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Climate Witness

Report for Kabara, Lau, Fiji Islands

WWF - South Pacific Programme

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Acknowledgement

This Kabara Climate Witness Report would not have been realised had it not been the constant support provided by the following individuals to the project; **Ms Diane Mcfadzien** (WWF-SPP Regional Climate Change Co-ordinator) who's drive to raise local community awareness on Climate Change in Fiji and bring sites such as Kabara to the attention of funders has been a major catalyst for enabling this type of initiative, **Ms Tarai Biuvakadua** (WWF- SPP Communications Officer) who was instrumental in the facilitation of the community workshops, **Mr Jone Levaci** (Kabara- Provincial Representative) for organizing the community sessions on the island and taking the lead in traditional presentations, and the contributions made by volunteers **Mr Jason Tuitani, Mr Johnny Masoon** and **Mr Baravi Thaman** to the actual fieldwork undertaken on the island. I would also like to acknowledge **Dr Simon Hales** of the University of Otago and **Professor Yasuwo Fukuyo** of the University of Tokyo for providing information pertaining to fish poisoning and its possible link with Climate Change. Last but not least the four village communities of Naikeleyaga, Tokalau, Lomati and Udu on Kabara, for their willingness to participate in this project and share local information on which this report is based.

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Executive Summary

The Kabara Climate Witness Project is one of the first initiatives undertaken in the South Pacific by WWF to collect local knowledge of impacts of climate change on community livelihood and their surrounding environment. To collect baseline information and assessing possible changes caused by Climate Change participatory learning appraisal (PLA) techniques were utilised during community sessions. Some of the main climate change related observations provided by the community through the use of these tools; included widespread coral bleaching and linked decline in fisheries with their I qoliqoli (fishing grounds), shortening of the rainy season causing water scarcity and decline in agricultural yield, coastal erosion and its impacts on local infrastructure, littoral forests and low lying productive land, changes in the fruiting season of trees and abundance of migratory birds, increase in storm surge frequency and intensity of cyclones and lastly the increase in local fish poisoning incidences.

From the community workshops, though a number of impacts were identified, the one that most prevalent in each of the four villages was the issue of water shortage due changes in the seasons and the amount of rainfall they received. The communities stated that the dry season now tended to be prolonged and during the wet season, although rain did fall it tended to be more sporadic. These community observations regarding the reduction in rainfall have since been confirmed by the Fiji Meteorological Office as being valid, through trend generation for the area over the last 43 years (1961- 2003). The island has a harsh natural environment. As the island is composed mainly of limestone, soils are poorly developed and even where agriculture is possible soil nutrients are deficient. Areas deemed suitable for agriculture comprises roughly 14% of the islands total area, much of this delimited to low lying coastal flats. The nature of the islands terrain coupled with the non existence of streams and rivers on the island further exacerbates the islands communities' capacity to cultivate traditional crops and their vulnerability to changes in weather patterns and extreme events that affect the availability of rainfall. In general rainfall in the area where Kabara is located is highly variable and droughts are common. All households on the island are entirely dependent on rainfall for drinking, washing, cooking, bathing and to some extent watering of their agricultural crops.

The reduction in rainfall and droughts in Fiji has been strongly associated with ENSO events such as the 1997/98 El Nino. The reality of the situation is that small isolated communities like Kabara often do not have the capacity to adapt and absorb the impacts of these events effectively. The limitation of options on these islands as water is often derived directly from rainfall or drawing from the water lens also adds to the problem. In such situations it has been suggested that focus should be made upon improving water resource management efforts and implementing more effective means of water harvesting, water recycling and proper maintenance of water storing devices.

One of the main outcomes of the workshop was the development of community adaptation action plans for each of the four villages. One of the adaptation strategies identified was the need to strengthen village rules on proper utilisation of collected rainwater and maintenance of existing water storage tanks. This was something the community identified as something they could action themselves. The other which they identified and would need external help, was to increase their capacity to store water, which WWF has committed to securing water tanks for the community. Some of the other adaptation strategies devised by the community include replanting trees and shrubs along village coastal boundaries to stem coastal erosion and act as a buffer against coastal flooding during storm surge events, reducing negative human based impacts upon the reef to increase resilience of corals to bleaching events and monitoring fish harvest and consumption from noted poison zones within their fishing grounds. Such action strategies enable these communities to better adapt and strengthen their resilience to climate change impacts.

WWF- Climate Witness Programme

The climate witness program is a global program that works to capture and provide information in relation to indigenous knowledge regarding climate change. The programme is far reaching as WWF's work with local communities extend from the Inuit of Canada, the Sherpas of the Himalayas, the mangrove island dwellers of the Sunderbans in India, the Pampas communities in Argentina and isolated Pacific Island communities like Kabara in Fiji. By collecting and documenting stories from these communities WWF not only attempts to highlight the multifarious impacts climate change has and is having on these communities but to also draw out and enhance the human face of the whole climate change phenomenon and debate on a global platform and getting developed nations such as the United States and Australia to ratify the Kyoto Protocol. A further overarching purpose of the programme is to raise climate change awareness within these communities that should empower them to take assertive steps and actions to increase their resilience to the adverse impacts of Climate Change.

Location of Project Site- Kabara Island, Lau Group, Fiji.

The island of Kabara (see map insert- dashed purple circle) is one of a hundred scattered small islands forming a north south belt along the eastern boundary of Fiji known collectively as the Lau Group. The Lau Group lies midway between the main island Viti Levu and Tonga and Kabara lies roughly 250 km from Fiji's capital Suva. The island covering a total land area of 32.75 km^2 can be located by the geographical co-ordinates 18.95° S and 178.97° W and is composed almost entirely of limestone with the exception of a large volcanic outcrop along the northwest side of the island. The volcanic outcrop, known as Delaioloi, is 36 meters above sea level and has been put completely under cultivation. The rest of the inland limestone areas of the island has an extremely rough terrain and is covered in native forest. A continuous emergent barrier and fringing reef surrounds much of the island. Kabara contains four coastal villages, Naikeleaga, Tokalau, Lomati and Udu and has a resident population of 482 people (Bureau of Statistics 1996).

Climate Change has been an overlapping activity with the WWF-Fiji Sustainable Forests Woodcarving Project on Kabara, a community forestry project that aims developing a community management plan to sustain a threatened native tree species used for the carving industry on the island. Earlier studies conducted on the island in 2003, showed that Kabara communities were unaware of Climate Change (99% of the population indicated that they had not heard or knew what Climate Change was) or the potential impacts upon their lives. It was for this reason that Climate Change awareness activities for the communities and schools on the island were incorporated into the WWF Sustainable Forests Woodcarving Project.

The nature of the island and susceptibility of such isolated island communities was another reason this site was chosen. Kabara is an island that is entirely dependent on its natural resources (both marine and terrestrial) for its community's subsistence and commercial needs. The island is devoid of streams or rivers making the resident population highly dependent on rainfall to meet their water needs. Infrastructure is limited to coastal areas and the limitation of coastal land hinders any further possibility for further development or relocation. In addition only 14% of the island's area is suitable for agriculture and much of this is again limited to low lying coastal flats. All these factors places Kabara as vulnerable to the impacts of Climate Change which include extended periods of drought, coral bleaching and the reduction in marine resources, increased cyclonic events and coastal erosion from sea level rise.

Kabara's isolation was another reason for its selection. Unlike the mainland islands where the impacts of Climate Change are often blurred due to amalgamation with anthropogenic impacts, on Kabara this was not the case. Intensive agriculture, potential for sedimentation and exploitation of marine resources are non existent, meaning should inferences be made with regard to coral bleaching around the island, the cause would more likely be natural such as warming oceanic waters rather than from sedimentation, nutrient enrichment or destructive fishing practices. Similarly due to the relatively small village population and limitation in infrastructural development, coastal erosion is less likely to be caused by construction and coastal manipulation but instead caused changing sea levels. By having Kabara as a site we not only remove variables and their degree of influence that would suggest changes given by the community as being anything other then climate change but also enhances the credibility and validity of the anecdotal evidence collected.

Kabara's topography is dominated by limestone cliffs and low lying coastal

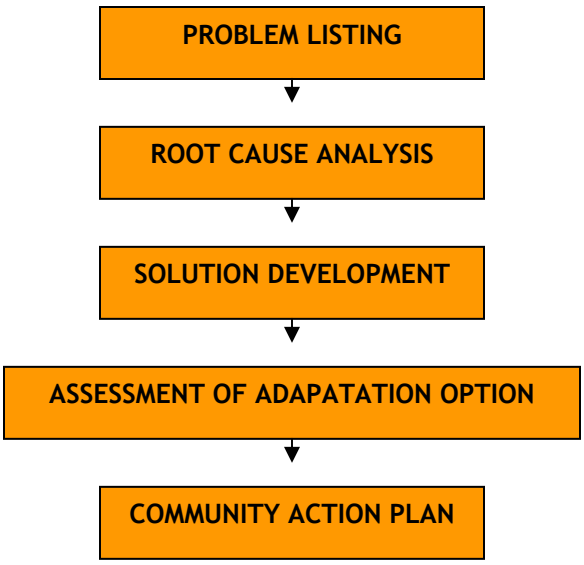
Activities Undertaken

The activities undertaken on Kabara under the Climate Witness Project has two main components; the first to conduct a community workshop involving all four villages on the island, and to use the workshop as a conduit for collecting climate change stories and developing community action plans to undertake adaptive measures for climate change problems identified through the workshop process; and the second was to undertake a biological baseline survey of the islands surrounding coral reefs and inter-tidal flats. This survey was to determine the extent on coral bleaching on the island and its impacts on the islands fisheries.

Workshop Methodologies

The workshop was divided into two sessions. The first was to collect local stories on climate change and this was done using the following Participatory and Learning Assessment (PLA) tools, community mapping, seasonal calendars, timelines and plant and animal inventories. Once this was done with the community participants, a cause and effect presentation on climate change was conducted. Once they had grasped the concept of Climate Change they were then asked to review the materials they had previously generated and to document changes and provide their reasoning behind these changes.

The second workshop session involved community climate change problem identification and the development of community adaptation action plans. Again PLA tools were used to generate these action plans, the process on how this was undertaken is provided below.



For a detailed explanation of the tools used during the workshop, refer to the ***Climate Change Toolkit*** (Appendix A).

Workshop Results

Section A.

Community Mapping

Community maps are useful in rapidly generating spatial characteristics in a given landscape and areas which communities would find synonymous with daily activity or their livelihoods such as natural resources. By having a sketch illustration of an area, it makes it easier for communities to mark out and discuss changes in their surrounding land and seascape that they would have noticed over time. It is these changes in spatial patterns identified by the communities that provide an indication of the influence of climate change and a useful measure of a community's vulnerability.

Community Discussion on Changes Identified

(Please refer to maps provided overleaf)

Naikeleyaga

Community Village Map

Coastal erosion *(highlighted in red)* was the main are of concern highlighted by this community. They indicated coastal erosion has accelerated over the last five to ten years and that the high tide mark has now moved roughly 10 meters inland. The reason for their concern, as seen from the map, is that many of their important buildings such as the school, teachers quarters, the islands post office, co-operate store and health centre lie within this zone of rapid coastal erosion.

Community Fishing Ground Map

The main change highlighted on this map by the community was coral bleaching *(highlighted in red)*, which covers quite an extensive portion of their-inter tidal area. Villagers indicated that in the past there used to be a lot of live colourful corals in this area, but this is now no longer the case. In addition much of these areas now do not much fish as it used to.

A Naikeleyaga Group discusses and maps out their fishing ground map in the sand

Jimaima Qalo, explains the village community map developed by her group

Tokalau

Community Village Map

The villagers of Tokalau also highlighted coastal erosion as a problem, as it has brought the ocean closer and exposing the houses in the village to more intense effects of storm surges and waves during cyclones. The area highlighted in red indicates where a number of houses used to be located in the past. These areas have now been abandoned in preference for building homes in somewhat sheltered areas inland. It should be noted that the high limestone cliffs that tower behind the village, places a limit on how far back the community can actually retreat. The villagers also verified that during the coastal flooding that ensured during the last cyclone, waves that swept into the village reached as far back as the cliffs destroying a number of homes, this was the first time such an event has ever occurred.

Community Fishing Ground Map

Much of the community's fishing ground has been affected by coral bleaching (*highlighted in red*), and villagers indicate recovery has been quite slow. The villagers indicated that this has been due to the frequent numbers of storm surges and the massive crown of thorns outbreak that occurred in 2000. Also interesting to note, is that, sections of their fishing grounds have been completely avoided by the villagers due to a number of poisoning incidents from consuming fish and other marine organisms from the area. They stated that these incidences of poisoning as strange as fish that they used to consume in the past have now become poisonous and have only occurred within the period when corals in the area became bleached and crown of thorns became prolific.

Tokalau Village Group lays out their fishing ground map

Tokalau Village Group scans their completed village map and begins transferring results to paper.

Lomati

Community Village Map

Coastal erosion was also featured by the Lomati villagers (*highlighted in red, marked Y*). They indicated that the high tide mark is now moving further inland and that much of the coastal vegetation that used be found along the beach has been destroyed by constant events of storm surge, leaving much of the coast exposed to further erosion. Also villagers now avoid building their homes closer to the beach as was common in the past (*highlighted in red, marked X*) preferring more protected areas inland.

Community Fishing Ground Map

Coral Bleaching is also featured by this community (*highlighted in red*), covering a very large section of the fishing ground. Villagers correlated the decline in the fisheries within the area to the bleaching, stating that because of the decline in fish they have not been able to have their annual traditional fish drive (yavirau) with their neighbouring village Tokalau. They also indicated that the corals have been very slow or do not seem likely to recover, as large sections of the reef and inter-tidal areas are still dead. In addition they stated that the bleaching seems to have weakened the structure of the reef and coral outcrops, as they now crumble very easily underfoot when villagers glean within the area.

Udu

Community Village Map

Udu did not mark any vulnerability on their village map like the previous three because their village is not located directly along the beach but behind a thick stretch of coastal vegetation, so coastal erosion and waves for surges place no immediate threats to homes. However the community indicated that erosion was occurring rapidly along their beach, as the high tide was moving closer to the coastal vegetation strand. They also highlighted that although the village is currently protected from exposure by this strand, it is laid out in a very long narrow strip of land, bordered by both the ocean on one side and high cliffs on the other. This means that relocation anywhere else should the tide continue to rise and the beach erode is extremely unlikely.

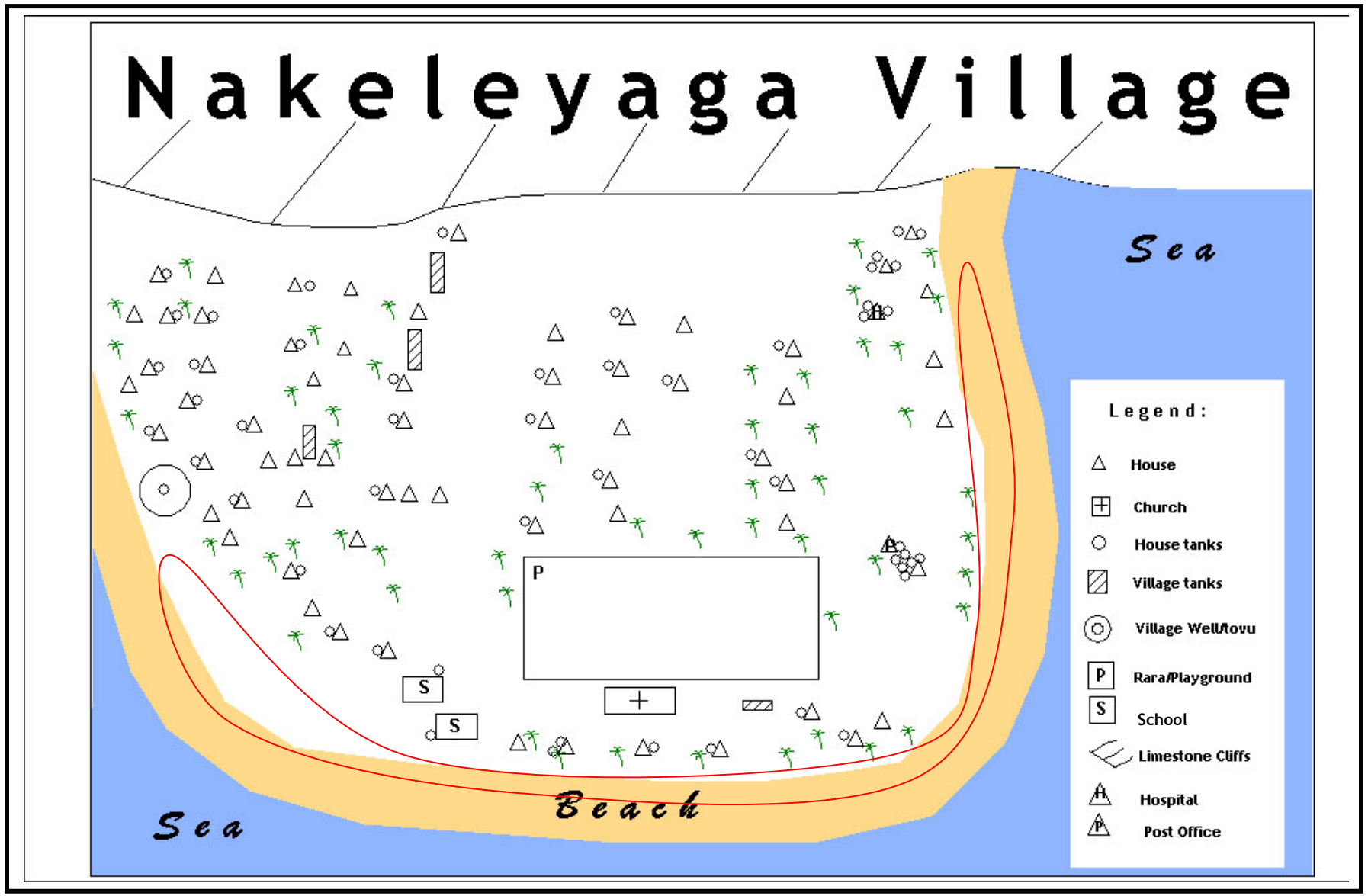
Community Fishing Ground Map

Coral Bleaching was similarly highlighted by the Udu community in certain areas of their fishing ground map (*highlighted in red, marked X*). As seen from the map, the bleached areas overlap with areas where the villagers harvest marine resources. Villagers indicated that with the incidences of coral bleaching and its relatively slow recovery, they do not catch as much fish in the area as they once did. Also marked was an area that has been rapidly eroding (*indicated by Y*), toward the southern end of the village and appears to be inducing changes in the areas ecosystems. A particular shellfish *gera*, is usually found within the vicinity, but the villagers say that is now difficult to find them there. The sea-grass beds (*indicated by* Y) have now extended their range and have become extremely prolific as sand that was once on the beach have now been spread within the inter-tidal flat, smothering areas that were once dominated by live corals

Udu Group discussing the layout of their village map

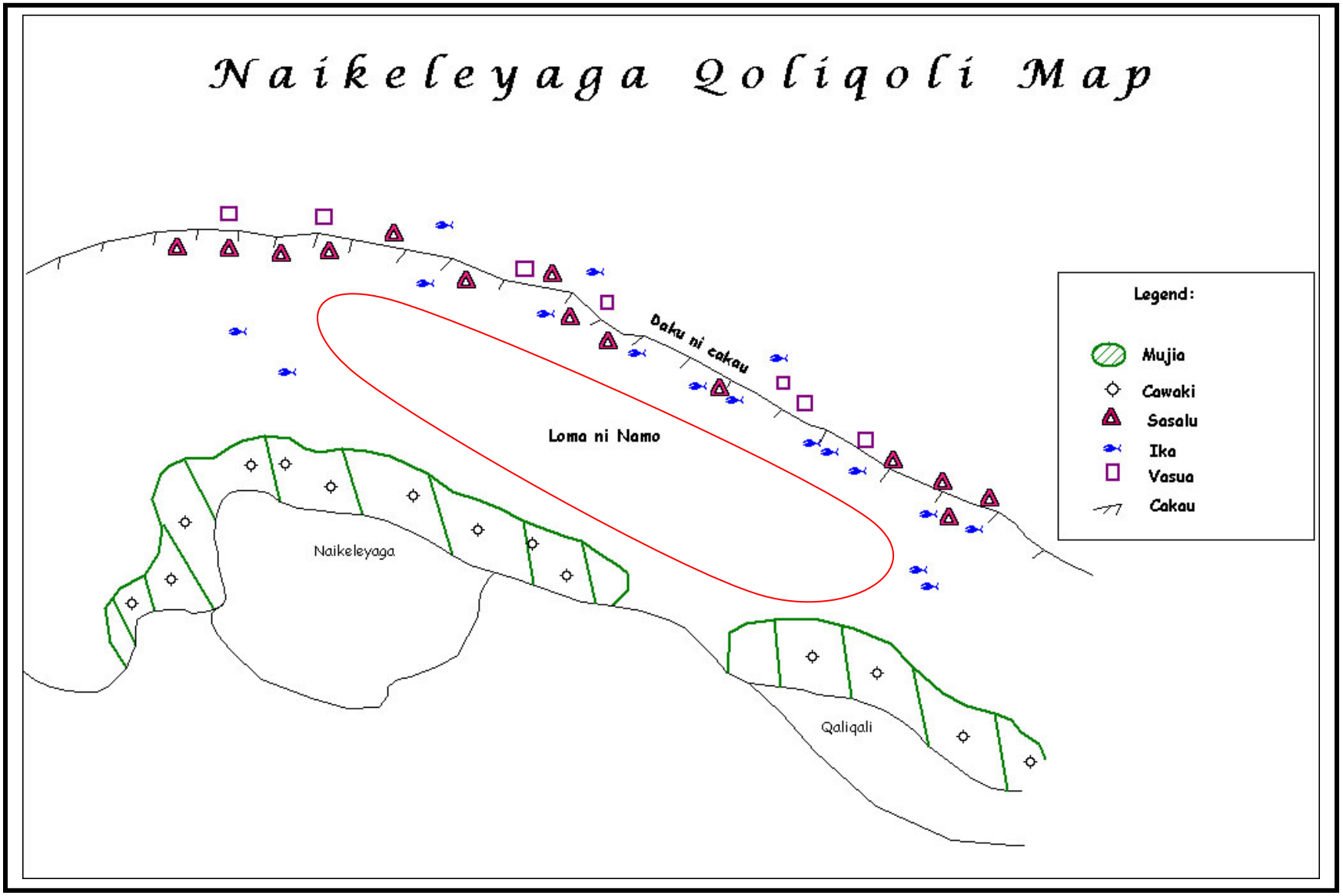
Udu participant discussing their village map and changes that have been observed.

