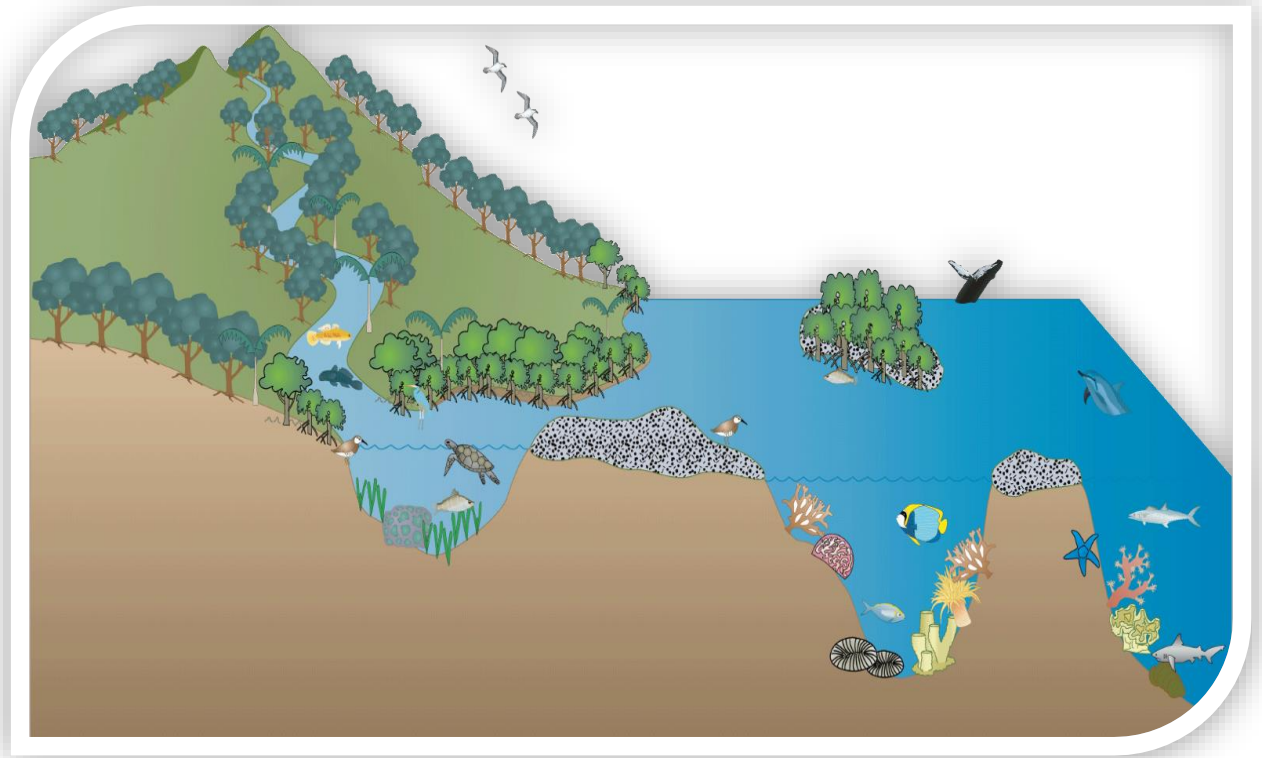


Tongatapu Integrated Coastal Management, Principle, Case studies and Lesson learned (Collaboration to achieve ICM goals)



1.0 Introduction

This report is mainly focused on a research to find out the importance of Integrated Coastal Management to the coastline of Tongatapu. Integrated Coastal management applied conscious management process that acknowledge the interrelationships among most coastal and ocean uses and the environment that potentially affected. Tongatapu is located to the Southern Hemisphere of the Pacific Ocean with the coordinates of latitudes $S21^{\circ}12'41''$, and longitude $175^{\circ}09'11''W$.¹ It has a total land area of 747sqkm; total economic exclusive zone is 200 nautical miles. Tongatapu island lies on the side of the Limestone covered islands which are on the north-northwest to south-southeast orient Tonga-Kermandec. The total coastline of Tonga is approximately 395km and the total distance along the coastline settlement is 158.76km. This indicated that most of the people stayed along the coastal area. The total population for the people stayed along the coastline communities is 59970.²

This report will emphasize on specific coastlines of Tongatapu which includes site 1-4 (Refer to table 1). It is aiming to notify the changes of coastal areas and to what extent; identify these changes cause issues on the sustainability of the coastline in terms of social, economic and environmentally; and to evaluate the procedures of coastal monitoring and resource management in Tonga.

