

Fisheries sector case study site assessment report for Nalema community and Tomman Island community

**Climate information services for resilient development
in Vanuatu**

**Vanuatu Klaemet Infomesen blong redy, adapt mo protekt
(Van-KIRAP) Project**

January 2024



SPREP

Secretariat of the Pacific Regional
Environment Programme

Fisheries Sector Case Study

Site Assessment Report for Nalema Community and Tomman Island Community



Climate Information Services for Resilient Development in Vanuatu
Vanuatu Klaemet Infomesen blong redy, adapt mo protekt (Van-KIRAP) Project

January 2024

Kalo M Pakoa, Jayven Ham and Natastashia Shing
Bluecoast Enterprise Ltd and Vanuatu Fisheries Department
Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity



SPREP
Secretariat of the Pacific Regional
Environment Programme



Australian Government
Bureau of Meteorology



Fisheries Sector Case Study Site Assessment Report for Nalema community and Tomman Island Community

**Climate Information Services for Resilient Development in Vanuatu
Vanuatu Klaemet Infomesen blong redy, adapt mo protekt (Van-KIRAP) Project**

Kalo M Pakoa^b, Jayven Ham^a and Natastashia Shing^a

- a) Vanuatu Fisheries Department, Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity
- b) Bluecoast Enterprise Limited

Table of Contents

1. INTRODUCTION	5
1.1 Background	5
1.2 Vanuatu climate	6
1.3 Fisheries Resources	10
1.4 Fisheries management and resilience	14
1.5 Van-KIRAP Project	15
1.6 Objective of this report	16
2. BASELINE ASSESSMENT METHODOLOGY	16
2.1 Project Sites	18
3. RESULTS OF BASELINE ASSESSMENTS AT NALEMA COMMUNITY	19
3.1 Community Governance	19
3.1.1 Nalema community setting	19
3.1.2 Consultation Meeting	20
3.1.3. Population	20
3.1.4 Chiefly Governance	20
3.1.5 Provincial and Local Area Council	21
3.1.6. Church Governance (SDA Church)	22
3.1.7 Non State Actors	22
3.1.8 Community Groups	22
3.2. Fisheries Resources and Development	22
3.2.1 Finfish resources of Nalema	22
3.2.2 Fisheries development	24
3.2.3 Fisheries monitoring, management and conservation	25
3.3. ENVIRONMENTAL MANAGEMENT AND CONSERVATION	28
3.3.1 Nalema Lake ecosystem condition	29
3.3.2 Upland Environment and Biodiversity	30
3.4. AGRICULTURE, FORESTRY, LIVESTOCK AND BIOSECURITY	32
3.4.1 Agriculture sector	32
3.4.2 Forestry sector	33
3.4.3 Livestock sector	33
3.4.4 Biosecurity and pests	33
3.4.5 Disaster preparedness and sea level rise	34
3.5 INFRASTRUCTURE AND PUBLIC UTILITY SERVICES	35
3.5.1. Energy sources and lighting	35
3.5.2 Water supply sources (WASH)	36

3.5.3 Sanitation and waste management	36
3.5.4 Infrastructure, shipping and airport.....	37
3.5.5 Telecommunication and radio services.....	37
3.5.6 Education and Health services	37
3.5.7 Business activities	38
4.0 RESULTS OF BASELINE ASSESSMENT FOR TOMMAN ISLAND.....	39
4.1 Tomman Island community Governance	39
4.1.1 Community Setting	39
4.1.2 Community Meetings	39
4.1.3 Population.....	40
4.1.4 Chiefly Governance.....	40
4.1.5 Province and local Government	40
4.1.6 Church Governance and non-State actors.....	40
4.1.7 Tomman Island Community Development committees	41
4.2 Fisheries resources and development.....	42
4.2.1 Fisheries Resources.....	43
4.2.2 Fisheries development	44
4.2.2 Fisheries monitoring and enforcement.....	45
4.3. ENVIRONMENTAL MANAGEMENT AND CONSERVATION	47
4.3.1 Terrestrial ecosystem condition	48
4.3.2 Upland Environment and Biodiversity.....	49
4.4. AGRICULTURE, FORESTRY, LIVESTOCK AND BIOSECURITY	49
4.4.1. Agriculture.....	49
4.4.2. Forestry sector	50
4.4.3 Livestock sector.....	51
4.4.4 Biosecurity and pests.....	51
4.4.5 Disaster preparedness and sea level rise.....	51
4.5 INFRASTRUCTURE AND PUBLIC UTILITY	52
4.5.1 Energy, lighting and heat sources	52
4.5.2 Water supply (WASH) and Sanitation	52
4.5.3 Infrastructure, shipping and airport.....	53
4.5.4 Telecommunication and radio services.....	54
4.5.5 Education and Health services	54
4.5.6 Tourism development.....	55
4.5.7 Employment opportunities	55
4.5.8 Business activities in Tomman Island.....	55

6. RECOMMENDATIONS	56
6.1 Recommendations for Nalema Community	57
6.2 Recommendations for Tomman Island Community.....	60
7. CONCLUSION	56
8. REFERENCES	63

1. INTRODUCTION ⁱ

1.1 Background

Vanuatu is the world's most at-risk country for natural disasters according to UN University of World Risk Index (UNU-EHS 2015). It's location in the 'warm pool' of the South Pacific Convergence Zone (SPCZ) means its population is highly exposed to tropical cyclone activity. The country is highly exposed to natural disasters that affect the country including tropical cyclone, earthquakes, tsunamis, droughts, floods, volcanic eruptions, landslides, and coastal inundation. Since the 1970s 4 category 5 cyclones have passed through Vanuatu group which is the highest in the region and indicating the level of high disaster risk the country is faced with. The lack of capacity to cope with disasters and inadequate infrastructure, water and sanitation and lack of society and policy adaptation to the prevailing environmental conditions present more risks and susceptibility to disasters.