Naikeleyaga Community Village Map



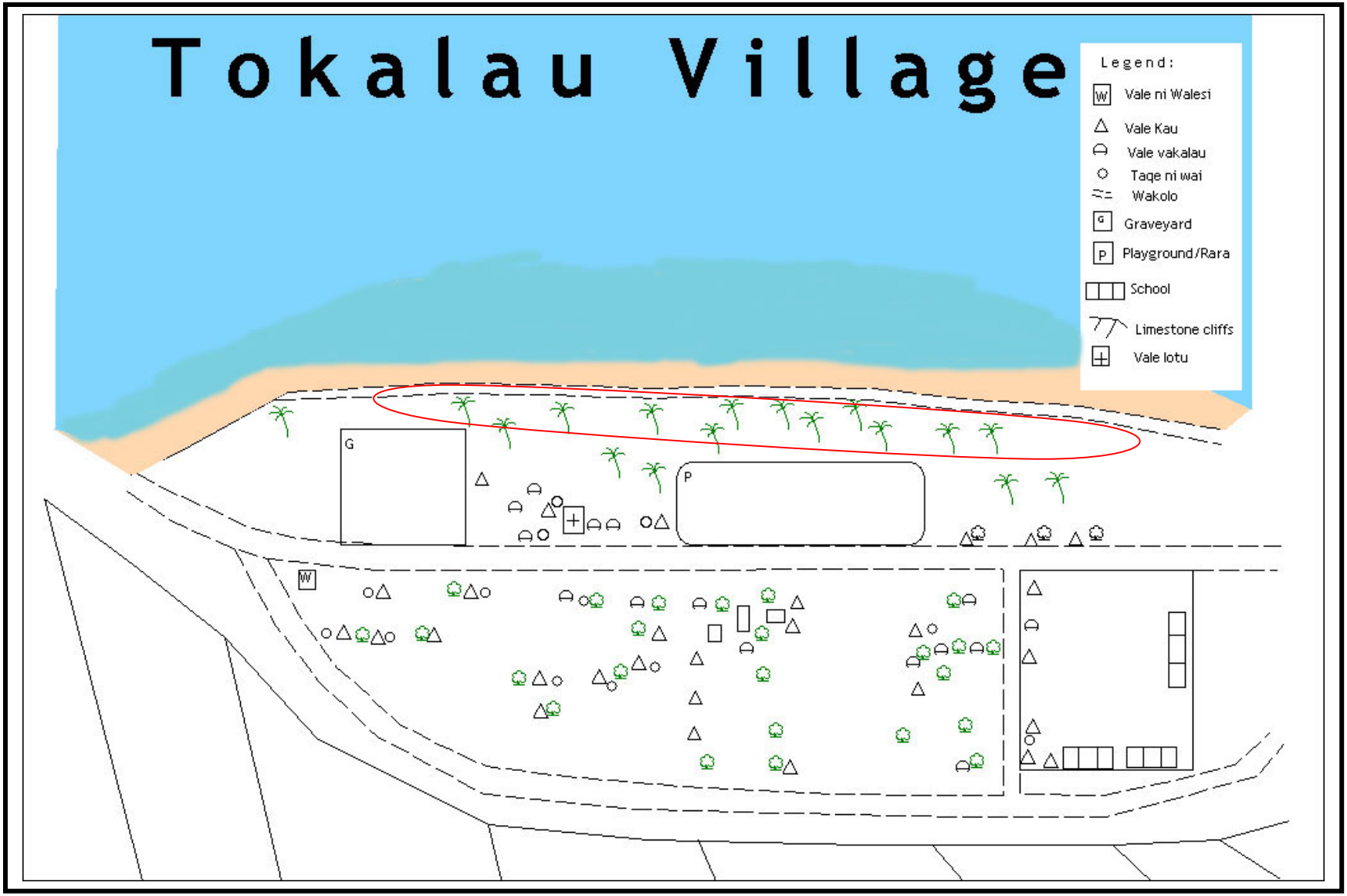
Community Village Map Generated by Viliame Suetolu, Tevita Qasi, Laitia Vakayatuyatu, Josua Yaco, Jimaima Qalo and Mary Borman
Map Digitised by Akosita Lewai- Ministry of Forestry

Naikeleyaga Community Fishing Ground Map



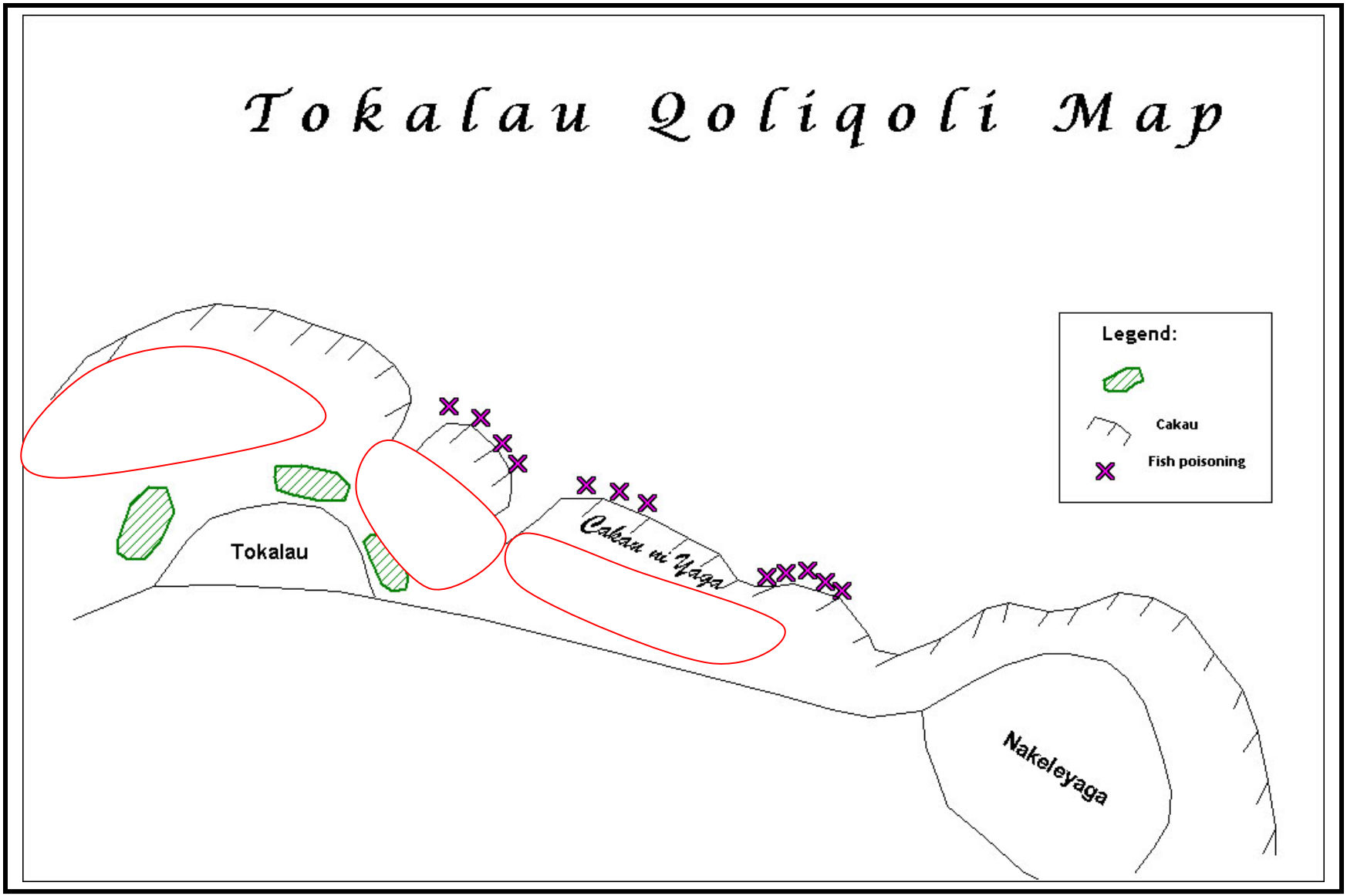
Community Fishing Ground Map Generated By Matai Dobui, Watesoni Vulivuli, Kevueli Buinisese, Leba Beitaki, Mere Ula Adi, JosaiaMatvura
Map Digitised by Akosita Lewai- Ministry of Forestry

Tokalau Community Village Map



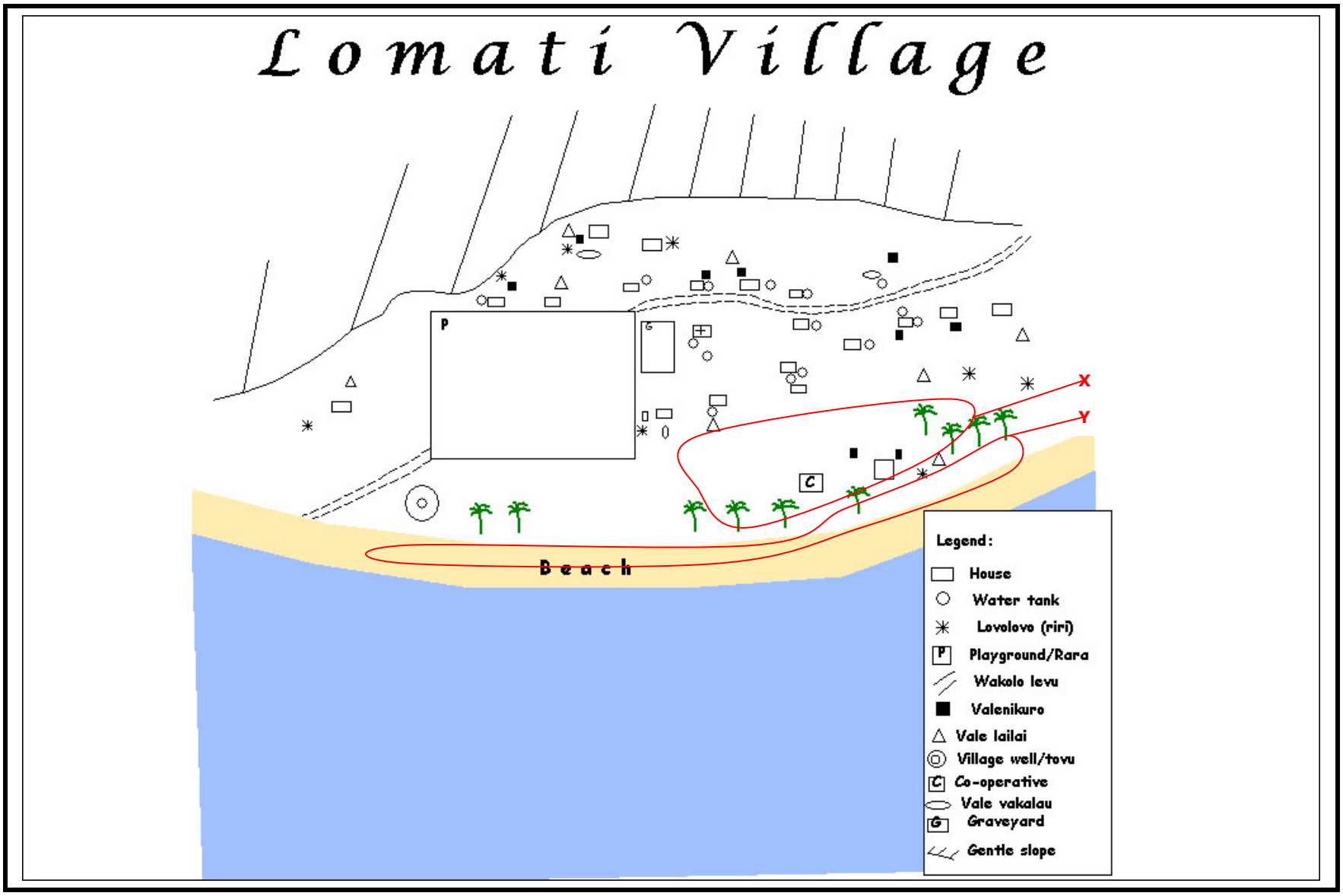
Community Village Map Generated By Lesi Seasea, Lesi Josefa, Lasarusa Moce and Fanoga Vahiga
Map Digitised by Akosita Lewai- Ministry of Forestry

Tokalau Community Fishing Ground Map



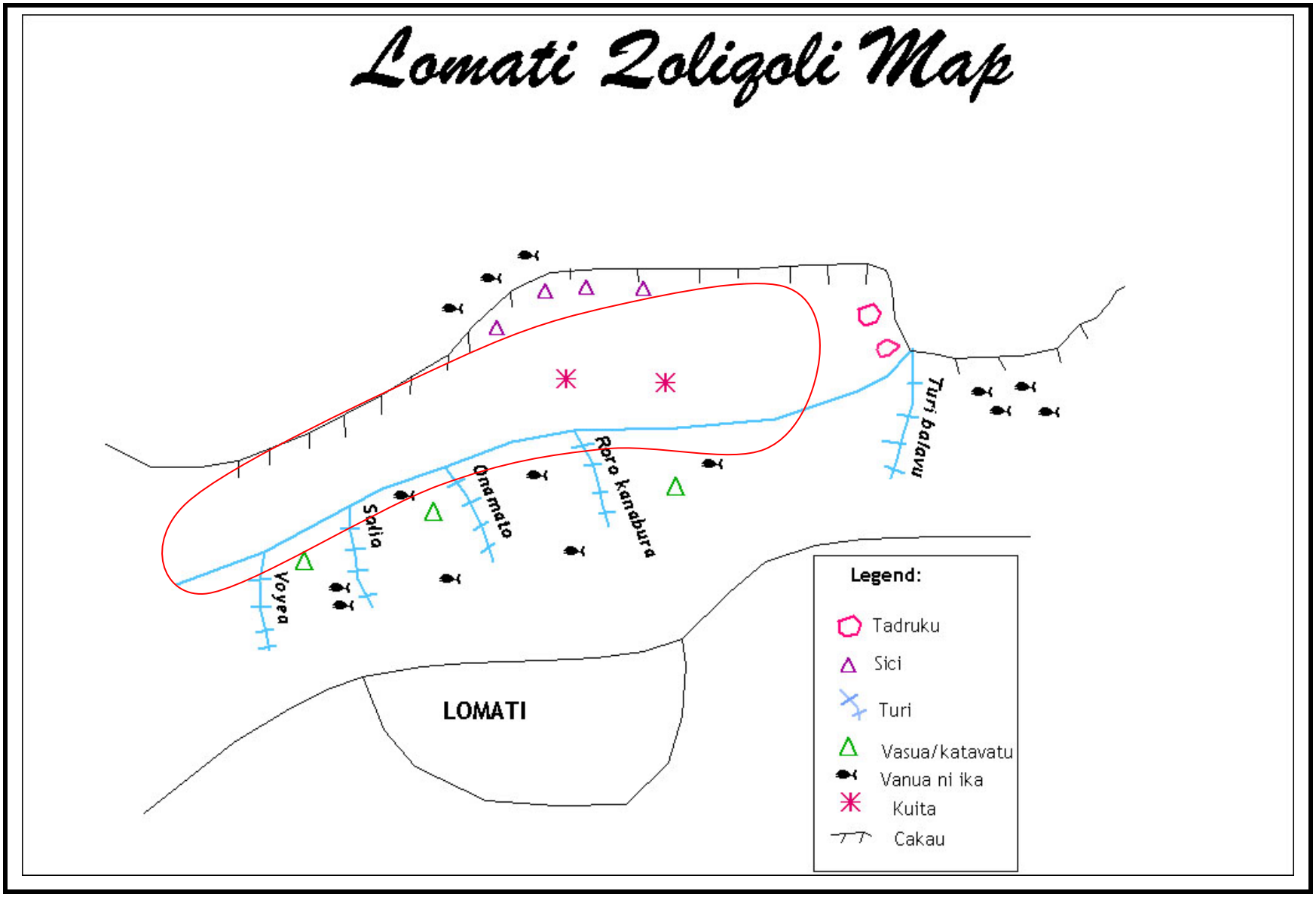
Community Fishing Ground Map Generated By Sefanaia Temo, Tudela Vodo, Epeli Moto, Jone Biu, Cama Tukana and Eseta Biu
Map Digitised by Akosita Lewai- Ministry of Forestry

Lomati Community Village Map



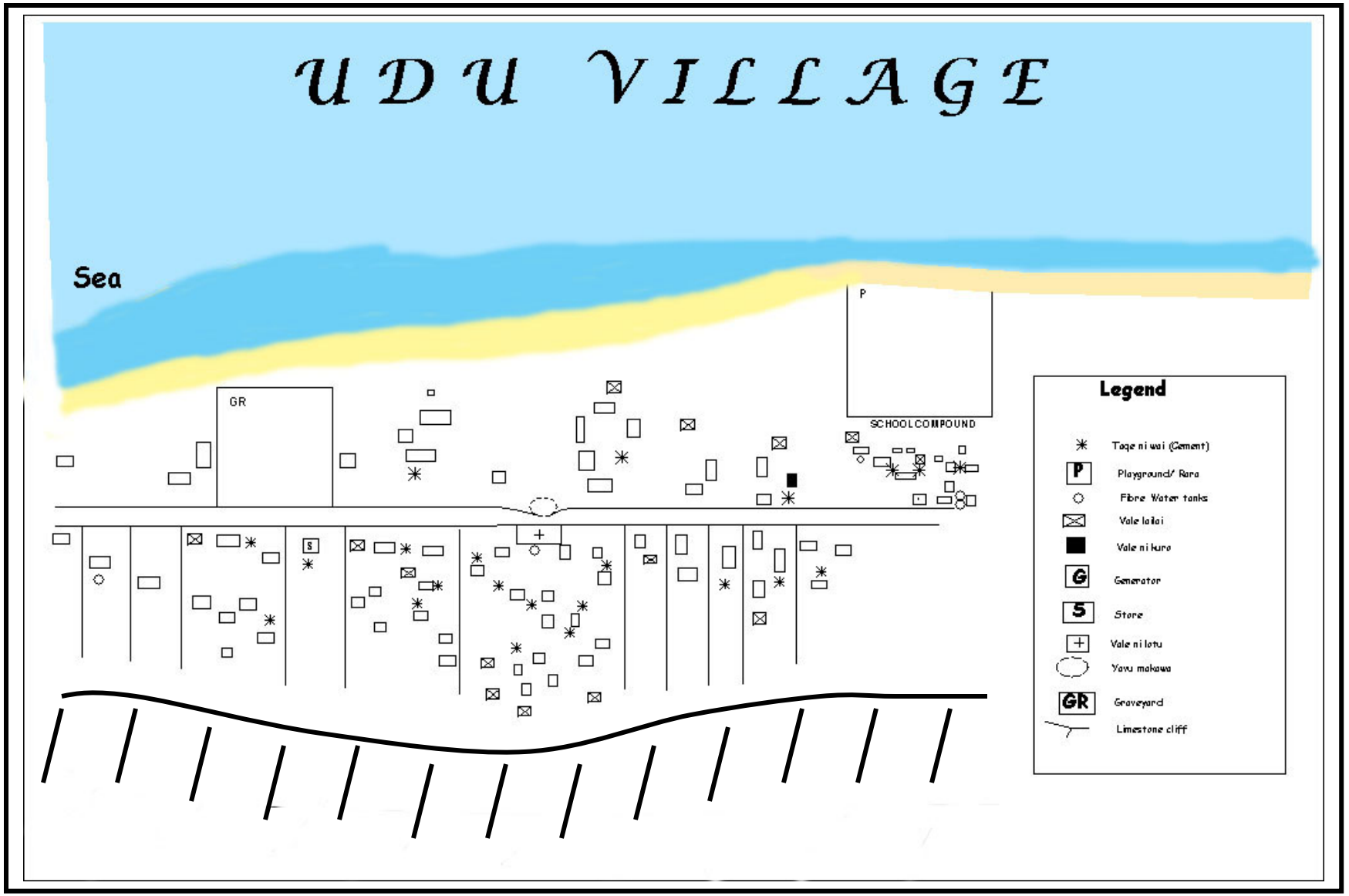
Community Village Map Generated By Jone Levaci, Ledua Beitaki, Sera Cavora and Volau Ruve
Map Digitised by Akosita Lewai- Ministry of Forestry