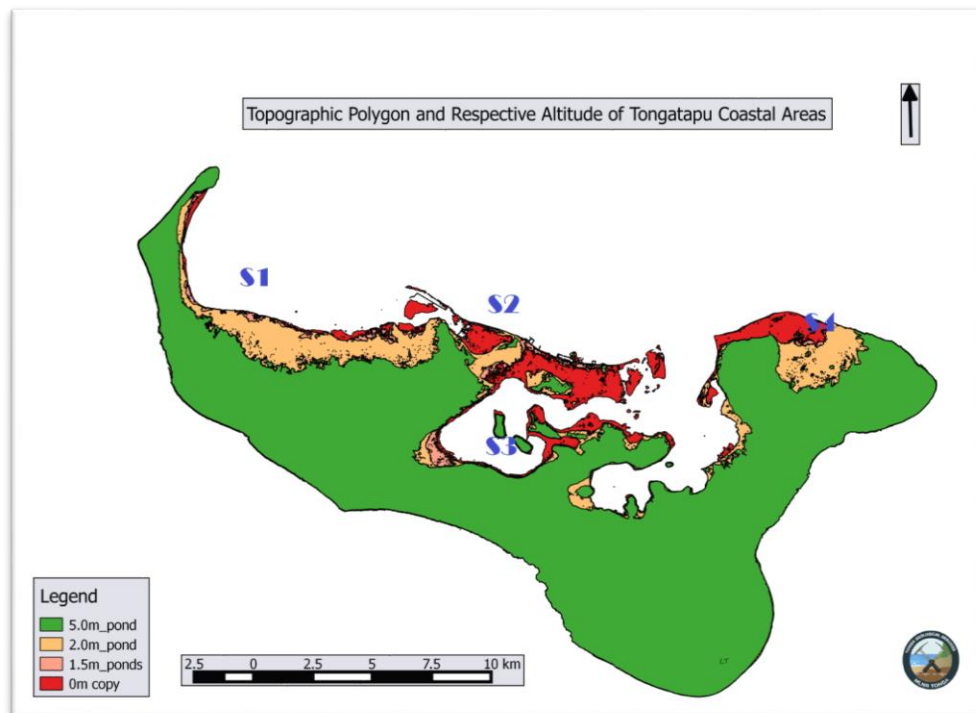
Table 1: Site location

Site 1: Vahe Hihifo	Site 2: Vahe Loto	Site 3: Fanga-'Uta	Site 4: Vahe Hahake
Ha'atafu	Hofoa	Havelu	Tatakamotonga
Kanokupolu	Sopu	Pea	Lapaha
'Ahau/ Ha'akili	Kolomotu'a	Ha'ateiho	Hoi
Kolovai	Kolofo'ou	Veitongo	Nukuleka
Ha'avakatolo	Popua	Nukuhetulu	Makaunga
Fo'ui	Tukutonga	Folaha	Talafo'ou
Te'ekiu	Nukunukumotu	Longoteme	Navutoka
Nukunuku	Pangaimotu	Vaini	Manuka
Fatai	Fafa	Malapo	Kolonga
Puke		Holonga	Afa

¹ En Wikipedia.org, 2009

² Ibid

Map: Site location



Source:

- Data will be collected through site observations and through research for secondary sources. Site observation was done on the first week of June, 2016 by the Coastal resources division. The Division do not acquire the appropriate tools during site visit; it was more a site observation rather than gathering the actual data.

Raw data were gathered, from other previous survey done in other division of the ministry for the similar purposes. Clinometer was not available to determine the slope of the coastal area studied, but we used the measurement tapes to determine its height from the beach end to the shoreline. Most data gathered were through sketching, recording observation, measurements and of taken images of the sites.

The acquisition of the data could be improved if the survey that was carried out was done in more days rather than one day and if the correct instruments were available to take accurate readings, rather than estimation.

