. Final Report, 30 April 2005.

Tebano-Farran pers. comm., 2008.

Wikipedia