Lomati Community Fishing Ground Map



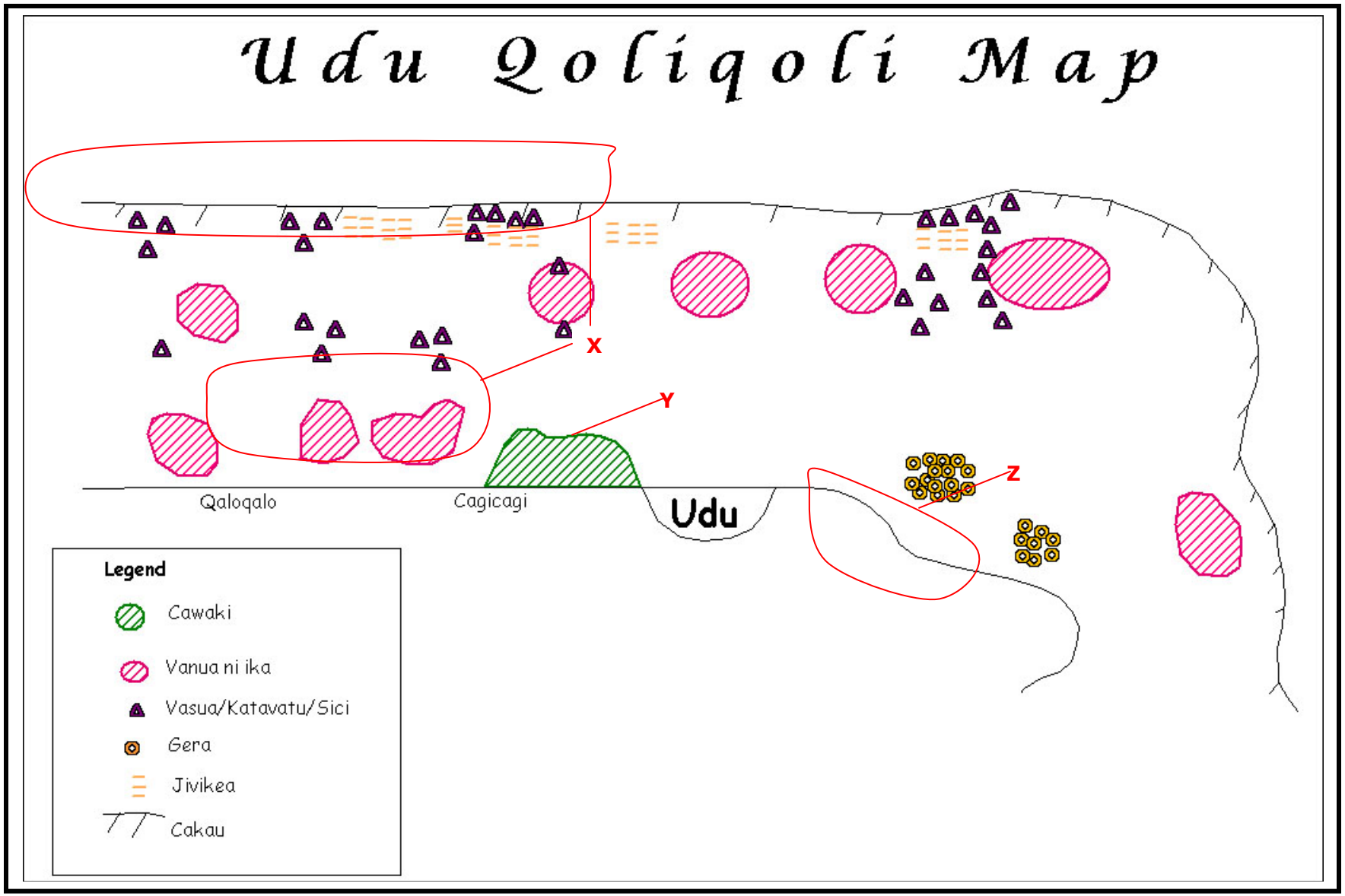
Community Village Map Generated By Jone Levaci, Ledua Beitaki, Sera Cavora and Volau Ruve
Map Digitised by Akosita Lewai- Ministry of Forestry

Udu Community Village Map



Community Village Map Generated By J. Waqa, K. Marau, M. Doko, I. Vakatawa, D. Yavimaiwai, L.Viliame, M.Bolei and T. Sorovakaono
Map Digitised by Akosita Lewai- Ministry of Forestry

Udu Community Fishing Ground Map



Community Village Map Generated By Apaitia Seru, Sitiveni Eleni, Matai Vuki, Iliaitia Vakarewa, Vakaloloma Liku, Penina Moce, Fipe Takayawa and Tevita Cama
Map Digitised by Akosita Lewai- Ministry of Forestry

Seasonal Calendar

Using seasonal calendars is an excellent tool for documenting regular or expected cyclical periods within a year influencing both occurrences within a natural environment and life within communities. By documenting these regulated natural occurrences and human activities within a given year, one can then use this as a baseline for determining changes due to skews in the normal cyclical periods and it being linked to climate change.

Communal Baseline Seasonal Calendar

(As part of the ensuing discussion please refer to the Kabara Community Seasonal Calendar provided on the next page)

The seasonal calendar generated by the communities on Kabara depicted a strong correlation between local climatic patterns and changes that occurred in their surrounding environment. Through separation of the marked dry and wet seasons some of the influencing distinctions of climate on natural occurrences and local human activities that occurred within these two periods were thus expressed

The communities marked out their distinct rainy season (period for continuous rainfall) from January to March and the period for occasional to sporadic showers between the months of April to June and October to December. The prevalence of rain during this period on the island also coincides with the hurricane season (November to April) for the region.

When aligning the marked rainy periods to natural occurrences within the terrestrial and marine environment on the island, one notices that there are certain natural occurrences that are specific to the period. For instance, the communities indicated the rainy period as the time when

- Mosquitoes were abundant on the island
- Land crabs come down from the limestone cliffs and inland areas to wash off their eggs in the ocean, turtles come ashore to nest and edible marine worms begin to appear.
- Certain fish species such as sharks, the trevally, surgeonfish and rabbitfish begin to breed.
- Migratory birds such as the Golden Plover visit the island and other resident birds (Tropic Bird, Pacific Harrier) begin to breed.
- Certain native forest trees begin to flower and seed such as the sinu, damanu, lagakali, vesi, lemon and ivi trees.
- There is an abundance of wild fruits in the forest.

Similarly when looking at local agricultural practices, one will also notice the rainy period as when most root crops such as yams, cassava and sweet potato are ready for harvest. Also in abundance during this period are the fruit from breadfruit, plantain, banana and coconut trees.

In comparison, the marked dry season (July to September) when almost no rain is expected on the island, one will notice a relative decline in natural occurrences with the exception of certain marine species breeding (cod) and native trees flowering and seeding (cibicibi and bolavatu) towards the end of the period in cue for the coming rain possibly a biological mean of ensuring seedling survival. Its is during this period that the villagers also clear and till the land for the planting of root crops, a farming strategy to ensure their crops grow well and mature during the wetter season.

From these communal descriptions of their environment, it is obvious of how important a role climate plays in regulating the growth patterns the islands terrestrial and marine flora and fauna in terms of reproduction and survival. This factor also regulates and influences the manner in which the islands community conduct their daily activities such as cultivation and when to expect and harvest certain marine and forest resources.

KABARA ISLAND SEASONAL CALENDAR

(Generated by the communities of Naikeleyaga, Tokalau, Lomati and Udu- 2004)

Communal Observations		January	February	March	April	May	June	July	August	September	October	November	December
Weather	Rainy Period												
	Dry period												
	Hot period												
	Cold period												
	Sporadic showers												
	Hurricane Season												
	Weather changes												
	Northern winds dominate												
	Winds come from all directions (unstable)												
	Southern winds dominate												
Marine	Time for the tave												
	Turtles breeding/nesting period												
	Time for the tuka (crabs)												
	Nuqa (rabbitfish) in season												
	Breeding period for kanace (mullet)												
	Time for balolo (marine worms)												
	Kawakawa (cod) in season- breed/abundant												
	Migrating Whales sighted												
	Time for Jiji												
	Time when octopus breed and is abundant												
	Fish in general is abundant/breed on reef												
	Breeding period for sharks												
	Breeding period for saqa (trevally)												
	Time for sisici/vivili (shellfish)												
	Time for the tabace (surgeonfish)												
Land Fauna	Time for mosquitoes												
	Time when the Golden Plover visit Kabara												
	Breeding period for Bobbies (Tavunasici)												
	Tropicbird visit and breed on island												
	Wild fruits in abundance												
	Breeding Period for Pacific Harrier (Taiseni)												

Data sheet continued on next page

Communal Observations		January	February	March	April	May	June	July	August	September	October	November	December
Forest	Cibicibi (*Cyanometra insularis*) flowers and seeds												
	Bolavatu *(Homalium pallidum)*flowers												
	Vesi *(Intsia bijuga)* flowers and seeds												
	Lagakali *(Aglaia saltatorum)* flowers												
	Mango trees flower												
	Lemon/orange trees bloom												
	Ivi *(Inocarpus fagifer)* trees flower and fruits												
	Gasau reed *(Miscanthus sp)*flowers												
	Male *(Myristica sp)* tree flowers												
	Yasiyasi tree flowers												
	Dilo *(Calophyllum inophyllum)* and Dakua *(Agathis spp*) trees flower												
	Drala *(Erythrina sp*) tree flowers												
	Makosoi *(Cananga odorata)* trees flower												
	Sekoula tree flowers												
	Buabua (*Fragraea spp*) tree flowers												
	Damanu *(Callophyllum vitiense)* tree flowers												
	Bau *(Palaquium sp)* tree flowers												
	Sinu *(Excoecaria agallocha)* trees flower												
Agriculture	Yams (uvi leka) ready for harvest												
	Land cleared and Yams (uvi) planted												
	Breadfruit (uto) flowers and fruits												
	Pineapples (painapiu) ready for harvest												
	Dawa begins to fruit												
	Harvest of Yams/cassava (Uvi/Tavioka) (Tara lololo)												
	Time for banansa and plaintains(jaina/ vudi)												
	Sweet potato (kumala) planted												
	Coconuts abundant												
	Sweet Potato (kumala) harvested												
	Land cleared and prepared for planting (uvi/kumala)												
	Cassava (tavioka) planted												

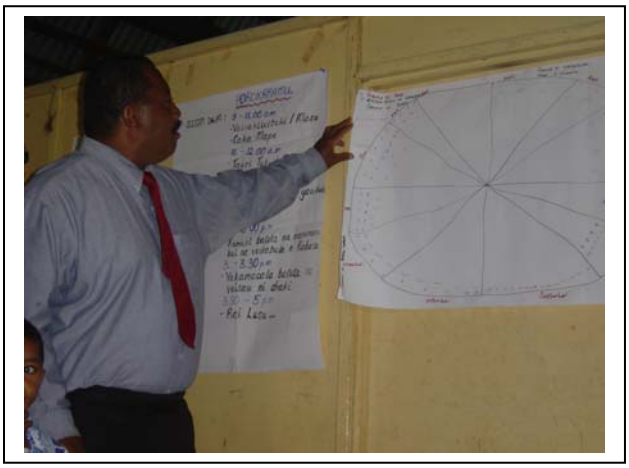
Community Discussions on Changes to Seasonal Baseline

Weather Patterns

The communities on Kabara have indicated that local weather patterns on the island are becoming more erratic. That the dry season has shifted into the normal rainy season and likewise the rainy season has shifted into the usual drier period. Other observations included

- Changes in the frequency and intensity of cyclones and hurricanes. One of the older villagers from Naikeleyaga indicated that a hurricane in 1948 lasted for three days and had devastating effects on the island. He noted the cyclone that hit the island the previous year lasted a single day, but had done more damage than the cyclone he remembered in 1948.
- The rainy period is not continuous and the dry season seems longer, this has resulted in water shortages on the island
- A general increase in frequency and intensity in storms and the storm surges that come with it. This has often prevented the villagers from going out to fish on the reefs.

Udu Community Participants developing their group seasonal calendar



Peni Dautu of Naikeleyaga explains the marine resource seasonal calendar and discusses observed changes in pattern.

Terrestrial Environment

Changes recorded were mainly with regard to native trees, changes in the flowering and fruiting periods due to change in weather patterns. Some of the observed changes include

- Mango trees bearing out of season or not at all. In the past the trees bore fruit mainly during the Christmas period- December.
- Lemon and orange trees now fruit earlier than in the past. They usually fruit and ripen around March, they now tend to fruit around October.
- Wild pawpaw trees no longer produce good quality fruit.
- The dawa trees no longer bear fruit when expected. In general villagers stated that the reason their fruit trees were less productive was due inconsistency in rainfall.

Observed changes with regard to the islands terrestrial fauna included

- The fruit bats in the forest are becoming less common as compared to the past, possibly due to decline in wild fruit sources.
- The golden plover do not come as often as in the past and now come often as individuals rather than in flocks.
- Mosquitoes were now less of a problem, as the there was now less rainfall to induce breeding.

Marine Environment

The communities did not record dramatic changes in the marine environment, however some of the observed changes include

- Turtles that used to breed near the coastline on Udu Village no longer come ashore to nest. Villagers stated the areas on the beach where they used to nest have been eroded.
- Migrating whales between the Kabara-Vuaqava passage were a common sight during the drier months are now a less common phenomenon.
- General decline in the abundance of Kawakawa (cod), common during the drier months- Villagers indicated that this was possibly due to the changes in water temperature

Community members on Kabara are excellent fishermen, this is based on an acute knowledge of their marine environment and the seasonality of the resources it contains

A Tokalau community group presenting the results of their agricultural seasonal calendar

Agriculture

The main change that the villagers could relate with regard to agriculture was the effects change in rainfall had on productivity of their crops. This included

- Yams being smaller and cassava being sour and inedible due to the insufficiency in rain.
- The lack of rain also seemingly causing an increase in the infestation of white fly on most of their crops.

Lomati Community Group presenting their weather seasonal calendar

Kabara islanders rely on traditional knowledge regarding seasonal weather pattern as cultivation of crops on Kabara must always coincide with the rainy season

Using community timelines is a useful technique in generating historical information on significant changes or changing conditions that occur in a particular community's environment. Generating a timeline also provides insight into whether changing conditions have improved or have had detrimental effects on the lives of these communities.

Community Timeline Generated by Villages on Kabara

UDU VILLAGE

1800-1900

1834	First village founded and settled-hill fort (Caukenaloa)
1835	Abandonment of first village, founding of second village/hill fort (Vakawaqa).
	First two villages founded when cannibalism was prevalent in Fiji.
	Christianity arrives and supplants old religion
	New village established along the coast (Udu)

1900-1940

1930	First cement water tank constructed in village

1941- 1969

1948	Strong winds and tidal wave sweeps through the village
	Hurricane hits island, followed by long period of drought
1958	Village church constructed (Valevatu)
1962	Village Co-op Store founded
1968	Udu villagers begin to carve tanoa's for income generation

1970- 1989

1970	Hurricane Vala
1972	Hurricane Bebe
1973	Hurricane Lote- destroyed houses, village gardens and surrounding reef areas
1985	Sea-grass begin to dominate marine areas along the Udu coast.

1990- 2004

1991	Radio transmission (radio telephone) house established in village
	Dispensary established
1993	Hurricane Kina
2003	Hurricane Ami
	Massive outbreak in crown of thorns in marine areas
2004	Establishment of satellite telephone in village

NAIKELEYAGA VILLAGE

1800-1900

1800 – 1900	Christianity established in Qaliqali (first village site)

1900-1940

1935:	Tidal wave hits Qaliqali followed by strong winds
1936 (March)	Qaliqali abandoned, new village established to the north of the island (Naikeleyaga)

1941- 1969

1948	Island health center established
	Village Church constructed
	Radio Transmission house established
	Hurricane hits island
1954	Post Office established
	First deacon posted to Naikeleyaga village
1963 – 1964	First cement water tank constructed.

1970- 1989

1972	Hurricane Bebe
1973	Hurricane Lote
1975	Hurricane Val
1980	Village Primary school established
	Generator house and communal electricity established
	First Hosting of Provincial Meeting
1984 – 1986	Construction of the Tai Kabara- inter island transport vessel

1990- 2004

2001	First Indo-Fijian teacher on Kabara (Mr. Dinesh Kumar)
2004	Establishment of satellite telephone in village

TOKALAU VILLAGE

1900-1940

1905	First Cement Water Tank constructed in village
1908	First island reverend posted to Kabara- Rev Isireli Cama

1941- 1969

1946	First primary school established on island (Kabara District School)
1959	First goat brought to Tokalau

1970- 1989

1970	First deacon posted to Tokalau Village
1971	Construction of new village church

1990-2004

1991	Generator house and communal electricity established in village
2004	Village satellite telephone established.

LOMATI VILLAGE

	1800-1900
1800-1900	First hill fort (Delainakaka) abandoned and new fort established (Nasuavesi) Second site abandoned and third village established (Nairairai) Arrival of Christianity and abandonment of third site New village established along coast- Lomati (Nuburavi)
	1941- 1969
1955	New church built in Lomati
1960	First cement house built in village
	1990-2004
2004	Satellite telephone established in village

Discussion on Community Timeline Results

The historical information generated by the four communities highlighted mainly communal developments and natural disasters. In general what can be perceived from the four timelines is that development in terms of infrastructure/communications on the island appears very intermittent and slow. There are various factors contributing to this, one is its isolation and another is its rural- subsistence setting. This strongly suggests that the communities on the island have very poor independent coping capability in adequately addressing impacts brought about by climate change.

Hurricanes and drought was a recurrent feature in the timelines as they had devastating effects on the islanders' homes and gardens. The communities indicated that whenever hurricanes hit the island, it took them time to recover in terms of rebuilding homes and replanting their crops. Usually after such events, there is shortage in food on the island and the government has often had to ship relief supplies for the communities. In addition because most of the crops in their gardens would have been destroyed, they have had to go to other nearby islands to obtain cuttings of sweet potato and yams to restock their gardens. The devastation from hurricanes also extends to their fishing grounds, as waves damage the coral reefs and scour the inter-tidal flats. It takes time for these areas to recover and for the fish to return.

Communities also indicated that often the government's response after a hurricane is often delayed and coupled with the depletion of food from their gardens and marine areas it places them in a vulnerable position in terms of food security. In comparison to the past the communities also mentioned that the frequency and intensity of storms and hurricanes affecting the island seemed to have increased. In the past older members stated they would have a major storm or hurricane every five to seven years, which allowed their communities to recover effectively, however over the past decade such events seem to occur every second year.

An interesting feature on the timeline was a massive crown of thorn outbreak on the islands reefs in 2003. This coincided with earlier coral bleaching on the reefs. Although the villagers were not able to make the correlation between warming of the ocean and coral bleaching, they indicated that in recent years this phenomenon has become prevalent. Older members of the communities stated that many of the coastal areas used to harbour colourful coral outcrops in the past, this is no longer the case as most areas are still bleached and have not recovered.