2.0 What is Integrated Coastal Management?

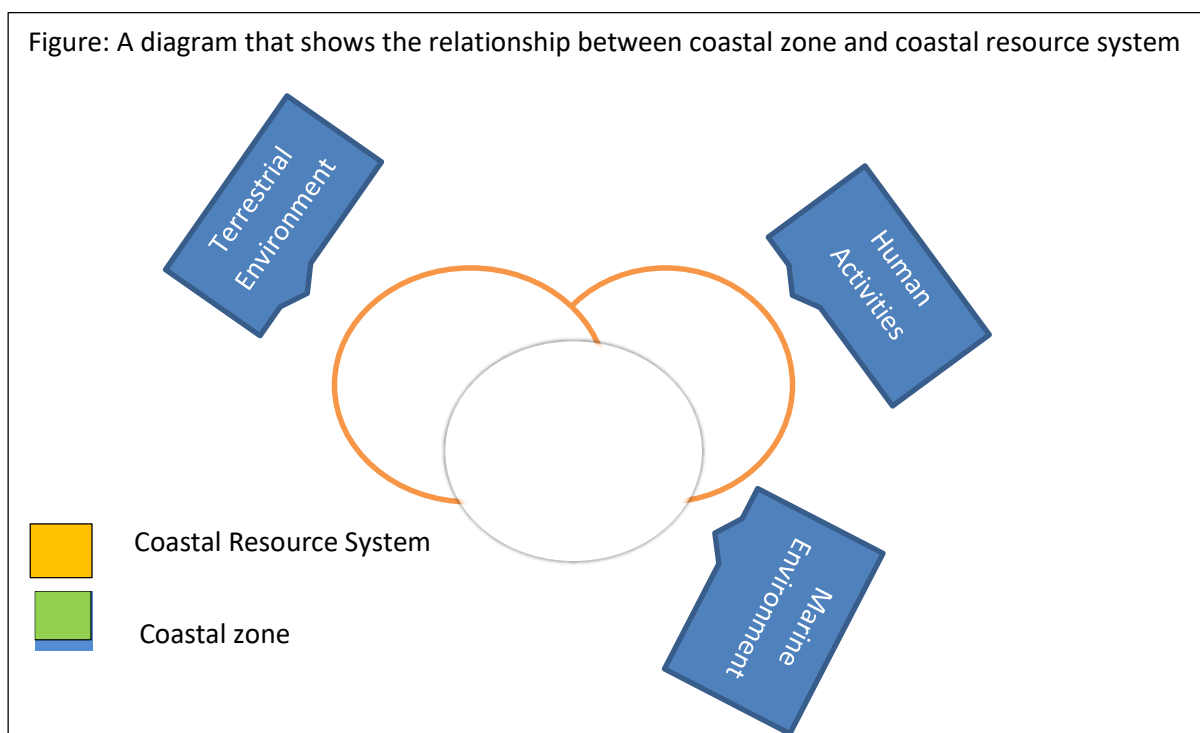
Integrated Coastal Management can be defined as a continuous and dynamic process by which decisions are made for sustainable use, development and protection of coastal and marine areas and resources.

As part of ICM, there are several dimension of integration need to be addressed such as

- Inter-sectoral integration (among sectors)- agriculture, forestry, mining, fisheries, oil, shipping, tourism, urban & housing
- Inter-governmental integration (different levels of government) – national, provincial, local
- Spatial integration- between land and ocean sides of the coastal zone
- Science- management integration among different disciplines
- International integration- integration among nations where nation border enclosed or semi-enclosed areas

First and foremost, the process is designed to overcome the fragmentation inherent in both sectoral management approaches and the splits in jurisdiction among levels of government at the land-water interface. The coastal area, be it continental or island based, is a special area where land and sea meet that includes various characteristics.

- ✚ Dynamic zone
- ✚ Valuable ecosystem
- ✚ Human population
- ✚ Limited space that often leads to conflicts



In order to properly manage the coastline and its resources, it is essential that some guidelines be formulated through an integrated approach by all sectors of the society. Coastal zone Management is an issue of growing importance in Tonga but the current situation is that management plan has not yet been fully integrated and its legislation relating to the development of the coastal zone remains scattered. Tongatapu faced a serious issue that triggers the need for Integrated Coastal Management (ICM) including the desire to increase the economic benefits flowing from the use of coastal zone resources;

- ✚ Serious resources depletion problems
- ✚ Increasing pollution of the coastal and ocean environment
- ✚ Loss of, or damage to productive coastal ecosystems
- ✚ Increasing losses of life and property from natural coastal hazard and disasters
- ✚ Perceived economic opportunities associated with new forms of development in the coastal zone

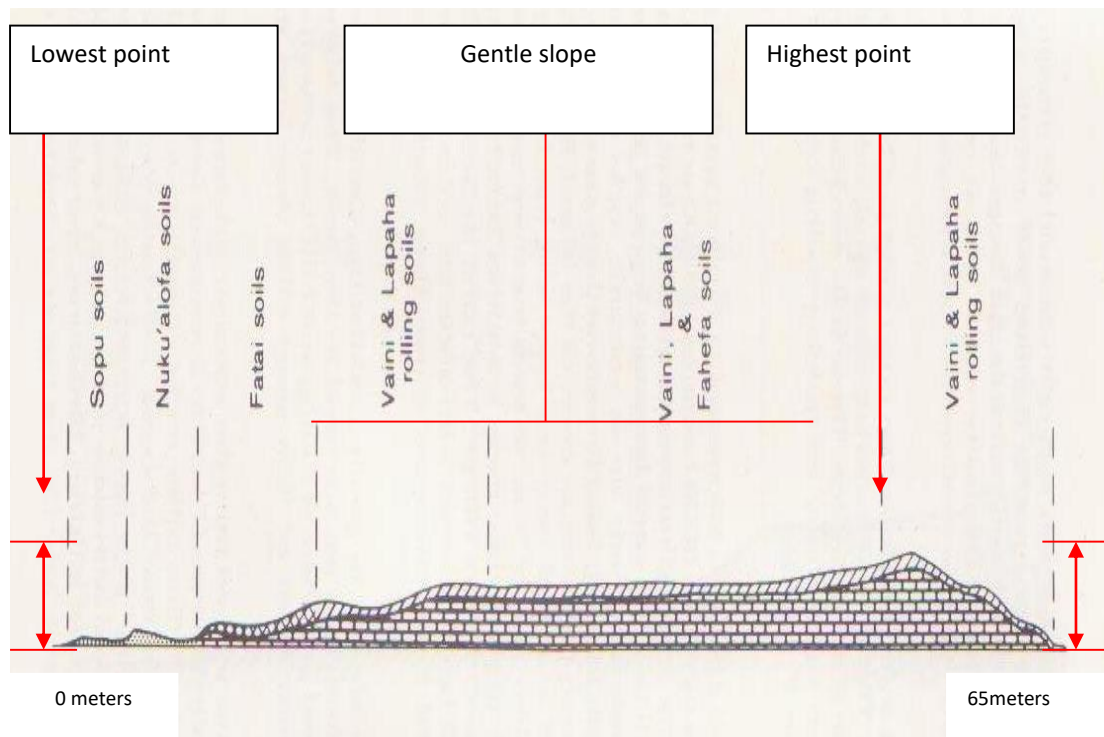
Integrated coastal management help to manage the land, seas, foreshores, resources and people. The functions of ICM is to manage the coastal through different perspectives of area planning comprises the characterisation studies of coastal environments and their uses, zoning of uses, planning for future possible uses, careful regulation of new coastal development through consideration of carrying capacity.