Plant and Animal Inventory

Local communities have an intimate knowledge of the plants and animals in their surroundings, making up what would be collectively be defined as traditional knowledge. Using this tool is rapid but a useful method in collecting information on local biodiversity and can be used as a baseline for determining the status of a particular plant or animal. In doing this, communities can categorise what in their environment is in decline or disappearing and deliberate on the reasons for this, whether their own actions have been a contributing reason behind the decline or is it due to some other external factor, inducing changes in the natural conditions of these species environment, such as climate change.

Community Results and Discussion

The species listing that the communities of Kabara generated showed a total of 108 plant species (70 wild or forest species and 38 cultivated or agricultural species), 125 marine species (including vertebrates and invertebrates) and 37 terrestrial faunal species (31 bird and 6 animal). From this entire listing various species were indicated by the community to be in short supply or locally extinct. A summary for each of the species categories and given reasons by the community for changes in their abundance is provided below.

Inland/Coastal Forest Resources

Much of the plant species listed under this category were mainly trees that the community utilised for various subsistence needs, such as wood for building material s and traditional artefacts, sources of wild fruit, firewood and medicines. The Naikeleyaga community listed one tree species to be in short supply, the lomavida (), as this tree species is utilised as timber for houses and woodcarving, and it is likely that the depletion is caused from over-harvesting. The Tokalu- Lomati community listed 12 tree species as declining in abundance, which included the vesi, bau cana and bau vudi, sevua, vobo, lagakali, makosoi, kavika, moli karo and moli madarini, pulipuli macoqe and masi. The first six species listed are utilised by the villagers as timber for building, so decline may again be linked to over-harvesting. The others listed are trees that are grow within the confines of the village boundary as they are utilised mainly for its fruit and flowers, it is likely that these trees were in any case never prolifically abundant. One tree listed, the lagakali, appears to be in decline within this particular communities forest area, which is unlike the other communities which listed it as still abundant in their areas. The final community in Udu listed only three tree species as in short supply, the drala, bitu and vunigigia. The bitu is an introduced species, and therefore is unlikely to have been abundant in the past. The vunigigia, the traditional tree of the Kabara people was indicated by the community as similarly never being abundant in the past. The drala, an important medicinal tree however is found mainly along the littoral coastal forest, and much of these areas have been impacted by coastal erosion.

Marine Resources

Much of Kabara's limestone interior is covered in native forest which provide an array of resources utilised by the island communities

Wild fruit such as the native chestnut (ivi) plays an important role in the local villagers diet.

communities on Kabara included the following; fish (tugadra, novu, vai, dabea, loulou, ogo and donu), shellfish (gera, davui and tadruku) crustaceans (urau), holothurians (sucuwalu, tarasea, loaloa, sucu-i-drau and dri loli) and turtles. As these marine organisms are harvested mainly for household consumption and in some instances for income generation, the reason for declining abundance may be due to harvesting pressure. However, considering static population growth and a very sporadic market for only one marine resource, holothurians or beche-der-mer, it is likely that changes in the marine environment may be a contributing factor. Villagers have observed widespread bleaching in many areas of their reefs and the increasing frequency of storm surges pounding their reefs may also be a contributing factor to the decline in productivity for these areas. It should also be noted that many of the breeding areas for turtles that frequent the island are now slowly being eroded.

The marine areas surrounding Kabara hosts unique marine species such as the giant clam

Coastal erosion threatens the habitat of the coconut crab , found mainly in coconut groves along the beach.

Cultivated and Wild Crop Resources

Kabara has very limited land capacity for agriculture, delimited mainly along low lying coastal flats combined with a complete dependence on rainfall for sustaining viable yields. Some of the traditional crops that are now less actively grown or cultivated include the uvi (yam) and dalo-ni-tana. The villagers stated that these two crops took time to cultivate and were in general very difficult to grow. Due to the unpredictability in rain, they tended to cultivate faster growing root crops such as cassava and sweet potatoes. Two wild root crops that were indicated by the Udu community in decline were the kawai and kaile, these are wild root crops that thrive in the forest. Possible reasons for its decline include over harvest by the community, as these root crops are often depended on during drought or after hurricane periods, and the foraging habits of wild pigs prevalent in this community's forest area. The last group listed under this category as declining in abundance, were mainly introduced agricultural crops such as melons, pumpkins, onions, tomatoes, egg plants, cabbage and sugar cane. The prevalent reason for their declining cultivation was because of the lack of suitable areas to cultivate them and the need for constant and dependable rainwater. Some of the villagers also stated salt spray due to the close proximity of their gardens to the sea affected crop yield.

Fauna Biodiversity

Kabara is typical of any oceanic island as bird, insect and certain reptilian species being the dominant natural fauna. Apart from fruit bats, all other mammal species were introduced by local people. Bird species out of the faunal listing was mainly indicated by the four communities as low or declining in numbers. This included the lulu, taiseni, beka, dilio, bisi, kasaqa, kula, gutudei, belo, lawedua, droe, lakaba, kula, kaseivau and ga ni vatu. The bisi (banded rail) is now locally extinct on Kabara due to the introduction of cats. The increase in feral cats may also be playing a major role in the decline in a number of these birds on the island. It should be noted that many of these listed birds were never really abundant on the island and some like the dilio, kasaqa, gutudei and lawedua are migratory birds. Their decline in numbers however may also be linked to changes in food abundance in the marine environment. The beka (fruit bats) once abundant is now rare on the island, community members from Udu, suggested a possible decline in wild fruit abundance as a major reason foir their decline.

A sweet potato patch in Udu village, one of the few agricultural crops that thrive on Kabara

A Tokalau Community Group listing their forest resource inventory

A Naikeleyaga Group developing their Marine Resource inventory

The kingfisher, one of the many bird species found on Kabara

Community Values

The impacts of climate change will be a major factor that will determine a community's outlook on the future and the actions they will need to undertake in order to adapt. However, by assessing community values it enables one to see what individuals within that community perceive in their environment as important in their lives and the reasons for wanting to maintain them as their environment changes. Often the basic reasons for why climate change is an issue for communities in the developing is overlooked and this exercise provides a means of looking at the world from their perspective.

Community Results

Udu Village

1. *Person:* Jo Taimarau

Item of Importance: Pawpaw/Papaya

Reason/Significance: When our ancestors first came to Kabara, this was probably the first thing that was available for them to eat because it is not cultivated and grows wild. I was brought up on this fruit and one of the few fruit trees that will always be around to help us survive. The province of Lau is well known for its pawpaw trees, it is the fruit of our province and to which we associate ourselves with.

2. *Person:* Samuela Cama

Item of Importance: Cassava/Manioc

Reason/ Significance: As most other root crops don't grow well on our island I think this is the most important root crop that goes with our daily meals and usually the main thing most of our families have with tea in the morning. This crop is important as it helps us meet our daily needs and when we have communal gatherings. Almost all families on the island rely on this crop for their meals each day, which is why it is important not only fro my family but everyone on Kabara.

3. *Person:* Samisoni Raika

Item of Importance: Water

Reason/Significance: Our island is known for being rocky and sandy and there are no springs or rivers from which we can get water. All the water we have comes from rainfall, which is why it is important. The water we get from rainfall helps us wash, cook, drink and bathe. Water is so limited that we treasure what we collect. Without it we would not be able to survive. All humans depend on water that is why it is the most important thing to me.

4. *Person:* Tuberi Tupulotu

Item of Importance: Coconut

Reason/ Significance: The coconut is really important as we can drink and eat of it, especially when there is water shortage on the island. Some of the families in the village also sell dried coconut as copra to earn money. This item is not only important to us as a community but also to Fiji, as it contributes to generating national income through the production of coconut oil.

5. *Person:* Penina Moce
Item of Importance: Plantain

Reason/ Significance: This is an important food item that is slowly disappearing from our island. I think this is a much better food item than the pawpaw and coconut, and when it is available, villagers ask for it. It is also important as we use it for traditional medicine.

Some of the Udu Community participants sharing an item of value with the rest of the community members- Clockwise from top- Penina Moce (Plantain), Samuela Cama (Cassava Plant) and Tuberi Tupulotu (Coconut). Items demonstrate how important agricultural produce is to the individual and the community at large.

Naikeleyaga Village

1. *Person:* Taito Kaumaitotoya

Item of Importance: Yam

Reason/Significance: It is part of communal way of life to grow yams, whether it be as individual households, households within clans or Kabara as a whole. To grow yams and the skills that go into its cultivation is an activity that defines manliness for males on Kabara. This has been the ways of our ancestors and they prided themselves on the abundance of their gardens, which is why the yam is important to me.

2. *Person:* Josaia Matavura

Item of Importance: Bau Tree

Reason/Significance: This is a tree that grows in the wild and when it bears fruit it can be collected and eaten, especially if we men are working in the forest, collecting timber. The tree is an important timber tree for building our homes and most of the outlying islands usually come to Kabara to get timber for similar reasons, some come as far off as Tonga and Suva.

3. *Person:* Timaima Qalo

Item of Importance: Flowers

Reason/Significance: I have chosen flowers as something important as I feel they are part of my life. I think flowers are important to a community because it brightens up our yards and the village in general.

4. *Person:* Watesoni Vulivuli

Item of Importance: Passion-fruit Plant

Reason/Significance: This is a relatively new introduction to Kabara, as I never saw this plant on the island when I was young. This plant however has become very useful to us as we can now make juice from it and something we look forward to especially at meal times and when there is a village gathering.

5. *Person:* Ilaitia Vakayatuyatu

Item of Importance: Coconut

Reason/Significance: I have chosen the coconut because I think it is a very important and useful resource to the whole clan. First of all the tree beautifies our village, especially when the coconut trees are laden with nuts. We all know that this tree is important to all us villagers, especially its juice when we have the dry season and not enough water. When it ripens we also use its milk to prepare our food and some of us sell copra to earn an income for our families. Even the trunk of the coconut tree is useful, as we use it for the poles for some of our houses. When you come to think of it all parts of the coconut tree are useful.

6. *Person:* Tevita Saqati

Item of Importance: Cassava/Manioc

Reason/Significance: Ever since I've actively taken communal tasks as an adult, the one thing I love doing the most is planting in my garden. The cassava is important to me because it is an integral part of my family's daily meal and helps meet my communal obligation by providing my share of root crops that will be used during communal gatherings. There is nothing more important to me than having a productive bountiful garden, as it ensures the survival of my family, relations and Kabara as a whole.

7. *Person:* Asaeli Titoko

Item of Importance: Vesi tree

Reason/Significance: This is one tree that I think has been wasted by us on Kabara. Often we have felled this tree and wasted the wood when we could have used to make other things rather than leaving them to rot in the forest. I think we need to try and market our carvings well if we want this resource to remain abundant. The vesi tree is

important because the carvings we make from its wood is the main source of income for almost all families on Kabara.

8. *Person:* Josua Yaco

Item of Importance: Vutu Tree

Reason/Significance: This tree is important as it provides shade within the village. More importantly the tree provides us with fruit to eat and it can be used as medicine for many ailments.

9. *Person:* Peni Dautu

Item of Importance: The Bible

Reason/Significance: This is the most important item in my life. Everything I do, whether it be hard or easy the bible helps me get through each day and helps me be a better leader within my household. With the help of the bible I'm made a better man, a better relative, have a good heart not to begrudge my extended family anything that I own and it broadens my perspective on life. This book is important to Kabara as it will help uplift its inhabitants in time of need and help us be better people.

Some of the items highlighted by the Naikeleyaga community participants as significant to their lives. Clockwise from top right- Jimaima Qalo (flowers), Tevita Saqati (Cassava plant), Ilaitia Vakayatuyatu (Coconut) and Taito Kaumaitotoya (Yam Plant)

Tokalau/Lomati Village

1. *Person:* Moce Lasarusa

   Item of Importance: Breadfruit Tree

   Reason/Significance: This tree is extremely important as its fruit feeds our families when there is a severe drought on Kabara and was highly valued by our ancestors because of this. The tree also provides shade within the village and can be used for traditional medicine.

2. *Person:* Jone Marau

   Item of Importance: Water

   Reason/Significance: Water is important for life. If there is no water, all the trees and crops on our island wither and die. Water is integral to the survival of the people of Kabara.

3. *Person:* Tevita Tawake

   Item of Importance: Lemon Grass.

   Reason/Significance: This grass is an important soil stabilizer and when it gets too hot the grass protects the soil from complete desiccation and it improves the fertility of the soil. The grass can be used by villagers for food and tea and even our goats feed on them. This grass is important because it protects our land and helps improves it.

4. *Person:* Ledua Beitaki

   Item of Importance: Coconut

   Reason/Significance: This tree symbolises happiness to us on Kabara because whether you want to eat or drink this tree will provide you with both. Whether there is enough food or a lack of it we always end up using the coconut tree.

5. *Person: Fanoga Vahiga*

   Item of Importance: Coconut (leaves)

   Reason/ Significance: The coconut tree is important because apart from food, we can use the leaves for many things we use daily in the village. The leaves can be used to make brooms, fans, traps, mats and the walls of our traditional houses. The leaves of this tree are especially valued because of this by the women of Kabara.

6. *Person: Gade Vuli*

   Item of Importance: Kura Tree

   Reason/Significance: This tree is important because of its medicinal value. The fruit when ripe is cooked to make medicines that I use. Everyone who lives on Kabara knows of its uses medicinally and how it is used to treat various ailments.

7. *Person:* Josefa Lesi

   Item of Importance: Water

Reason/Significance: This is the most important thing for survival on Kabara. As water is a scarce commodity on the island, it is something we value and try to not to waste.

8. *Person:* Cakau Lutu

Item of Importance: Uci Plant

Reason/Significance: This plant is important as we use it for traditional medicines, to scent our body oils and for traditional garlands used during traditional dances. The medicine derived from this plant is something we use from childhood until we get old.

9. *Person:* Jone Levaci

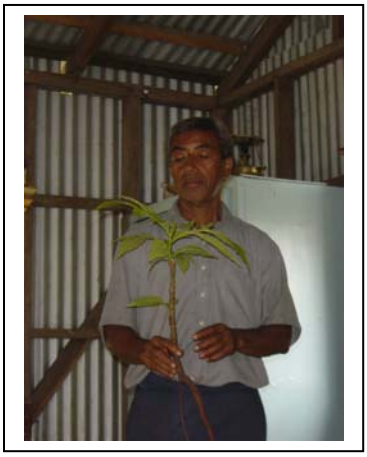
Item of Significance: Vesi Tree

Reason/Significance: The wood from this tree is important to Kabara because it is the main source of income for all families on the island. Because the tree is slowly disappearing from the island I feel ill at ease knowing that a time will come when our children will not have enough vesi to earn a living and to meet their cultural obligations.

10. *Person:* Volau Ruve

Item of Significance: Two-Dollar Note

Reason/ Significance: Money is an important thing to have in our daily life nowadays. Most of the things we need as a family require money, whether it is for household needs, our children's schooling or meeting our communal obligations, whether we like it or not money is important.



Tokalau and Lomati Community participants with their item of value- from left to right- Moce Lasarusa (Breadfruit Tree), Fanoga Vahiga (Coconut tree), Jone Marau (Water), Ledua Beitaki (Coconut), Cakau Lutu (Uci Plant) and Volau Ruve (Money)



Section B

DEVELOPMENT OF COMMUNITY ADAPATATION MANAGEMENT PLAN

Community Problem Listing and Categorisation

The first step towards identifying community climate change related impact problems was to first get the communities to discuss what they considered priority problems that affected everyone within their community and to list them. To remove any form of bias towards directly focusing on possible climate change related problems and overemphasizing them as a major communal problem on Kabara, the community members were encouraged to list all problems including those that were more socio-economic in nature. The matrix below contain the results from this problem listing exercise for each of the four villages and have been separated into two categories (***listing the problems under these two categories were only achieved after conducting a root cause analysis for each problem***), those that are climate change related and those that are socio-economic. Some problems listed are clearly village specific; however there are other problems are common to all four communities.

Climate Change Related Community Problem	**Naikeleyaga**	**Lomati**	**Tokalau**	**Udu**
Water Shortage	*	*	*	*
Coastal Flooding from storm surges/hurricanes	*	*	*	
Coral Bleaching	*		*	*
Coastal erosion	*	*		*
Decline in Productivity of food gardens		*	*	*
Socio-economic/Environmental Related Community Problem				
Decline in village population				*
Limitation in alternative sources of income				*
Decline in vesi- native tree used for woodcarving		*		*
Low price for copra				*
Fish Poisoning	*		*	
Feral Goats	*			
Invasive spread of spike grass	*			
Fish Poisoning	*		*	

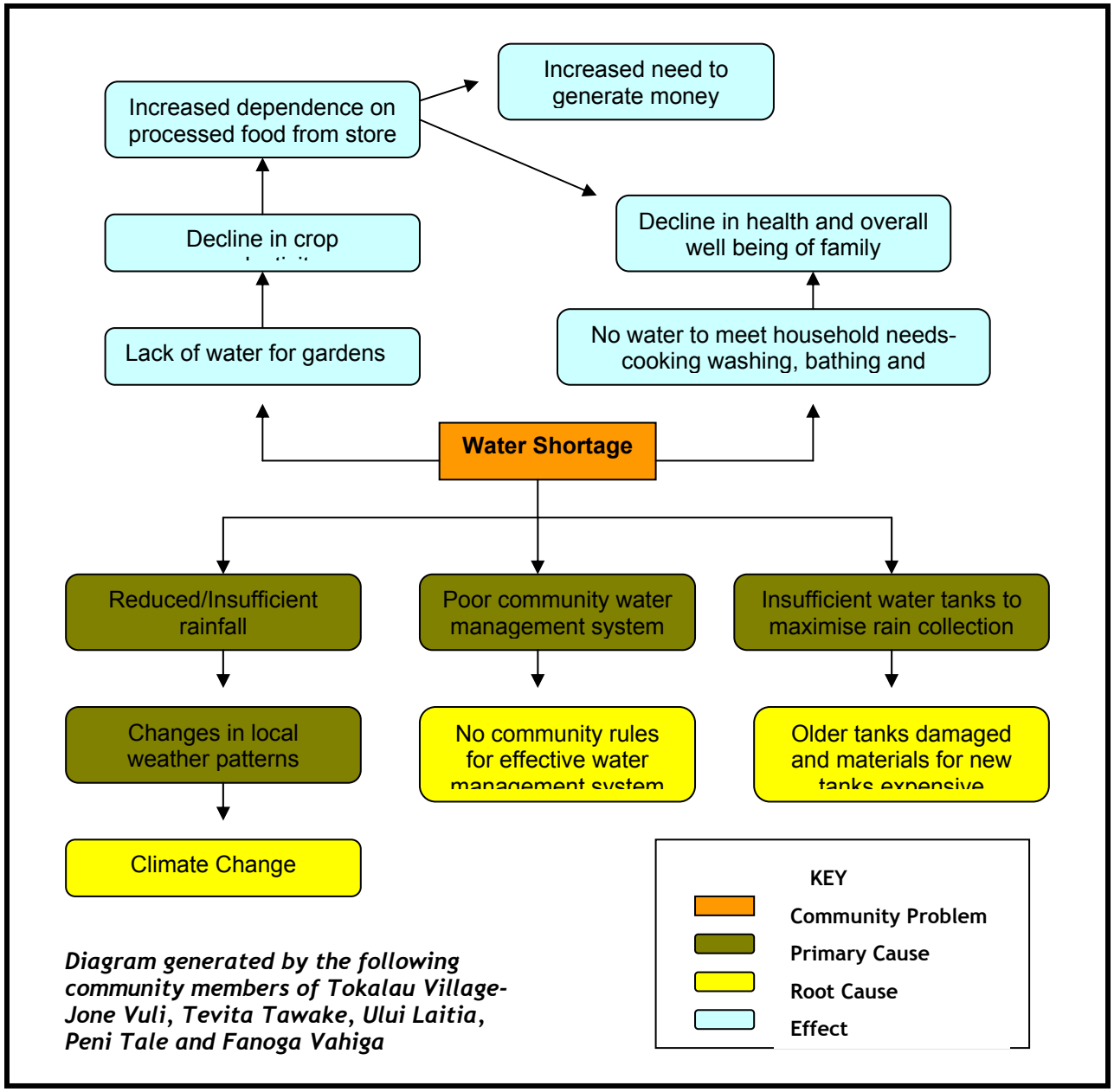
Coral bleaching is a widespread problem in the reef areas of Kabara and is identified as a major cause for decline in fisheries productivity by the villagers

Coastal erosion is another major problem identified by the communities on Kabara

Root Cause Analysis for Community Problems Listed

For every problem identified and listed the communities were asked to develop a cause and effect flow diagram for each of them. This was done in order to help the communities scrutinize and identify for themselves the cause and effect of a specific problem. A particular identified problem may have multiple effects, which denotes the extent of the problem and its overall impact on the community. Similarly the identified problem may have multiple causes, some which may be linked and others, which act as an independent variable.