2.0 Observation

2.1 Organisation of the study

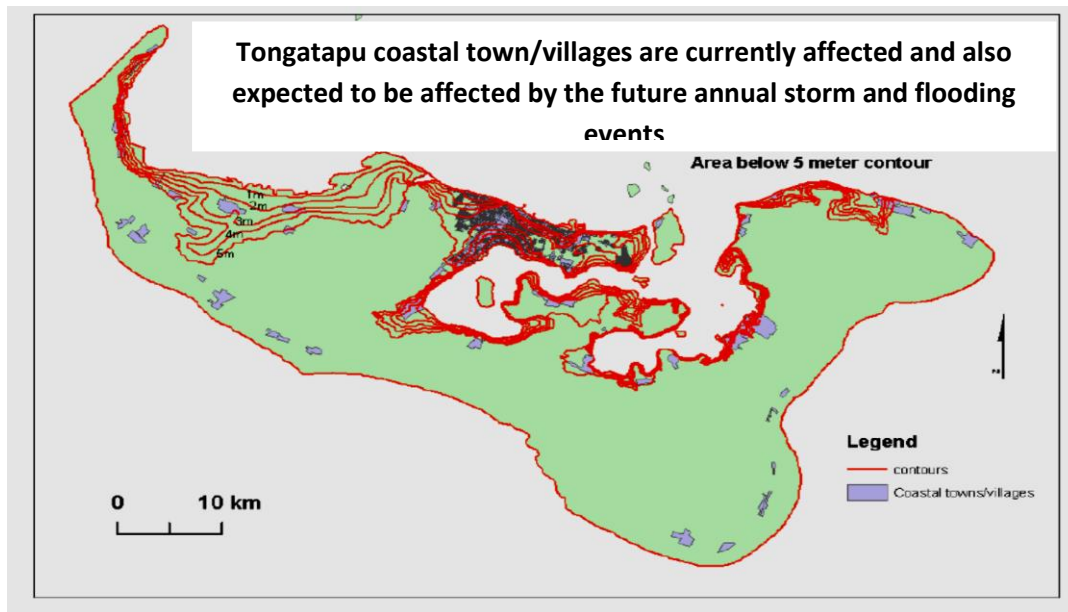
The study only based at the coastline of Tongatapu which identify the different activities occurred in the coastal area and some villages are more prone to coastal changes due low elevation and some places with rocky shore located on the high elevation are less vulnerable to coastal changes. (Figure 1). The coastline of Tongatapu is consisting of 81.7km basically along the area where the community situated. The Integrated Coastal Management is importance to the country's long term and economic development.

Figure 1: Cross-section of Tongatapu (Side view)



Source: Taken from pg. 25, Soils of the Kingdom of Tonga, with my own annotations on the slopes of the island, in which it was taken from a topographic map

Map 2: Relief map of Tongatapu showing areas below 5 meter above sea level.



Source: Taken from pg. 59 of Fine Fatehine Tutu'u Lao Thesis, 2007

The lowest elevation from sea level of Tongatapu is at the north-eastern part of the island and central area. These low lying areas are < 5m above sea level are considered to be very large threats to the impacts of climate changes and are prone to changes in the coast line.

The type of threats it will caused to the environments and it will be classified into different areas such as No threats/Low threats /Medium threats and High Threats. The areas with high threats, the rate of coastal processes and hazard is increasing due to strong waves and high tides it causes beach degradation, coastal erosion, storm surge and more vulnerable to tsunami. Fresh water quality and freshwater supply is also affected due to the location of these area is very close to the sea and the soil is very thick and thinner in some parts. The quality of the water is affected from the salt water intrusion. There are few coastlines they have coastal protection such as Ha'akili, Ha'atafu and Kanokupolu.