By isolating the causes one can then determine those that are actually induced by the communities themselves and would need direct intervention on their part to address them and others that are climate induced which they would need to adapt to, to effectively reduce the extent and intensity of the effect arising from the problem. Thus in identifying the root cause of a problem the communities would then be able to develop actions in effectively addressing them. An example of a problem (water shortage) for which the community undertook a root cause analysis is provided overleaf.



By developing a root cause analysis tree, the communities are systematically able break down and visualise the cause of the problem into subset contributing factors. In the above case concerning water shortage, the identified root cause was identified to be climate change, causing a reduction in rainfall and the other two were more socio-economic in nature, the lack of community water resource management rules and lack of community capital to provide for and increase water storage capacity. As the communities cannot address the climate change cause as it is a more global issue, they must instead focus on the socio-economic causes as it is within their capacity to so. By addressing the socio-economic components of the problem they will not entirely remove but can effectively reduce their overall vulnerability to water shortage. In retrospect this becomes their adaptive strategy to a climate change induced problem.

One of the Tokalau community groups discussing the root cause for one of their identified community problems

Tokalau villager, Jone Marau, shares the results of his groups root cause analysis with the rest of the participants

Community Root Cause Analysis by Village

The following results were drawn from the root cause analysis charts undertaken by the communities during the workshop.

Naikeleyaga Village

Climate Change Related Problems

1. **Water Shortage**
   Effects:
   - Households faced problems with not having enough clean water to drink, cook, wash and bathe. This often results in family members being susceptible to sickness
   - Shortage of water in the village often resulted in the primary school being shut down for the period. This compromises their children's education.
   - Lack of water also affected their gardens and plantations, where most of their crops died or did not produce enough.

   Causes:
   - The insufficient number of tanks and guttering to channel water to tanks. This was because the cost of tanks, materials and transporting them to the island were too expensive.
   - Most of the existing water tanks were very old and could not be repaired.

- The island was experiencing less rainfall due to a longer dry period.

2. **Coastal Flooding from Storm surges/ Hurricanes**
   Effects:
   - Caused erosion to accelerate along their village coastline, destroying their coastal vegetation that bind and stabilise coastal land, undermining the foundation of village houses near the beach and reduced the overall area of the village.
   - Destroys much of the area from which they gather marine resources from.

   Causes:
   - Villagers have not been actively protecting or replanting their coastal vegetation which would act as a buffer from such events as wave surges.
   - Dynamiting the reef to allow boat access may have weakened the reef barrier, allowing for stronger wave impact along the coast of the village.
   - Increase in the number of storm and hurricane events over the number of years.

3. **Coastal erosion**
   Effects:
   - Loss of coastal land on which a number of village homes and important infrastructure such as the village school is built.

   Causes:
   - Increase in the number of storm and hurricane events over the number of years.
   - Higher sea level, accelerating erosion
   - Villagers not maintaining coastal vegetation along the coastline to stabilise soil.

4. **Coral Bleaching**
   Effects:
   - Loss of habitat for fish and other marine organisms. This results in less food for the community from their fishing areas.
   - Weakens the coral reef structure, that acts as a buffer from strong waves hitting and eroding the village coastline

   Causes
   - The use of traditional toxins used by villagers for fish harvesting eg Tuva (*Derris trifoliata*)
   - Crown of thorns outbreak in the area. Villagers indicated that's this could be due to changes occurring in the ocean and the over harvesting of the triton (davui) which feed on them.
   - Rubbish being dumped into the ocean by villagers because there was no proper disposal area.
   - Warmer ocean waters caused by the climate.

Socio-Economic/Other Environmental Problems

1. **Fish Poisoning**
   Effects:
   - Members of the community have been hospitalised due to consumption of poisonous fish.
   - Villagers do not have enough fish for food as they are afraid to consume fish from their fishing grounds

   Causes:
   - Possibly due to pollution from the inter-island vessel that berths near their fishing grounds
   - Villagers dumping their rubbish into the ocean

- Changes occurring in the ocean that affect the fish or something that the fish consume that are poisonous.

2. **Feral Goats**
   Effects:
   - Damage village gardens and plantation
   - Damage native forest trees and consume seedlings on which villagers depend for various reasons.

   Causes:
   - Owners of goats do not keep them in a contained area, fenced off from doing damage.

3. **Spread of the invasive spiky bur**
   Effects:
   - Taking over most of the village grounds and coastal area, making certain places inaccessible
   - The spikes responsible for cuts and scratches which often fester into sores especially amongst the children

   Causes:
   - Villagers do not weed and burn them, to make spreading to other areas less effective.

Coastal erosion is a major problem for the Naikeleyaga villagers as it threatens infrastructure such as the school and medical center

Naikeleyaga community member sharing his groups root cause analysis results.

Tokalau Village

Climate Change Related Problems

1. **Water Shortage**
   Effects:
   - Households do not have enough water for cooking, bathing, drinking and washing. Hinders villagers from going about their daily life and activities.
   - Unable to water their gardens to help make their crops grow

   Causes:
   - Poor community water management system as there are no village rules on the utilization of water
   - Insufficient water tanks to maximise rainwater collection during rainy periods.
   - Insufficient rainfall due to changes in normal seasonal weather patterns.

2. **Coastal Flooding from Storms/Hurricanes**
   Effects:
   - Erodes coastal area and reduces the total area of the village
   - Flooding of the village kills all the vegetation and destroys their homes

   Causes:
   - Insufficient coastal vegetation along their village coastline to act as a buffer and reduce erosion from waves during storms and hurricanes.
   - Damaging their corals by dumping rubbish into the ocean and coral bleaching from a warmer ocean, reducing their effectiveness as barriers against waves.
   - Lack of a man made barrier to effectively reduce flooding during such extreme events.

3. **Decline in Productivity of Food Gardens**
   Effects:
   - Community unable to meet their cultural and church obligations through the presentation of food.
   - There is insufficient food for households, affects the health of the family.

   Causes
   - Insufficient rainfall as the dry season has become longer.
   - White flies seem to thrive during this dry period destroying most of the remaining crops.
   - Villagers not planting enough and diversifying the types of crops they grow.

4. **Coral Bleaching**
   Effects:
   - When the corals bleach, the fish move away, when this happens there is not enough to eat and to sell to earn money.
   - The reef structure becomes weak and cannot be effective in acting as a barrier against incoming waves that damage the village

   Causes:
   - The use of traditional toxins used by villagers for fishing
   - Dynamiting part of the reef to allow for boat access to the village
   - Warmer ocean
   - Increase in the number of storms, causes the intensity waves to batter the coral reef to often, allowing less time for recovery.
   - Possible infiltration of the area by underground freshwater
   - Villagers dumping their rubbish into the ocean.

Socio-Economic/Other Environmental Problems

1. **Fish Poisoning**
   Effects:
   - Makes the villagers sick and some take months to recover.

   Causes:
   - Water Pollution due to wanton dumping into the ocean by the villagers
   - The fish eating something in the ocean (bulewa) that causes them to become toxic

Tokalau Participant, Fanoga Vahiga, explains her groups root cause analysis for water shortage

Fish poisoning was identified by Tokalau participants as a possible community problems caused by climate change.

Climate Related Problems

1. **Water Shortage**
   Effects:
   - Community members become susceptible to sickness
   - Their crops are unable to grow
   - Their livestock suffer from lack of water
   - Households in have insufficient water cook, wash, bathe and drink

   Causes:
   - Insufficient rainfall
   - Community members not being careful with stored water as they do not have village rules to restrict unnecessary utilization of water.
   - Not enough water tanks in the village to store water and not enough guttering to channel water from house roofs to the tanks.

2. **Coastal Flooding from Storm Surges/ Hurricanes**
   Effects:
   - The sea is beginning to encroach into village grounds, making land and houses vulnerable to wave action and salt spray.
   - Tends to kills the corals in their fishing grounds, causing a reduction in fish and marine organisms collected for food

   Causes:
   - The dynamiting of part of their reef for boat access has added to the intensity of wave action coming towards the shore.
   - The villagers have not maintained their coastal trees nor replanted them to act as a buffer against waves during storms and hurricanes.

3. **Decline in Productivity of Food Gardens**
   Effects:
   - Households are not able to get sufficient food to meet the daily needs.

   Causes:
   - Insufficient rainfall for crops.
   - The spread of crop disease possibly due to introduction of crop cuttings from other places, which have been infected, and villagers not being careful with what they bring to the island to plant.

Lomati community members discussing some of their climate related community problems as part of their root cause analysis

Water shortage was identified by Lomati community members as their main climate change related impact problem

Socio-economic/Other Environmental Problem

1. **Decline in vesi- native tree used for woodcarving**
   Effects:
   - Loss of income for households in the village
   - Unable to produce wood artefacts for traditional ceremonies

   Causes:
   - Over harvesting and not maximising production of artefacts from wood
   - Feral goats feeding on the seedlings of the vesi tree
   - Tree is very slow growing, cannot meet demand by communities.

Udu Village

Climate Change Related Problems

1. **Water Shortage**
   Effects:
   - Household face problems in going about their daily activities such as cooking, washing, drinking and bathing.

   Causes:
   - Insufficient rainfall
   - Insufficient community water tanks to store water when there is rainfall.

2. **Decline in Productivity of Food Gardens**
   Effects:
   - Households do not get enough food for the daily meals
   - Community unable to meet traditional obligations where presentation of root crops and food is important.

   Causes:
   - Soil becomes too dry for crops to grow. This is due to insufficient rainfall and poor agricultural practices by the villagers such as not using the grass they weed as mulch to keep the soil moist/cool.
   - Spread of white flies when it becomes too dry, crops do not grow properly.
   - Lack of large trees near their gardens to shade their crops.

3. **Coral Bleaching**
   Effects
   - Fish habitats destroyed, fish move away and there is not enough for meals for the villagers. This may cause an indirect dependence on food from the store and villagers lose a source of income by not being able to sell fish to the visiting inter island vessel.

   Causes:
   - Warmer oceans and constant high intensity wave action resulting from frequent storms.
   - The use of traditional toxins by villagers to fish
   - Dumping of rubbish into the ocean

- Spilling of fuel and other wastes from visiting ships.

4. **Coastal Erosion**
   Effects:
   - The erosion of the coastline and the spreading of sand into the inter-tidal area have caused much of the fishing ground to become shallow. This has changed the ecosystem of the area, as sea grass beds have come to dominate where coral once where. It has also made it difficult for villagers to use their boats in the area.

   Causes:
   - Higher sea level and accelerated erosion
   - Increase in storms has increased wave action in the area.
   - Coral bleaching has weakened the reef as a barrier to wave action.

Socio-economic/Other Environmental Problem

1. **Decline in vesi- native tree used for woodcarving**
   Effects:
   - Loss of wood from this tree would mean a loss in income for households, children's education and church tithes
   - They will not be able to produce traditional artefacts that they are responsible for during traditional provincial ceremonies.

   Causes:
   - Slow growing tree and often damaged by cyclones
   - Over harvesting by the villagers as it is one of their main sources of income. Low price offered makes the villagers harvest more to earn more. Main cause for this is the lack of market control and lack of marketing skills by the villagers.
   - Feral goats eating the vesi seedlings and saplings

2. **Decline in Copra Production**
   Effects:
   - Causes a heavy dependence on vesi as an income source, an already declining resource
   - Villagers begin to neglect their coconut plantations by not planting new trees nor keeping the plantations clear of bush.

   Causes:
   - Lower price offered for copra
   - Lack of alternatives for copra production.

3. **Decline in Village Population**
   Effects:
   - The village school might be forced to close down
   - Not enough young people to keep their traditional way of life going.

   Causes:
   - A lot of young people leave for the capital city to further their education and never return.
   - Not enough sources of income on Kabara, forcing people to leave for urban areas to look for jobs.
   - Young people in the village are not marrying, most of the men remain single because they spend too much time around the kava basin drinking and not spending enough time courting future wives.

4. **Limitation in Alternative Sources of Income**
   Effects:

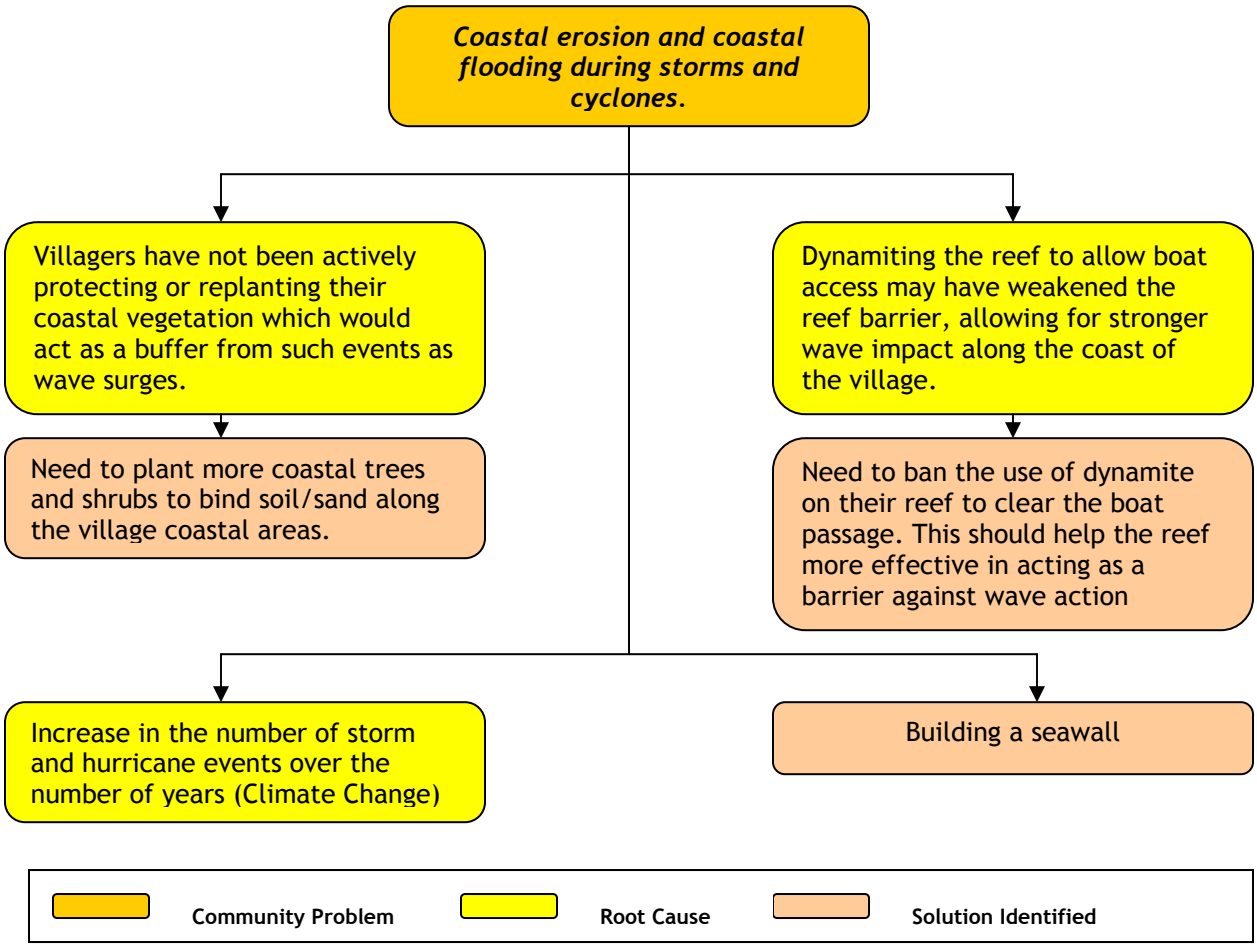
- Community members face the problem of getting money to obtain basic household supplies, for their children's education, church titles and other traditional obligations

Causes:

- Poor access to markets for traditional crafts, produce and other marine resources like beache-der mer.
- Poor price for copra

Solution Development

Once obtaining results from the root cause analysis, community members then began to look at providing solutions to identified problems. This is achieved by looking at the root cause or causes for a particular problem and then determining the measures that would need to be taken to effectively address them. For example, using the problem of coastal erosion and coastal flooding during storms and cyclones In Naikeleyaga Village, the process in identifying solutions is shown below.



The solutions generated by the community for this particular problem was obtained by simply "flipping" the cause of the problem into a solution or in other words the problem itself becomes the solution. For example the lack of coastal vegetation was found to be a contributing factor to accelerating coastal erosion and coastal flooding through a lack of a coastal buffer, the solution therefore once "flipped" is simply to plant more and maintain coastal vegetation along the village seaward areas. The other option is to provide solutions directly as in the case of building a seawall.

The cause of increased storm and cyclone events through climate change has not been given a solution by the villagers because it is beyond their scope to directly address it. However, by identifying this as a contributing factor to their communal problem, it strengthens and enhances the need for governments in the Pacific to take an active stance with industrialised nations to undertake mitigative actions in reducing their greenhouse gas emissions.

Assessment of Adaptation Option

Once solutions were generated by the community, they were the tasked with determining through general consensus which of the solutions would work and which wouldn't. Consideration was made with regard to past experiences on some of the solutions, the capacity for the community to initiate it themselves and the prospects of obtaining external assistance in implementing some of the adaptive solutions to climate change. The tables below highlight the solutions identified by village, their assessment of the solutions and their justification for inclusion or rejection in the community action plan.

Naikeleyaga Village

Community Problem	Adaptive Solution	Level of Effectiveness		
		Low	Moderate	High
Water Shortage	Develop and Implement village rules on the proper utilization of collected rainwater and maintenance of community water tanks			*
	To obtain more community water tanks to increase the community's water storage capacity			*
	To have a bore hole that will tap into the islands water lens	*		
Coastal Flooding/ Coastal Erosion	Plant more coastal trees to stabilise coastal area and act as a buffer against waves		*	
	Ban the use of dynamite on the reef to clear the boat passage, making the reef a more effective barrier against waves			*
	To build a seawall to stem erosion and protect the village from flooding during extreme events.		*	
	To relocate the teachers quarters and school to a more protected area inland		*	
Coral Bleaching	Ban the communal use of traditional fishing toxins on the reef		*	
	Restrict the harvest of the trident (davui) that feed on the Crown of thorns on the reef		*	
	Restrict ships that berth near the island from dumping their waste into their fishing grounds		*	

On the issue of water shortage, the Naikeleyaga community indicated the installation of more water tanks and having community rules on proper use of water as the best adaptive option as

it would allow them to maximise water collection and storage during the rainy season. Coupled with better community rules on utilization they would thus be able to sustain themselves more effectively through the dry season. They also stated that this solution would only work, provided the dry season was not excessively prolonged. The community also highlighted the possibility of having a bore hole installed to access water from the water lens. However, through consensus this option was rejected for a number of valid reasons, it was too expensive to undertake and there would need to be an environment impact assessment undertaken as the community were not certain what happen to the surrounding landscape should a bore hole be installed.

With regard to the impacts of coastal flooding and coastal erosion, the community suggested strengthening their natural buffers such as their coral reef and coastal vegetation. This included banning the dynamiting of the reef for the boat passage and restoring coastal vegetation to stabilise land along the coast. The communities indicated restoring coastal vegetation would be a moderately effective adaptation. That though coastal vegetation would slow down erosion and provide some measure of protection from wave surges during extreme events, they were not sure it would be totally effective long term. The solution regarding the building of a seawall was also raised, the community however indicated there have been three previous attempts to halt coastal erosion through the construction of seawalls, all of which have proven ineffective and may have exacerbated the problem of erosion. Through consensus this solution was rejected, with the mention that if the construction of a seawall was to be attempted again, they would want a proper coastal processes assessment undertaken and an appropriate seawall tailored under the assessment built.

The relocation inland of buildings near the coast such as the school, although indicated by community as an adaptive option (abandoning high risk coastal areas), was noted as going to be a very costly exercise for them to undertake. Furthermore the community stated there was very little land available inland to relocate the school too. Due to these factors the community indicated that they would as a short-term adaptive solution aggressively plant more coastal trees and shrubs to bind soil and sand along the coastal edge of school compound.

The community also tried to address the issue of coral bleaching and its contributing effect on the declining productivity of their fishing grounds. Although the main root cause of the problem was identified as climate change inducing warmer ocean waters and to which the community would be unable to directly remedy, they instead decided to focus on and address other possible human induced contributions that may also aggravate coral bleaching in the area. This included banning the use of traditional toxins (tuva) for fishing, restricting the harvest of the triton that feed on the Crown-of Thorns starfish and placing restrictions on ships that berth near the island from dumping oil and other wastes into their fishing grounds. This was stated by the community as their best attempt at an adaptive solution, but would still have a moderate effect overall as bleaching from high ocean waters temperatures could overwhelm their attempts.

The increase in frequency of storm surges on Kabara is responsible for widespread coral damage and accelerating coastal erosion by weakening the reefs ability to act as a buffer

One of the of the soft adaptation measures being undertaken by the Naikeleyaga community to stem coastal erosion, coastal replanting.

Tokalau Village

Community Problem	Adaptive Solution	Level of Effectiveness		
		Low	Moderate	High
Water Shortage	Develop and Implement village rules on the proper utilization of collected rainwater and maintenance of community water tanks			*
	To obtain more community water tanks to increase the community's water storage capacity			*
Coastal Flooding/ Coastal Erosion	Plant more coastal trees and shrubs to bind soil/sand along the village coastal area		*	
	Build a seawall along the coast of Tokalau village			*
Coral Bleaching	To implement village rules that will forbid dumping of village wastes into the sea and to find a proper village dump site for their rubbish.		*	
	To ban the use of destructive harvesting practices that harm live coral on the reef for example the use of crowbars to pry free shellfish from coral heads, use of traditional toxins to fish etc.		*	
Decline in Productivity of Food Gardens	Determine how existing agricultural pests/diseases can be controlled effectively with pesticides			*
	Encourage village men and youths to be more active in planting their traditional crops and crop varieties in their village gardens.		*	

Due to the similarity in conditions throughout the island of Kabara, the Tokalau community generated similar climate change related community problems and adaptive solutions. With regard to water shortage during dry spells, they also suggested that the best adaptive solution was to have more water tanks installed in the village to maximise water collection during rainy periods. The community indicated that they would also strengthen their village rules on proper utilization of water as part of this adaptive solution.

The community also stated a collective concern regarding the rapid erosion of their village beachfront and their exposure to waves and flooding during extreme events such as storms and cyclones. As part of the adaptation solution to this problem, the community decided that the restoration of coastal vegetation along the beach to act as a protective buffer and soil stabiliser would be a suitable one. However, in terms of its effectiveness the community

indicated that it would not be completely effective, as they have in the past attempted to plant coastal trees but most did not survive. The more effective option suggested by the community would be to build a suitable seawall, however they would not be able to action this solution themselves as they would need external financial and technical assistance to undertake this.

Coral bleaching within their communal fishing grounds is also prevalent. As they community understood that the main cause of this was due to higher sea temperatures and had no control over this phenomenon, they instead focused on other factors that might contribute to damaging corals in the area, such as destructive fishing practices and dumping of communal waste into the ocean. As their contributing adaptive solution to reducing coral bleaching they decided to ban all forms of destructive fishing and the dumping of communal waste in to the ocean that may harm live corals within their fishing grounds.

The final concern discussed was in regard to the decline in productivity of their food gardens due to insufficient rainfall and thriving crop pests during the extensive dry periods. The community decided that the best and most effective solution would be to use pesticides, but only after they had been advised on the type of pesticide to use by the agricultural department. The other solution devised by the community as a means to maintain crop productivity was to encourage the men in the village to plant different varieties of root crops, as certain types would be more resistant to pests and to drought.

Lomati Village

Community Problem	Adaptive Solution	Level of Effectiveness		
		Low	Moderate	High
Water Shortage	To develop and implement village rules on proper utilisation of collected rainwater and maintenance of water storage tanks			*
	Obtain and install more guttering and pipes that direct rainwater to village water tanks and to obtain or build more water tanks (either fibre or cement) within the village.			*
	Obtain materials (cement/plaster) that will help fix old and leaking tanks within the village.			*
Coastal Flooding/ Coastal Erosion	Plant more coastal trees and shrubs to bind soil/sand along the village coastal area		*	
	Ban the use of dynamite on their reef to clear the boat passage.			*
	Build a seawall along sections of the coast by the village			*
Decline in Productivity of Food Gardens through spread of crop pests and diseases.	Place village restrictions on bringing plants from areas other than Kabara for planting in their gardens.			*
	Determine how existing agricultural pests/diseases can be controlled effectively with pesticides or better agricultural practices.		*	

Water shortage, coastal flooding and erosion; and the decline in crop productivity were the main climate change related community problems raised by Lomati villagers. Their adaptive solution for water shortage was similar to that of the communities of Tokalau and Naikeleyaga,

the need to strengthen community rules on water utilization and storage; and to install more and repair damaged community water tanks to enhance their water storage capacity. The community felt that maximised water storage with complementing community rules on restrictions and utilization would be the most effective means of adapting to longer drier periods.

On the problem of coastal flooding and erosion, the community suggested planting more coastal trees and shrubs to stem erosion, ban the use of dynamite to clear parts of the reef to allow outboards access to the village and the possibility of building a seawall. Although the community stated building a seawall would be the most effective solution, to implement this adaptive solution would be difficult as they did not have the financial means to do so. Instead they would undertake the replanting of coastal trees as a temporary solution even though it would not be in their opinion, totally effective. As an extra measure to help reduce coastal erosion and flooding, community restrictions would be made against any activity that damaged their reef, ensuring it would be a more effective barrier against intense wave action drifting towards the shore.

The Lomati community indicated a link between the decline of crop productivity from their gardens and reduced rainfall and the spread of crop pests and diseases during such periods. Although dry periods seem to worsen the spread of crop pest and disease, the villagers indicated they could have contributed to the problem, by introducing contaminated crop plantings from the mainland and other islands. Their adaptive solution was to strengthen community restrictions on bringing crop planting from anywhere outside the island or areas with known crop infestations. In addition, they would need to find out the best means of controlling existing infestations, through the use of pesticides or improved agricultural practices. As they were not knowledgeable on the use of pesticides, they indicated they would require assistance from agricultural experts on suitable types and its application.

Udu Village

Community Problem	Adaptive Solution	Level of Effectiveness		
		Low	Moderate	High
Water Shortage	Develop and implement village rules on proper utilisation of collected rainwater and maintenance of water storage tanks			*
	To install more guttering and pipes that direct rainwater to village water tanks and to obtain or build more water tanks (either fibre or cement) within the village.			*
	Fix old and leaking tanks within the village.			*
Decline in Productivity of their agricultural crops	Plant more fruit trees along the periphery of the garden boundaries that should help shade their crops and enable a higher retention of moisture in the soil			*
	Determine how existing agricultural pests/diseases can be controlled effectively with pesticides		*	
	Install tanks or drums near their garden areas to store water			*
	Encourage the better agricultural practices that encourage the retention of soil moisture			*
	Implement village rules that will forbid dumping of village wastes into the sea and to find a proper village dump site for their rubbish.		*	
	Banning the use of duva in Udu's i goliqoli		*	

The villagers of Udu also identified water shortage as a community problem. Like the other three villages, they indicated their adaptive strategy for this to be; better-enforced community rules on water storage and utilization, and to fix old water tanks and install new ones to enhance their overall water storage capacity.

It was indicated that the decline in crop productivity caused by reduction in rainfall, caking of soil from excessive dryness and the spread of crop infestation during these dry periods. The Udu villagers devised some interesting adaptive strategies to counteract these effects, which included planting more trees in their food gardens to shade crops, encourage better agricultural practices such as not burning weeded grass surrounding their crops but rather leave the grass to decompose as mulch and assist in moisture retention and installing water drums or tanks nearby so that they could water their crops. With regard to the spread of crop pest and diseases, they suggested the use of pesticides as an option.

Coral bleaching was also highlighted as a community problem, as it caused a decline in the productivity of their fishing grounds. Although the community understood that the main cause for bleaching was due to warmer ocean temperatures, they indicated that they would instead try to address some human activities in their fishing grounds that contribute damage to the corals. This included restricting the dumping of community rubbish into the ocean and making a proper dumping area on land for this purpose, banning the use of fish toxins to fish and to issue restrictions to ships that berth near Kabara from dumping waste and oil into their fishing grounds.

The villages on Kabara are all located on low lying coastal flats which are vulnerable to coastal erosion and flooding during extreme events. The problem is exacerbated as relocation is retarded by the cliffs in the background

Rainwater is integral to the wellbeing of community members on Kabara- Water scarcity is an event that will increasingly become part of this island communities lives.

Community Climate Change Adaptation Action Plan

Once the communities had determined the appropriate adaptive solutions to their climate change related problems, they were then asked to devise their community five-year adaptation action plan. The action plan was devised by listing the problem and the identified actions or adaptive solutions needed to address them beside them. For each of the actions listed, a person or body was identified to undertake initiating the actions and by when. The five-year action plan (2004-2009) devised by each of the four villages in Kabara, is provided below. The action plan has been separated into climate change related problems and those that were not

linked to climate change but were identified by the community as a problem they needed to address. Also note that fish poisoning is listed under the latter category, though there is literature that support possible links between fish poisoning and climate change further scientific investigation would be needed to determine whether this is indeed the case for Kabara.

NAIKELEYAGA COMMUNITY ACTION PLAN (2004-2009)

Community Problem	Action Needed to Address the Problem	Who will be responsible for this action	When will this action be initiated
Water Shortage	1. To develop and implement village rules on proper utilisation of collected rainwater and maintenance of water storage tanks	Village Council	2005
	2. To obtain and install more guttering and pipes that direct rainwater to village water tanks and to obtain or build more water tanks (either fibre or cement) within the village.	WWF/Government/Kabara District Council	2005
	3. To obtain materials (cement/plaster) that will help fix old and leaking tanks within the village.	WWF/Government/Kabara District Council	2005
Coastal erosion and coastal flooding during storms and cyclones.	1. To plant more coastal trees and shrubs to bind soil/sand along the village coastal area.	Village Council	2005
	2. To ban the use of dynamite on their reef to clear the boat passage. This should help make the reef more effective in acting as a barrier against wave action	Village Council/District Representative	2005
Coastal erosion within the school compound	1. To plant more coastal trees and shrubs to bind soil/sand along the coastal edge of school compound.	Village Council	2004
	2. To relocate the school and teachers quarters to a more protected area.	Village Council	2004
Coral Bleaching	1. To ban the use traditional fish toxins (duva) on their reefs.	Village Council	2004
	2. To impose village restrictions on the harvest of the davui (trident), this should help in the control of crown-of-thorns starfish.	Village Council	2004
	3. To place restrictions on ships that berth near the island from dumping oil and other wastes into the community fishing grounds	Village Council	2004

Community Problem	Action Needed to Address the Problem	Who will be responsible for this action	When will this action be initiated
Fish Poisoning	1. To ban the use of dynamite used to clear the boat passage along their stretch of reef.	Village Council	2005
	2. To implement village rules that will forbid dumping of village wastes into the sea and to find a proper village dump site for their rubbish.	Village Council	2005
	3. To place restrictions on ships that berth near the island from dumping oil and other wastes into their i qoliqoli.	Village Council/District Representative	2005
	4. To find out the cause of the poisoning and whether there are means of determining types of fish species that are poison and at which times and which areas of their fishing grounds should be avoided.	District Representative/Ministry of Fisheries/WWF	2005
The increase in goats and its damaging effects on Kabara forests and village gardens	1. To have the goats fenced in certain areas and to have better control on their numbers.	Village Council	2004
The spread of the spiky bur within village grounds	1. To have villagers periodically cut the grass and burn it after raking to prevent the bur from spreading further.	Village Council	2004
	2. To identify a suitable weedicide that could be used to effectively control the spread of the bur	Village Council/District Representative/Ministry of	2005

TOKALAU COMMUNITY ACTION PLAN (2004-2009)

Community Problem	Action Needed to Address the Problem	Who will be responsible for this action	When will this action be initiated
Water Shortage	1. To develop and implement village rules on proper utilisation of collected rainwater and maintenance of water storage tanks	Village Council	2004
	2. To obtain and install more guttering and pipes that direct rainwater to village water tanks and to obtain or build more water tanks (either fibre or cement) within the village.	WWF/Government/Kabara District Council	2005
Coastal Flooding during cyclones/coastal erosion	1. To plant more coastal trees and shrubs to bind soil/sand along the village coastal area.	Village Council	2004
	2. To build a seawall along the coast of Tokalau village (Initiate discussions with relevant bodies)	Government/Kabara District Council/District Representative	2005
Spread of agricultural pests/diseases- Reduction in Crop Productivity	1. To determine how existing agricultural pests/diseases can be controlled effectively with pesticides.	District Representative/ Ministry of Agriculture	2005
	1. To encourage village youths and men in the village to be more active in the planting to traditional crops and crop varieties in their village gardens	Village Council/District Representative	2004
Coral Bleaching	1. To implement village rules that will forbid dumping of village wastes into the sea and to find a proper village dump site for their rubbish. By not dumping their waste into the sea it is hoped this action will heighten the resilience of the coral reef surrounding their coast and its ability to act as a wave barrier.	Village Council	2004
	2. To ban the use of destructive harvesting practices that harm live coral on the reefs eg the use of crowbars to pry free molluscs, use of fish toxins duva etc.	Village Council	2004

LOMATI COMMUNITY ACTION PLAN (2004-2009)

Community Problem	Action Needed to Address the Problem	Who will be responsible for this action	When will this action be initiated
Water Shortage	1. To develop and implement village rules on proper utilisation of collected rainwater and maintenance of water storage tanks	Village Council	2004
	2. To obtain and install more guttering and pipes that direct rainwater to village water tanks and to obtain or build more water tanks (either fibre or cement) within the village.	WWF/Government/Kabara District Council	2005
	3. To obtain materials (cement/plaster) that will help fix old and leaking tanks within the village.	WWF/Government/Kabara District Council	2005
Coastal Flooding during cyclones/coastal erosion	1. To plant more coastal trees and shrubs to bind soil/sand along the village coastal area.	Village Council/Village Youth	2004
	2. To ban the use of dynamite on their reef to clear the boat passage. This should help make the reef more effective in acting as a barrier against wave action.	Village Council/District Representative	2004
	3. To build a seawall along sections of the coast by the village. (Initiate discussions with relevant bodies)	Government/Kabara District Council/ District Representative.	2005
Agricultural pests/diseases	1. To place village restrictions on bringing plants from areas other than Kabara for planting in their gardens. This should limit the introduction of other agricultural pests /diseases in future that are already present on the mainland but not on Kabara.	Village Council/District Representative	2004
	2. To determine how existing agricultural pests/diseases can be controlled effectively.	District Representative/ Ministry of Agriculture	2005

UDU COMMUNITY ACTION PLAN (2004-2009)

Community Problem	Action Needed to Address the Problem	Who will be responsible for this action	When will this action be initiated
Water Shortage	1. To develop and implement village rules on proper utilisation of collected rainwater and maintenance of water storage tanks.	Village Council	2004
	2. To obtain and install more guttering and pipes that direct rainwater to village water tanks and to obtain or build more water tanks (either fibre or cement) within the village.	WWF/Government/Kabara District Council	2005
	3. To obtain materials (cement/plaster) that will help fix old and leaking tanks within the village.	WWF/Government/Kabara District Council	2005
Insufficient Water for their agricultural crops	1. To Plant more fruit trees along the periphery of the garden boundaries that should help shade their crops and enable a higher retention of moisture in the soil.		
	2. To determine how existing agricultural pests/diseases can be controlled effectively with pesticides	District Representative/ Ministry of Agriculture	2005
	3. To have tanks or drums placed near their garden areas to store water	District Representative/ Provincial Council	2005
	4. To encourage the better agricultural practices within the village, such as not burning weeded grass surrounding their crops but rather leave the grass to decompose as mulch and assist in moisture retention.	Village Council	2004
Coral Bleaching	1. To implement village rules that will forbid dumping of village wastes into the sea and to find a proper village dump site for their rubbish.	Village Council	2004
	2. To ban the use of traditional fish toxins (duva) in Udu's fishing grounds	Village Council	2004
	3. To ban the dumping of rubbish and oil from ships that come to Kabara	District Representative/ Provincial Council	2004

Discussion of Community Results

This section briefly discusses and attempts to validate some of the problems identified by the community on Kabara and its possible link to climate change. Water shortage stands out as the most prevalent problem on the island. The communities indicated during workshop sessions that the dry season now tended to be prolonged and during the wet season, although rain did fall as expected it however tended to be more sporadic. Although no rainfall data is available for Kabara specifically to corroborate this, data from another neighbouring island Ono-i-Lau, which would be similar in circumstance to that of Kabara, can be used to generate trends on whether the communities' observations are indeed valid. Data from the Ono-i-Lau weather station has rainfall recordings for the last 43 years (1961-2003). Trends generated from this data indicate that on average for a given year more than 60% of days have rain, however 30% of this, record a rainfall measurement of ≥ 1mm/day. The average rainfall measurement for rain days for the 43-year dataset is provided below.

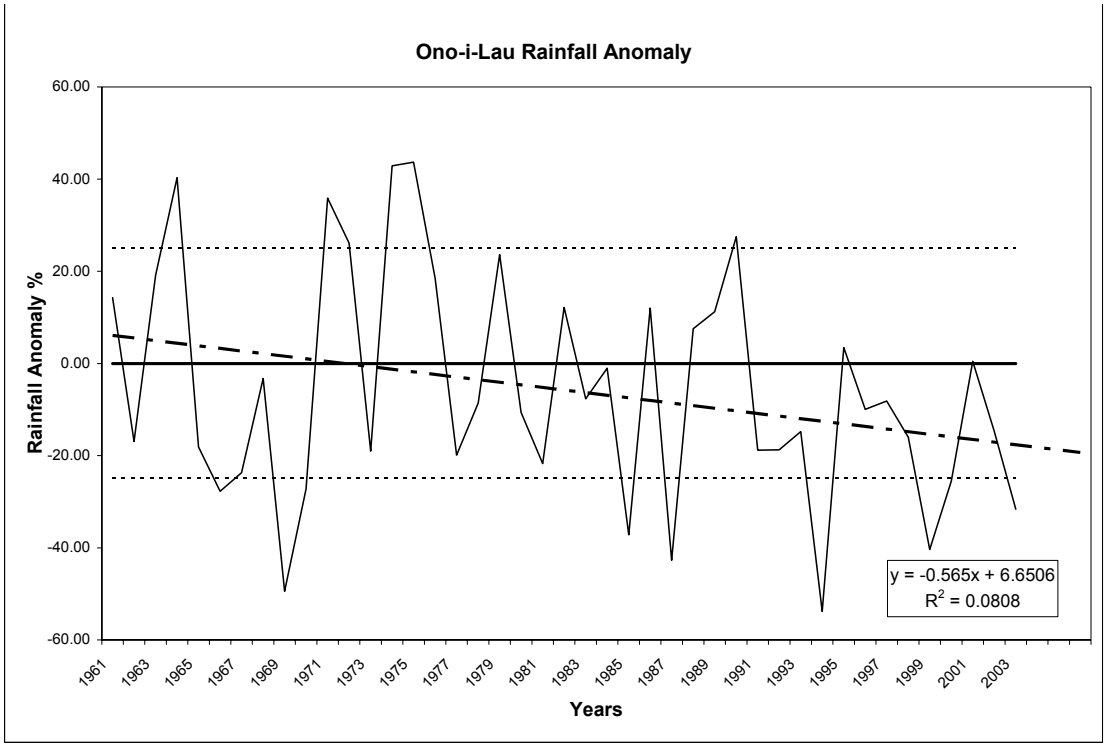
Table Showing Average Daily Rainfall Recorded for Ono-i-Lau between 1961-2003

Rainfall	Average No of Days
>=1mm/day	111.5
>=5mm/day	58.9
>=10mm/day	40.17
>=20mm/day	23.5
>=50mm/day	7.1
>=100mm/day	1.6

Source: Fiji Meteorological Office

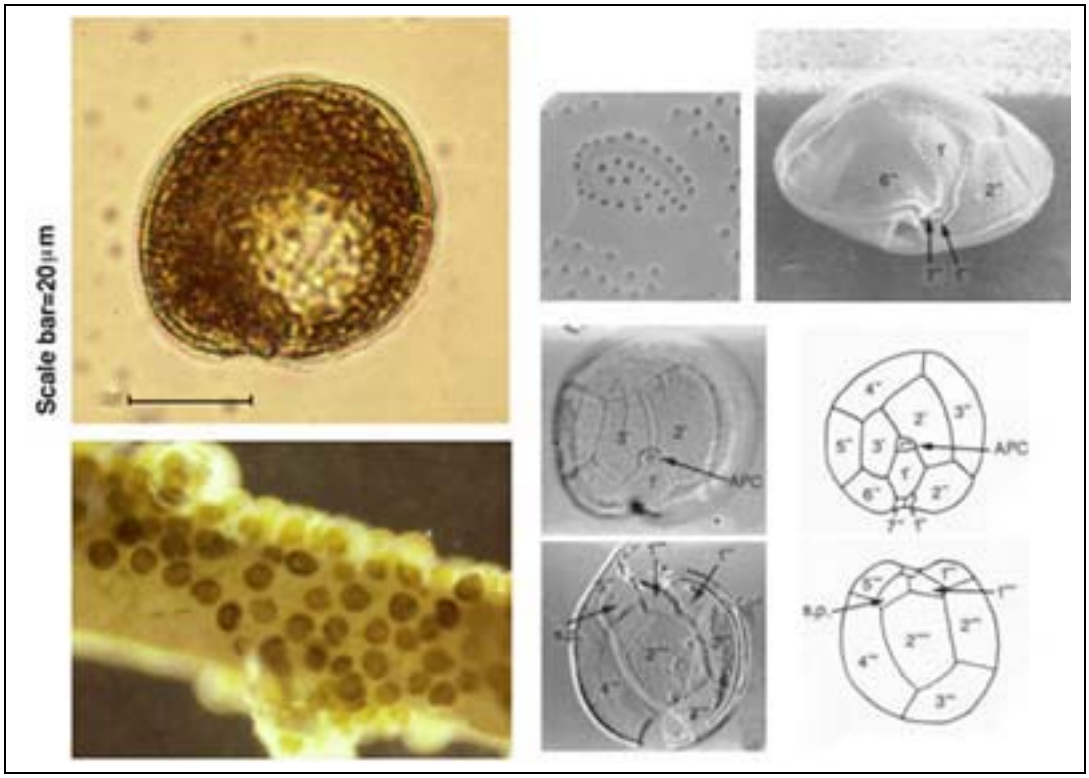
What the table indicates essentially is that although rainfall occurs throughout much of the year, the amount of rainfall received for a large part of is still minimal, and altogether insufficient for collection and accommodating sustained continuous water consumption. In addition, the graph generated (shown below) for rainfall anomaly for the southern Lau area over the last 43 years indicates a negative slope. This suggests that the area is receiving less rainfall than normal (mean) or in other words is becoming drier.