Freshwater Quality/ Freshwater supply

Near shore natural resources (mangrove)

Coastal Ecosystem Quality

3.0 Coastal Changes on Tongatapu

The formation of the island of Tongatapu is one of the coral limestones and it's a flat land area. It is likely to susceptible to sea level rising and it affects many of the coastlines in the low lying areas. Not only had the natural hazard affect the coastline but human action also contributed to the changes in the shoreline. Coastal changes are most acute in the urban centre of Nuku'alofa which it adjacent to a partially enclosed lagoon. The nation coastline is important as protection, biodiversity, water quality improvement, transportation and recreation. However since Tonga is a developing state there are various extent changes in the coastal area due to the development such as

3.1 Coastal construction

With coastal construction, coastal vegetation are needed to be cut down; soil and rocks are used to fill these areas to level up with the land before construction. This work will affect the entire ecosystem around this area due to losing of habitat and coastal erosion. For example: At the village of Sopu, Popua and Tukutonga (Patangata) it used to be a swampy area where all surrounded by mangrove. Due to the movements of people and population growth, they starting new settlements by cutting down mangrove and filled up with rock in order to build their house. As for the consequences both marine and terrestrial environment were affected. Ecosystems stayed in this area are displaced also change the livelihood of group of fishermen they rely on fishing for their everyday needs.

However, for the long run this construction affects its sustainability in regards to the location of this area they are more vulnerable to sea level rising. The more they cutting the mangrove and buried with rocks, the faster the rate of erosion because the nature of the sea they will flow and they destroy the formation of rocks. This would cause a collapse on the house and ponds which allow mosquito to staying in there and became threats for human health.