Graph showing rainfall anomaly in the southern Lau area for the years 1961-2003



Source: Fiji Meteorological Office

Two villages (Naikeleyaga and Tokalau) indicated fish poisoning as a recurring problem often observed to coincide with bleaching events and the outbreak of crown- of thorns starfish. Fish poisoning (ciguatera) is caused by the ingestion of reef fish that been contaminated by marine toxins such as from the toxin-bearing dinoflagellates called ***Gambierdiscus toxicus***. These are microscopic, single-celled, free-swimming marine organisms, which have attached themselves to the coral-dwelling marine macro-algae. Herbivorous reef fish become contaminated when feeding on these macro-algae. The toxin increases in concentration as it moves up the food chain, when herbivorous fish prey upon by larger carnivores such as barracuda, snappers, groupers and moray eels (Baden et al *in* Hales et al 1999). The presence of these toxins in the marine environment is often a naturally occurring phenomenon as ecological conditions in some localities support a continuous population of dinoflagellates, which then produce more ciguatoxin-bearing fish than other areas. However disturbances to a reef, such as storm surges, careless development and pollution, can also cause the toxic organisms to spread rapidly.



Microscope enhancement of Gambierdiscus toxicus (Picture by Yasuwo Fukuyo)

A more interesting cause of fishing poisoning has been correlated between such outbreaks, El Nino events and changes in sea surface temperatures. Data of reported fish poisoning cases in the South Pacific islands have been used in a study to investigate the relationship between fish poisoning and the El Nino southern oscillation (Hayes et al 1999). The results demonstrated strong positive correlations between the annual incidence of fish poisoning and warming of local sea surface for island groups experiencing warming during El Nino conditions. In contrast other groups of islands, which experienced cooling of the sea surface during El Nino events as in the case of Fiji, showed weaker negative correlations between fish poisoning and local sea surface temperatures. Although there was no apparent relationship between SST and ciguatera in Fiji for the period 1973-1994, what the study still suggests is a statistically significant correlation for other areas between fish poisoning and warmer sea surface temperatures.

In the case of Kabara, one cannot conclusively state fish poisoning outbreaks as the result of warmer local sea surface temperatures until thorough research is conducted in the area. As villagers in Naikeleyaga and Tokalau still utilize water-seal latrines there is a possibility that sewage may be percolating through the limestone rocks, which end up in the inshore areas, inducing the proliferation of marine toxins in areas where the villagers harvest fish. As the

island is often affected by storm surges this again may be contributing problem through coral reef damage, a precursor for macro-algal blooms. In retrospect, fish poisoning is not a new occurrence in the area, as there is earlier documentation of certain fishing areas near these villages being avoided due to this effect (Thompson 1940)

This however does not suggest that one should ignore the likelihood of this event being a climate change impact. When considering that the population for the two villages have been relatively static for the last ten years and that development and pollution in these areas have been very minimal, the changes that have been observed by the community with regard to the exacerbation of fish poisoning, spread into areas previously safe to harvest fish from and the poisoning of fish species that had been previously safe to eat, would suggest the causative agent to be a more of a natural or environmental variable rather than human induced.

It has also been suggested that healthy coral reefs may be a deterrent to ciguatoxigenic organisms by not allowing for suitable habitats for their proliferation (Lehane and Lewis 2000), but with greater events of coral bleaching and mortality throughout the region, fish poisoning incidences are likely to increase. When considering the coral in the inshore areas near these villages have been heavily bleached and in general have been slow to recover, this leaves the area open for macro-algae colonization. This colonization by macro algae, which are ideal hosts for ciguatoxigenic organisms, further heightens their spread within an area (de Sylva 1994 and Chinian et al 1999). Warmer conditions also lead to increase in the growth of dinoflagellates and the feeding behavior in fishes. This would greatly increase the potential for toxins to accumulate at the top of the food chain and toxicity to humans (Morton et al 1992). The scientific information available supports the observations mentioned by the communities, however as previously mentioned further research specific to the area would be essential to corroborate and conclusively validate the climate change link.

Coral Bleaching

Coral bleaching was a problem highlighted by all four communities on the island because of declining productivity of fisheries, possibly due to degradation of fish habitats from bleaching events and because the coral reef were becoming less of an effective buffer for wave action along the shore. There are a number of contributing factors for bleaching on Kabara, warmer ocean waters resulting from El Nino events being an obvious one (*this will not be discussed here as the information is covered in the Kabara Biological Report- Please refer to relevant section)* or longer localized daylight hours which heat surface seawater temperature. Considering that much of the coral reef areas are found at shallow depths the heating of the surface water can have an impact on the extent of mortality and recovery for the area. The information obtained from the baseline survey is only a snapshot of the area, therefore cannot conclusively denote bleaching.

Another stressing factor to the island coral reef ecosystem is the crown of thorns outbreaks that were observed by the communities to coincide with the bleaching events in 2000 and 2002. There has been suggestion by the scientific community that crown of thorns outbreaks are linked to the timing of the El Nino- Southern Oscillation which cause dramatic changes in local climates throughout the South Pacific (Harriet and Hoggin 2003). The actual cause for outbreaks is still a very contentious issue within the scientific community, as other suggested causes include nutrient enrichment and the abundance of algal blooms, allowing the Crown of thorns larvae which feed on them to flourish, storm events that churn up nutrients from the sea floor creating a similar effect as formerly mentioned and over harvesting of its natural predators (Van Woesik 1994). Some of the crown of thorns natural predators includes certain shrimp species, mollusks such as the triton and various fish species such as the pufferfish, sweetlips, warasses and snappers (Moran 1997; Madl 2002; Zann 1995).

The crown of thorn outbreak on Kabara although likely to have had a considerable impact on coral mortality on the islands reef ecosystem cannot be isolated as a singular cause. It is plausible to consider that the coral mortality observed on Kabara may be a combination of warmer sea surface temperatures during El Nino events, acting as a precursor to the crown of

thorns outbreak or it could be that the effect of the former two is more pronounced once coupled with the over-harvest of natural predators of the crown of thorns by the villagers. Until more biological data is collected and the extent and harvest subsistence fishing practices is assessed for impact in the area, one cannot conclusively suggest or justify possible links between the outbreaks observed on the island and climate change.

Kabara Marine Biological Baseline Survey

Introduction

During late September a team of 3 enthusiastic marine persons accompanied 2 WWF staff to Kabara Island in the Lau group. This was the first marine oriented team to carry out biological baseline surveys of Kabara's reefs where such snapshot studies provide information on the status of these reefs and assess the extent and severity of coral bleaching (if any) related to climate change. It was also anticipated that as an outcome of this marine exploration of Kabara's reefs will allow for community-based monitoring of coral bleaching and opportunities for capacity building. Two community members who represent two out of the four villages on Kabara were trained in basic survey techniques for meaningful and effective participation in community-based monitoring of their own reefs in future.

There were 4 main parts to the team's activity plan on Kabara Island during a Climate Change Adaptability community outreach program. First, the manta tow method allowed for quick assessment of the interested extensive reef area, which provided the team a fair idea of the outlying reefs of Kabara.

The second part to this marine team's objective was to conduct point intercept surveys at the inshore reef areas by snorkeling. This survey method provided more detail in terms of the fish and invertebrate taxa found along 100m transects at its two selected sites. There were 2 sites with 3x100m transects laid per site located at both the leeward and windward sides of Kabara Island. In overall, all sites surveyed indicate minor sign of bleaching and yet recovery from evidence of a past disturbance. The common perception is of the 1998-2000 bleaching event which also affected Fiji, may have been the cause of the observed sight of dead corallite structures still intact and covered with algae. After each survey it is always amazing how each site mistaken to be less interesting at first glance until the tape is laid and observations were noted for the fish, substrate type and invertebrates found. In overall, the selected indicator species from Reef Check for example, Tridacna clams were a common find in sites selected.

Seagrass meadows are located on both leeward and windward sides of Kabara. Consequently, 2 seagrass sites were conducted with at least 3x50m transects at the windward side and 5x50 m transects laid at the leeward end of the island where a more extensive Seagrass meadow is located. From the surveys, 2 seagrass species Halophila ovalis and Halodule uninervis were found in described lush seagrass meadows. It was also interesting to note that at one of the Seagrass sites in Udu, clams were being placed in them by the villagers to grow to a size large enough to cater for upcoming functions or be brought to mainland Suva for family and or to be sold.

The fourth part to the marine team's activities on Kabara was to place a temperature logger provided by the Global Coral Reef Monitoring Network based at the University of the South Pacific. This will allow for annual logging of the sea surface temperature since its placement done by snorkel and free diving to at least 4-5m depth of water. The selection of site was based on accessibility by the team and easy check of the temperature logger by the two community members who were part of the marine team and live close to the site.

Another highlight for the marine team is being able to go on an exploratory trip to Vuagava Island, which belong to Kabara. The island contains a saline lake that is large enough to host several interesting associations of species which included mangroves, Seagrass, turtles, ducks and an endemic shellfish. Considering the unexplored nature and traditional value of this island, Vuagava has potential to be regarded as a unique hotspot for species associations. The island's reef areas are also popular fishing spots for the islanders.

Methodology and Results

(All methods adapted from English et. al 1997, WWF Coral Bleaching Monitoring Protocol, Reef Check)

Manta Tow

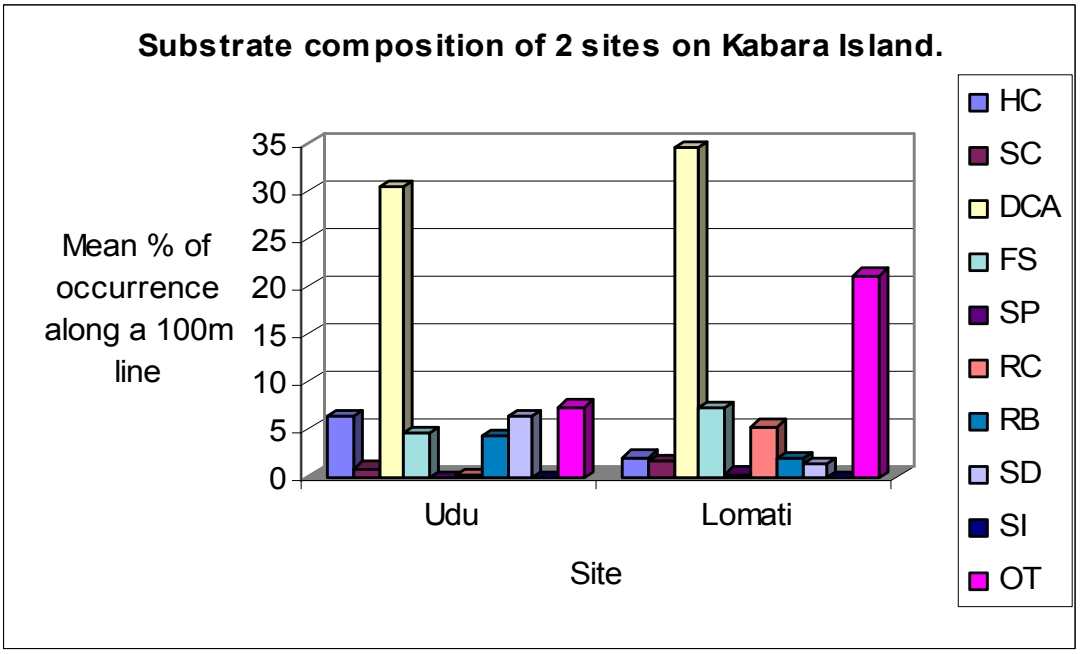
The manta tow is a quick and easy way of assessing broad changes in the benthic communities of extensive reef areas within a short space of time. An observer with mask and snorkel is towed along an 18-metre rope dragged behind an outboard boat for 2 minutes at a slow constant speed before stopping. This allows the observer to note what he/she sees on the manta board according to certain criteria like hard coral cover and its species level for some.

Towed Reef Area	Mean % Hard Coral Cover	Mean % Dead Coral Cover	Mean OTHER Cover (%) (coralline algae, sponges, soft coral)
Udu	10.6	5	37.5
Tokalau-Lomati	11.0	38.7	11.7
Naikeleaga	12.2	22.2	33.3

The manta tow data suggests that live hard coral cover is very low. The dead coral cover as recognized by the still intact corallite structures are sparsely found along the tow, much of which are either Pocillopora or Porites corals. To describe the level of bleaching in all towed reef areas, the extent falls under Index 1 (1-10%) and is described as low or mild bleaching. The occasional bleached colonies sighted were conspicuous. During tows no stressors like the crown-of-thorns were noted. Despite the low coral cover an abundance of large sized fish and turtles were a common sight.

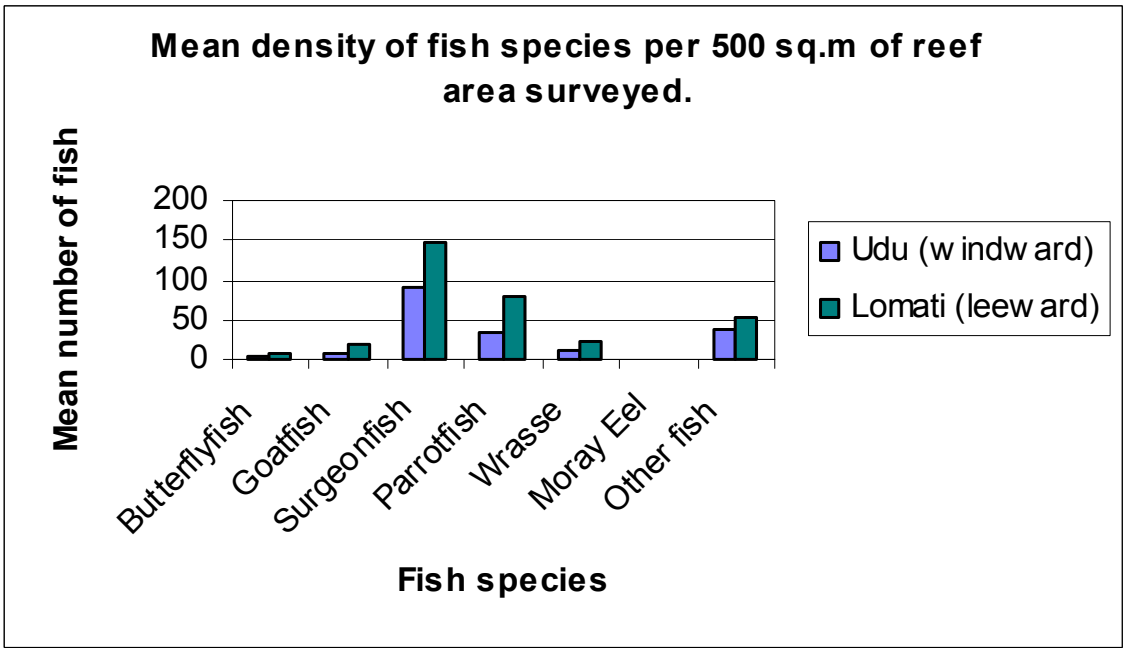
Point Intercept Transects

To undertake this survey method, a team of 5 snorklers working in pairs allowed the 2 community persons ease of identification in invertebrate and fish taxa along the 100metre transect. Basically, the first pair of snorklers swim along a transect line and record fish, then behind them follow the second pair who record the benthic category that is directly below the transect line at every 0.5m interval along the transect and finally the last snorkler records the invertebrates, 2.5m on either side of the transect line at 5m intervals.



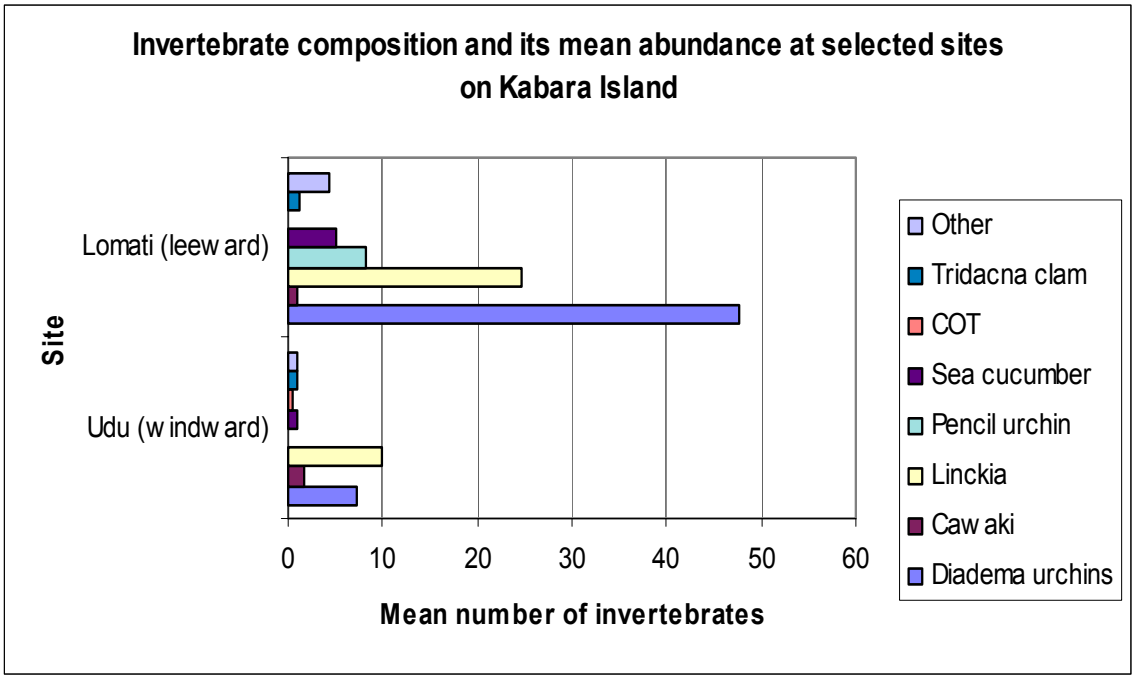
The graph illustrates a fair representation of the different substrate categories at each of the sites with a mean % occurrence of less than 35% cover for all categories listed. Please refer to the Appendix for description of these benthic categories.

The most common substrate along the 100m transects for both sites were the dead coral with algae (DCA) described as the corallite structure still intact. It is neither live with some color to it nor bleached (which appear white) but in most cases found to have some algae growing on its corallite form. The Other category (OT) is everything else either plant or unrecognized coral or plant found that is not under any of the 9 categories described eg. *Halimeda*.



The most common fish observed along the transect at both sites were the surgeonfish and parrotfish family which are herbivorous and foraging in their feeding habits. The corallivores butterfly fishes were quite rare where much of the surveyed reef area where low in hard coral cover. In overall, Lomati (protected site) transects exhibit more fish observed than the

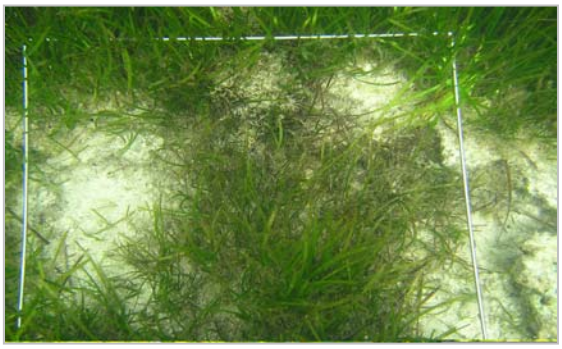
windward transects at Udu. There are listed 63 fish species observed during the surveys. Please refer to the Appendix for a listing of fish species noted during the Kabara surveys and community consultation for their common food fishes.

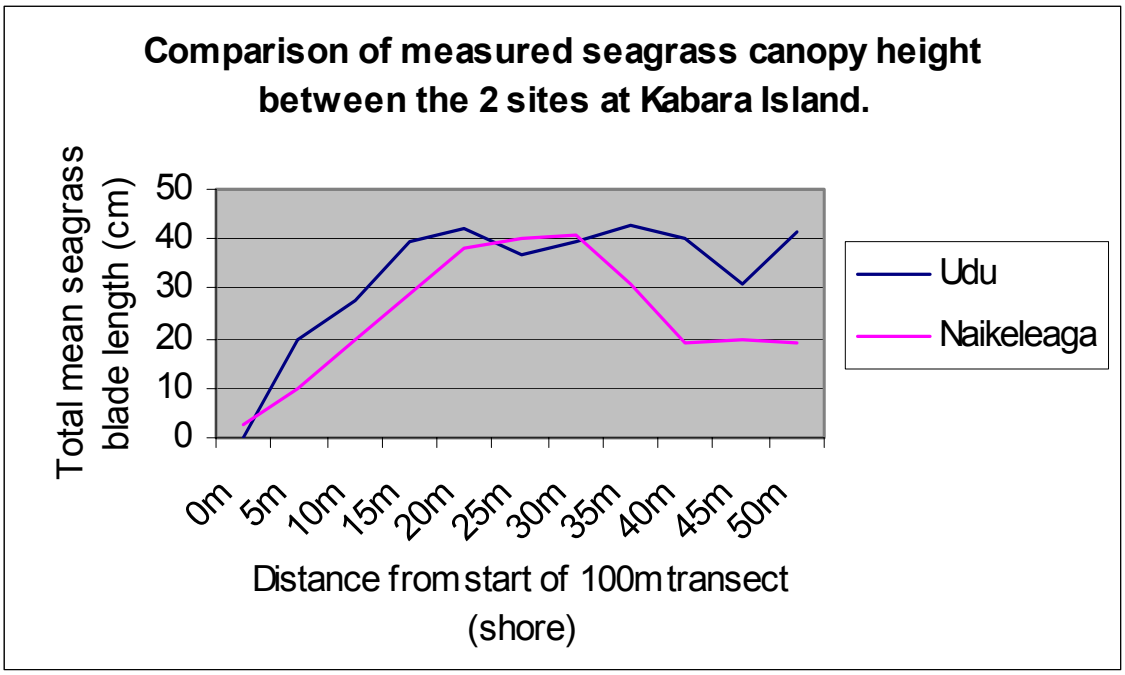


The invertebrate distribution is more varied at Lomati transects. D*iadema urchins* which are known bio-eroders commonly found on hard substrate on the reef is the most common invertebrate recorded. The crown-of-thorns starfish which kills coral is absent to one found in all transects. Please refer to the Appendix for the pictures of the different invertebrates found along the Kabara transects.

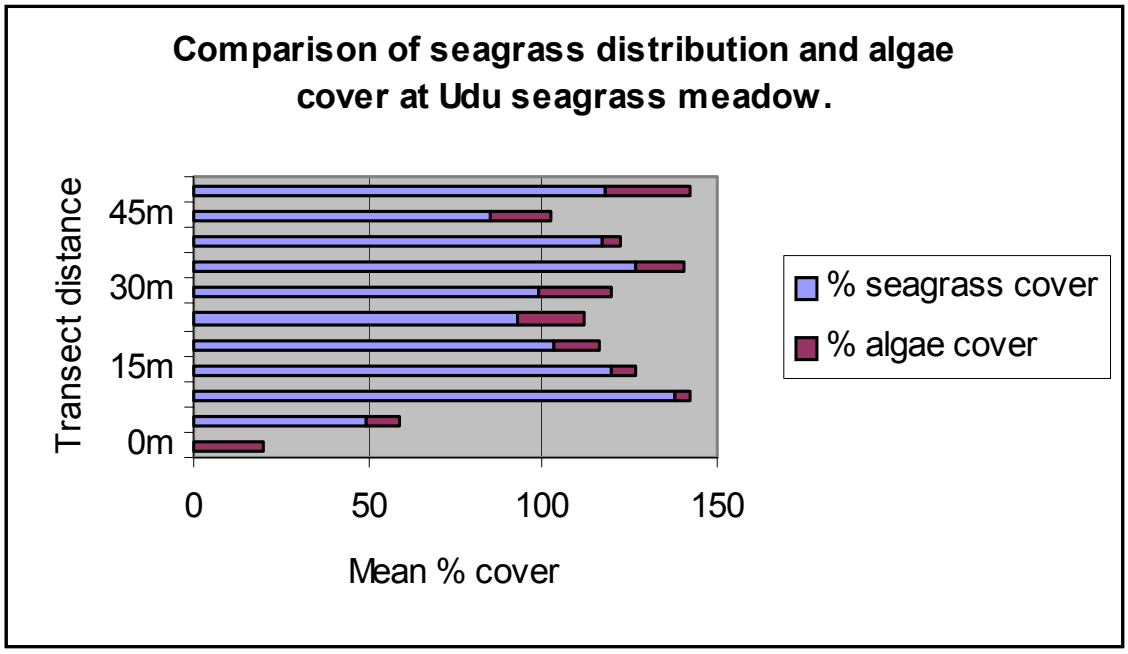
Seagrass surveys

These surveys encompassed a total of 8 transects (@3x50m transect lines) at 2 seagrass sites, one located on the leeward and the other its windward side of Kabara Island. Seagrass canopy height, sediment type and invertebrates found in the seagrass were taken note of during surveys done at low tide. Quadrats were placed every 5m along the transect line for estimate of seagrass and other benthic type percent cover.

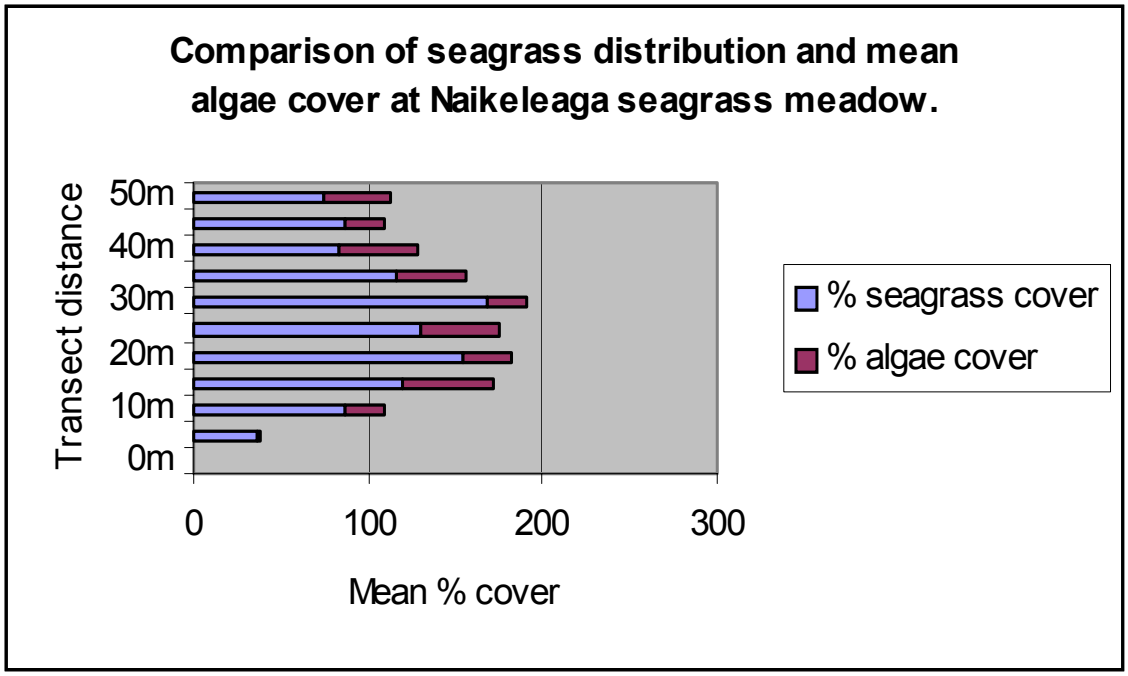




Canopy height of seagrass measured exhibit similar trends until at 40-45 metres from shore where the windward (Udu) meadow had longer seagrass blades. Naikeleaga meadow is located at the leeward (protected) side of the island.

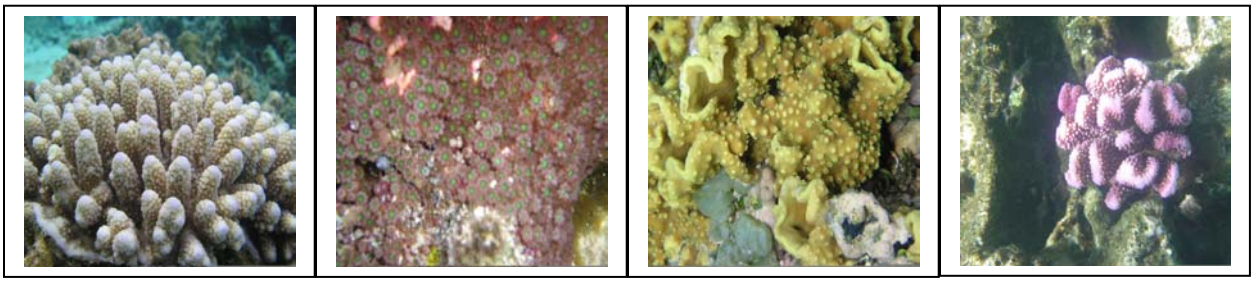


The two graphs illustrate that algae cover at Udu meadow is sparsely distributed when compared to Naikeleaga meadow. The total mean seagrass cover is more at Udu (windward) meadow.

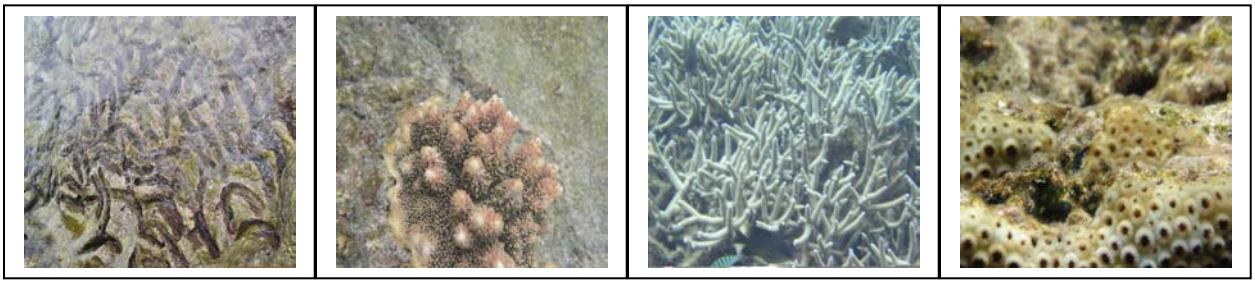


From seagrass surveys of the invertebrates (animals) that live in the meadows, Udu exhibited more in number as compared to Naikeleaga (protected) seagrass meadow. Invertebrates include urchins Tripneustes gratilla, sea hares, turtle(s) and Tridacna clams that is 'farmed' at Udu site by individuals. Sediment type for both seagrass sites were varied along transects laid from shore extending out. Finer sediment composition is prominent in the middle of the seagrass meadow especially in the windward meadow (Udu).

Examples of life-form benthic categories found in Kabara Island transect surveys:



Acropora Digitate | **Echinopora species?** | **Montipora sp.?** | **Pocillopora verrucosa**



Diadema etching | **Acropora ?** | **Acropora Arborescent** | **Monastrea sp.?**

Acropora tabular

cf. Oxypora lacera

Bleached Acropora

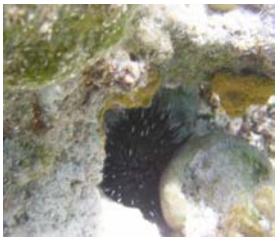
Lobophyllia sp.

Goniastrea sp.?

Diploria sp.?

Pocillopora sp.

Holothuria edulis



Diadema urchin

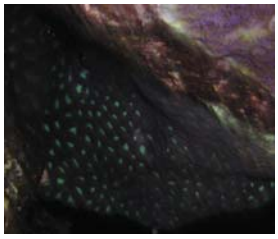
Soft Coral

Lobophyllia sp.

Linckia starfish

Tridacna clam

Platygyra.sp?

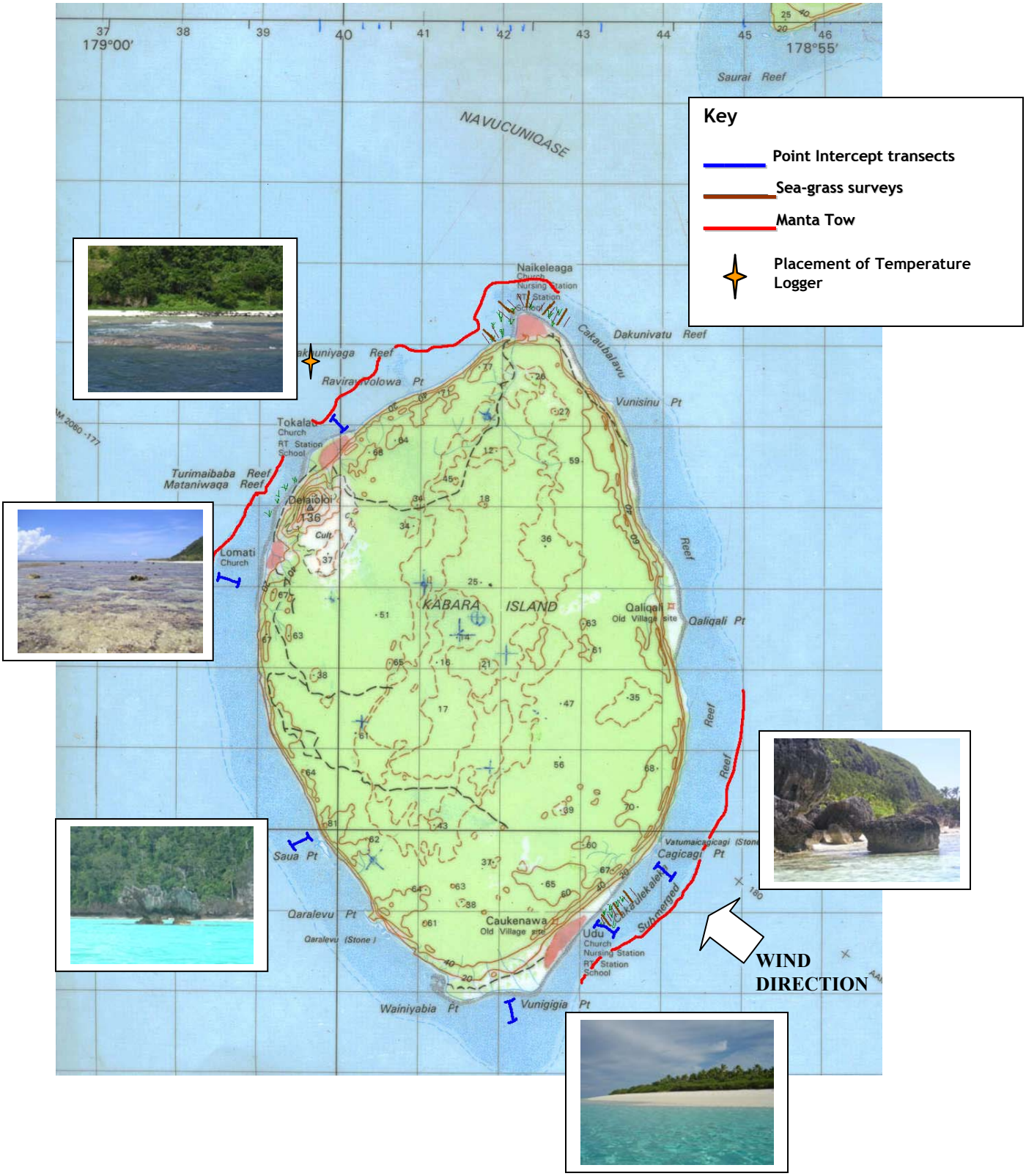


Micromusa sp.?

Pencil urchin

<u>Source Text for Identification</u>: Veron , J. Corals of the World and Gosliner et. al. Coral Reef Animals of the Indo-Pacific.

ACTIVITY MAP (inserted pictures of sites where point transects were laid)



Discussion

The 2-week survey provided a 'snap-shot' understanding of Kabara's reef area. An interesting deduction is that despite the low live hard coral in most of the transects laid, the fish and invertebrate cover is relatively from medium to high. In overall, the surveys and observation(s) at both sites were both interesting and similar. The only difference noted was the windward site, which was more prone to windy conditions, and strong wave action exhibited more rubble coverage than the protected site Lomati (please refer to Activity Map). The manta tow technique provided an estimation of the percentage cover of dead coral, soft coral and live hard coral which was further categorized for better precision of percentage cover for the different hard coral types. Major description of the towed reef area (which was at most 50% of Kabara's reefs) allowed the team to think of future sites for more detailed dive surveys. A temperature logger provided by the Global Coral Reef Monitoring Network at the University of the South Pacific was placed to record the sea surface temperature for the next 12 months or so.

The survey of the seagrass meadows located on both the windward and protected end of Kabara identified the seagrass species present and the bio-diversity of the meadow as gauged by the presence of marine animals that are found there. The seagrass beds were observed to be mooring areas for outboards owned by the villagers. Apart from this, the value of the seagrass area is minimal. During the community sessions, the value of the seagrass area as a nursery and breeding spot for fish and turtles which visit for feeding on the seagrass itself, including its potential for buffer zone to the beaches, were emphasized. Explanations on the connection of the reef, seagrass, beach and land were illustrated for better understanding of how this links to the islanders' vulnerability to impacts of climate change. In Kabara's situation with a small land area and an ever increasing eroded coastline that threatens villagers' coastline dwelling and school buildings, the monitoring of coastline habitats is essential for activities/efforts to counter, reduce and adapt to such change. The survey and monitoring of the seagrass meadows, allows for community to protect effectively the habitat by devise of actions substantiated through observed changes. For instance, if it is observed that the shifting sand along the beach (a sign of coastline erosion in noted areas), this will affect the health and extent of seagrass area, which will in turn, affect the animals living in the seagrass area. These are areas where turtles are often seen foraging. From the community's perspective, maybe it would be more appropriate for action when the seagrass area is being used to dump rubbish by the villagers or that the number of outboard boats moored be relocated. During one of the community sessions, one of the outboard motor owners indicated that the thick seagrass area proves a problem for boats running in the area. The threat to 'mow' down the seagrass for easy boating as suggested would be drastic. This will be no problem, provided that basic education and awareness programs targeted for the island schools and communities allow communities to collectively manage and make decisions.

In summary, the marine baseline biological survey of Kabara's varied habitat has led to future thinking of how useful this information gathered, is to the community. It is anticipated that a follow up to this baseline inventory of Kabara's marine resources will enhance the community's understanding of what they have and widen their scope of limited livelihood options. In this note, the community must be involved and actively participate in activities as listed.

Recommendations

1. Training of community persons, which must be representative of the 4 villages on Kabara Island, in basic survey techniques. This will enhance the importance of a community-based monitoring program.

2. Establish a community-based seagrass watch instead of a visiting team to re-survey. It is suggested that students with the supervision of teachers at the schools located near the seagrass area be trained and provided with the survey kit to be involved.
3. With the continued assistance of WWF establish a school outreach program in coral reef education and awareness. This be in conjunction with departments and other

non governmental organizations that can provide education material for the schools. Schools in such locality often miss out on opportunities presented to urban schools, that such activities in the island schools provide the students access to information and activities rarely available. This provides a link to Kabara children.

4. From community consultation and workshop input from all villages, a popular concern raised was fish poisoning. How this might be related (indirectly) to climate change is still open for discussion and research.

5. Opportunities for research in areas

    a. Fish poisoning
    b. Exploration of Vuaqava Island

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