Figure 3: Coastal construction in the village of Popua



6th June, 2016

3.2 Mangrove Reclamation

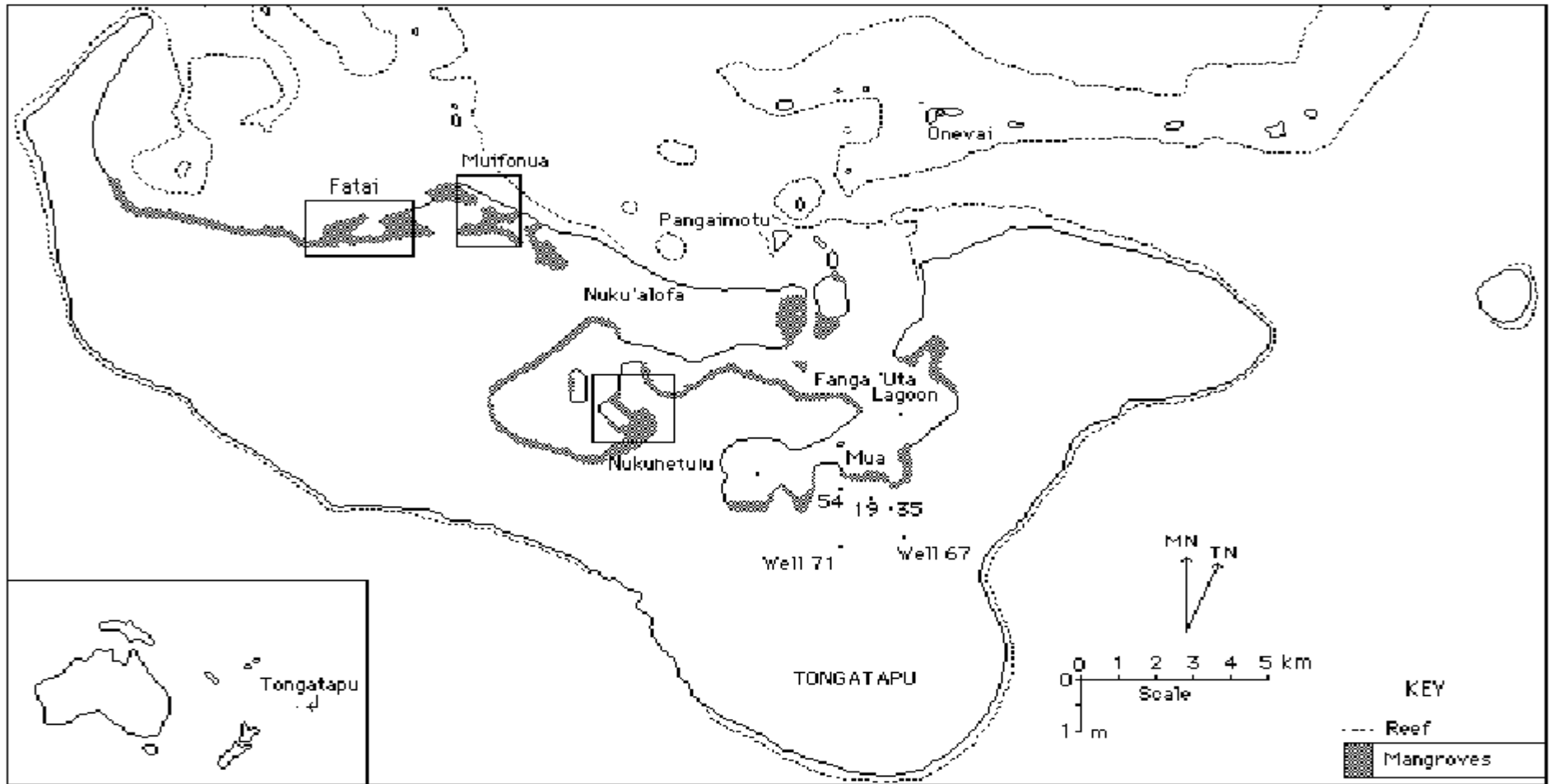


Figure 4: Mangrove distribution in Tongatapu

Source: Taken from Joanna C. Ellison report, 2013

Mangrove ecosystem has a significant value along the coastline of Tongatapu. Mangrove is a useful buffer between the land and the sea. They act as a sink for sediments, nutrients and other contaminants to maintain coastal water quality, and so promote coral reef and sea grass growth offshore. They also protect the land from marine inundation, during storms and sea-level rise.

The mangrove areas are important for maintenance of water quality of the semi-enclosed Fanga 'Uta lagoon. The growing city of Nuku'alofa is located on the northern shores, increasing pressure on the lagoon from disturbance and runoff. The mangrove areas act as a sink for nutrient rich runoff from these settlements, protecting the lagoon from eutrophication. The mangrove area acts as a sink for sediment released during land development, maintaining the clarity of lagoon or nearshore waters (which is good for coral growth). The mangrove area also protects the inland land use activities from waves and wind damage during storms.

Moreover the mangrove cover has since reduced, with losses from coastal reclamation, particularly on shores adjacent to Nuku'alofa and Fanga 'Uta Lagoon.

Figure 5: Mangrove reclamation at Sopu



2nd June 2016.

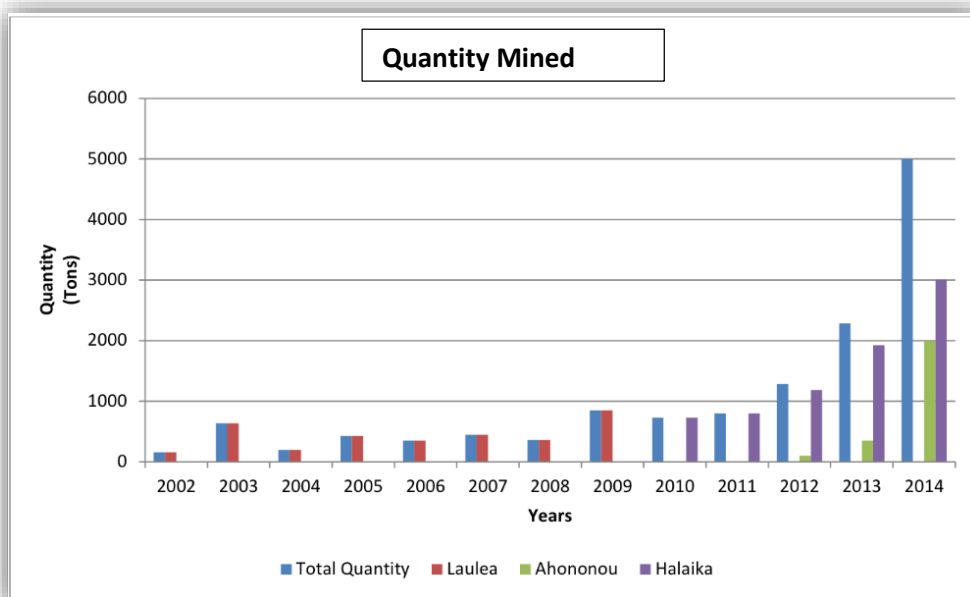
The high demands for space together with the development cause the deforestation of mangrove which causes soil erosion. It both affects the terrestrial and marine environment.

3.3 Beach Sand Mining

Sand mining is one of the major effects on the coastal areas around the world especially here in Tongatapu. A mature of a beach is well determined by the berm generated by waves on the sand from top to low water marks.

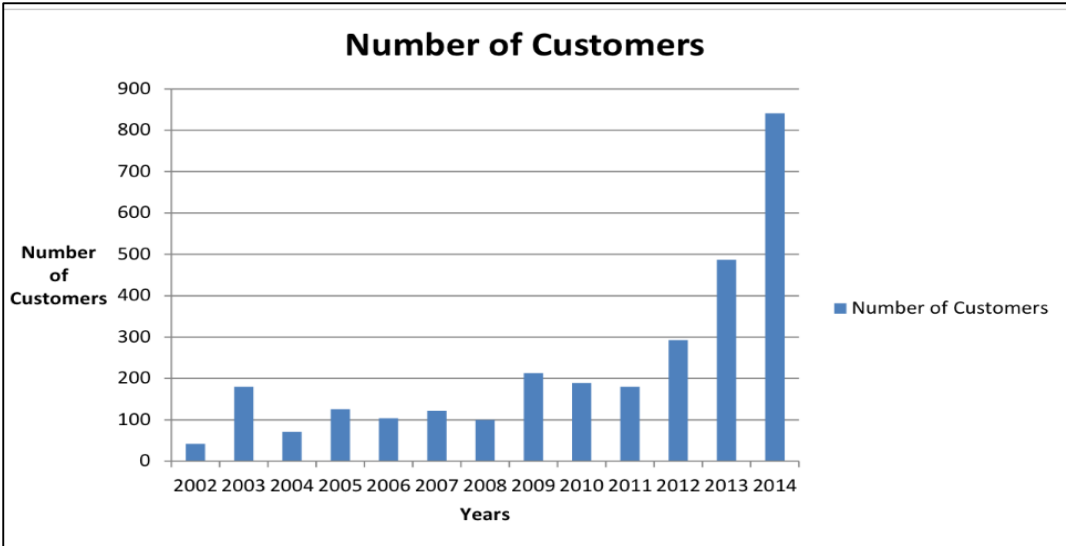
Removed of the sand from coastal areas or beaches, is the way we minimising the natural protection of the mainland from waves to move further inland and also destroyed most of the vegetation on the beach. The sand is widely habitat for most living organism on the coastal area. Sand mining in Tonga usually takes place to the East and South East coastal of the island at 'Ahononou and Laulea. Sand mining is mostly done for financial, constructions and social purposes. The amount of sand removed per annual directly proportional to the number of constructions, building and private needs. Construction working and building are getting increased from time to time refer to Figure 6, the amount of sand (tons) removed per annual accelerated. Sand mining is a good economic resource for different company.

Figure 6: Amount of Sand in Tons removed per year

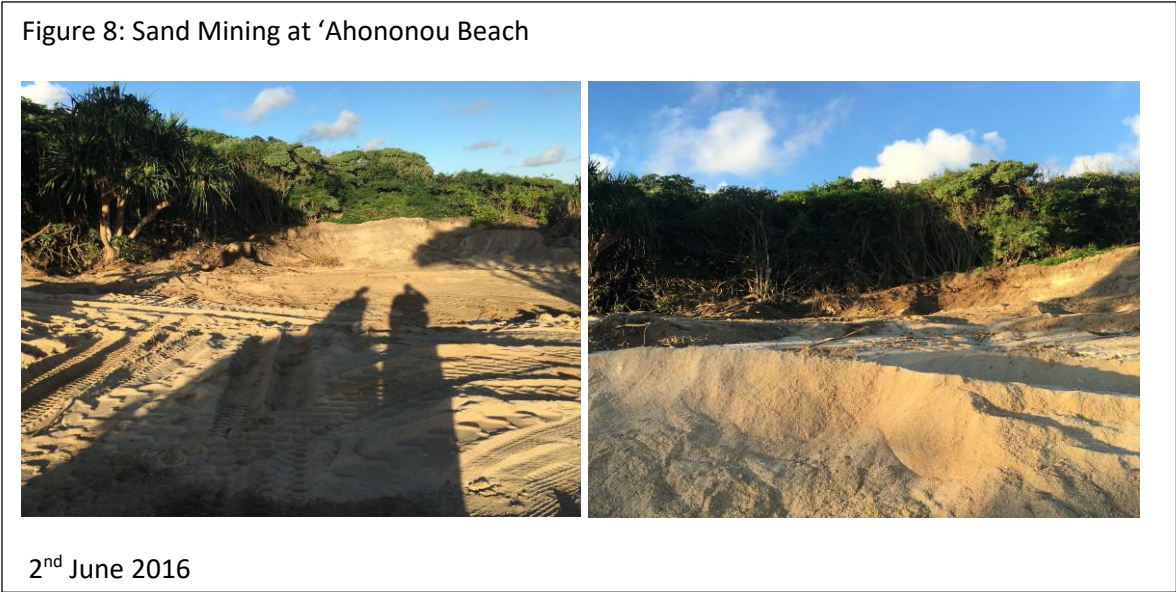


According to Figure7, the number of customers is increased every year for sand mining. To avoid over using this resources, a regulation and a procedure should be established for people to follow in order to minimise removed of sand from the beach, by allowing enough people to do sand mining with a given or limitation of the amount needed per annual.

Figure 7: Amount of Sand in Tons removed per year



Source: Taken from the Ministry of Lands and Natural Resources Sand Aggregate Annual Report for 2015.



However from this photos it shows how further up the sand mining from the beach end to the shoreline which not only change the shape of the beach but it also affect the beach profile. From the decreasing of sand it would accelerate soil erosion when its high tides.

3.4 Waste & Chemicals Disposal

Consumption of a final product that has been process from raw materials into intermediate and final products including human activities, agricultural, and special are known and waste disposal. Waste disposal is one of the major problems that affect the coastal areas of Tonga. Approximately 60-70% of the coastal are consumed with waste.

First of all, humans generate waste disposal by throwing unwanted products near coastal. This is happening due to lack knowledge and resources. Secondly, are sewage sludge and industrial waste. Most company and housing these days they just release the waste disposal and leftover straight to the sea which is much cheaper and easier way to do. Lastly, vegetation waste disposal. As we all see in most beaches the have bonfire and BBQ and some they just burned their rubbish. These are the different types of waste disposal that occurred in Tonga nowadays.

The effect of these waste disposals, as it goes in the sea, it releases out chemical nutrients such as phosphate and nitrate (eutrophication) to the water which affect the lives of living species on the coastal areas. This disposal also pollutes the environment and can bring disease to the society.

Provide procedures and practice from the establish regulation to minimise throwing waste or burning near coastal area. Also provide a program to bring the people of the village near coastal atleast three times a year to collect disposal near their own coastal.

Figure 8: Waste Disposal at the coastlines of 'Ahononou Beach and Popua.



2nd June 2016

3.5 Road, foreshore Construction and Port Development

The impacts of road and port development in the Coastline are poorly understood in Tonga. It is therefore imperative that the government should consider programs and activities to road and port development include Coastal issues in its design and implementation. Subsequently, road and port development affected coastline in different perspectives. Road and port Development had direct impacts on marine ecosystems and species. Consequently, degradation of the marine ecosystems refers to damage caused by heavy machineries and human activities; therefore there were fewer habitats for marine species in that area.

Figure 9: Construction of the Wharf



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From the photos above it shows the working still on progress of the construction development on the wharf at Nuku'alofa waterfront. Not only affect the marine environment through sediment dispersion as a result of piling and dredging works, possible effects of this sediment plume on nearby reef and its inhabitants but also other impacts on the Social systems like construction and health issues. Sea Pollution and all this dust affect the small kids used to swimming around this area. This work changing their lifestyle and the way they used to be.

In addition, with concerning the marine ecosystem the flow of chemical and sediments into the sea has negative impacts to the marine organisms that live there. If these works are not reduced, the pollution of marine ecosystem will increase bringing more harmful effects to the ecosystem. This can lead to more vulnerability to food poisoning in humans, seeing that many of Tonga's people have depended on the marine ecosystem for food source for centuries now.

Figure 10: Fore shore construction



This photo shows the difference between the coastline before and after construction of the foreshore. It seems that the strong current and wind cause too much pressure and force to ruin the foreshore by eroding the rocks back to the sea. Thus human societies have had to come to terms with changing conditions and the threats of floods. Over time they developed ways of protecting themselves against the forces of nature. Today distinct strategies are used; none of them are successful in long term. Therefore for the people living in the coastlines which they confronted with rising sea levels they have the choice of either adapting or retreating. According to the United Nation Convention Law of the Sea, Rio Declaration Principles number 15 it says that “in order to protect the environment, the precautionary approach shall be widely applied by states according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. Thus integrated coastal management applied a conscious management process that acknowledge the interrelationships among most coastal and ocean uses and the environment that potentially affected.

5.0 Recommendation

However all challenges there is always a solution. In this section there is few number of management strategies or policy framework recommend for the people of Tongatapu especially the people stayed in the coastal area.

Community based management

- Community should work together and to evaluate the best possible solutions to be implemented by the communities in order to minimise, reduce or even stop the vulnerabilities like raise awareness.
- Community should continue to work by themselves in trying to manage these challenges not only rely on the government.
- Community can force their children and youth to go to school which they can grow up and work and help for their community.
- Community can also raise funds and with some help of their relatives (remittances) to build a bridge across the river to make the transportation easier in the time of flooding.

➤ Government

- Undertake public awareness activities (Radio and T.V)
- Carries out enforcement of environmental law
- Attempts to promote coordination between different government departments whose activities may impacts on the coastal areas.
- Promote CBM and EBM of both terrestrial and marine resources.
- Use Ridge to Reed Approaches
- Encouraging to conduct the Environmental Impact Assessment (EIA)
- Government and other relative organisation should have special aid for the rural areas not only focus in the urban area.
- Government also apply for a foreign aid from developed countries for financial assistance for the community of For examples : Foreshore Construction
- Building resistance / infrastructure also help for the people to overcome the impact of flooding in the low lying areas. For example: Building houses that withstand the climatic condition
- Avoid deforestation to reduce the soil erosion they practicing afforestation or they cutting sown of trees and also replanting (mangrove)