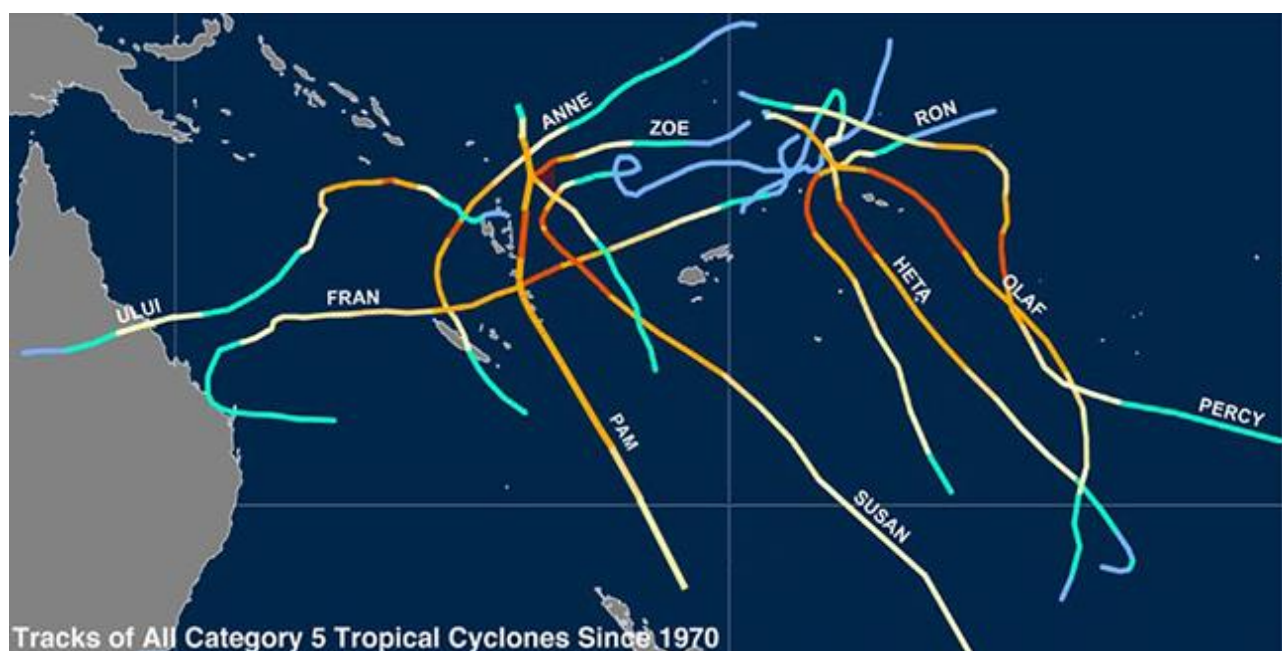


Figure 1. Cyclone tracking map (Google, down loaded dated Mon 25 Sept 2017)

Pacific islands people living on the coast rely heavily on fisheries resources for their food security and livelihood. In Vanuatu 80% of the population live in rural areas and agriculture and fisheries are the source of sustenance. Many coastal people who depend on fish for protein face environmental shocks and stresses. Climate change will exacerbate non-climate pressures on fisheries resources such as overfishing, pollution and loss of habitat. Increasing temperatures, sea level rise and ocean acidification will affect the structure and productivity of marine and coastal ecosystems and fish stocks.

The islands is divided into six Provinces of Torba, Sanma, Penama, Malampa, Shefa and Tafea from North to South and the islands are mostly mountainous volcanic in origin with steep catchments and narrow coastal plains which are vulnerable to flooding and landslide. Some islands are geologically young and surrounded by cliffs which continuous erosion and landslide. A tropical climate moderated by southeast trade winds from May to October, and moderate rainfall from November to April, often affected by cyclones from December to April.

The country's population is 319,137 as of 2021 national census and concentrated along the coastal environment that plays a vital role in the subsistence and commercial life of the Ni-Vanuatu people. Increased human activity in this coastal environment is placing greater pressure on sensitive areas such as beaches, coral

reefs, seagrass and mangroves. The low-lying coastal areas of Vanuatu are particularly vulnerable to climate change consequences. Some of these climate related risks include the following:

- By 2040, daily temperatures will increase from 1995 levels by 1.2°C;
- Sea level rise will continue and accelerate, so risks of coastal inundation will be high when combined with storm surges and high seas;
- Ocean acidification may degrade 80% of coral reefs within 20 years;
- Extreme temperatures will reach higher levels and become more frequent;
- Extreme weather events, including cyclones and storms, will increase in intensity but not necessarily in frequency; and
- Dry periods will last longer and extreme rainfall will be more frequent and intense, so Vanuatu will be susceptible to intensified erosion and flooding.

The country's economy is based primarily on small-scale agriculture, which provides a living for about two thirds of the population (and is a particular source of income and livelihood for women). Fishing, offshore financial services, and tourism (with nearly 197,000 visitors in 2008), are other mainstays of the economy. Most of the population does not have access to a reliable supply of potable water, though 94.5% has access to 'improved' water sources, and deforestation exists as a major environmental challenge.

The main climate hazards for Vanuatu include tropical cyclones with high winds and wave energy, heavy rainfall resulting in flooding, extended periods without rain causing drought, rising sea levels threatening coastal environments and property, as well as sea temperature increase and ocean acidification impacting highly valuable coastal ecosystems and resources (including coral reefs, seagrass and fisheries).

1.2 Vanuatu climate

Temperature and Rainfall

Vanuatu's climate has two distinct seasons: a warmer, wetter season from November to April and a slightly cooler, drier season from May to October.

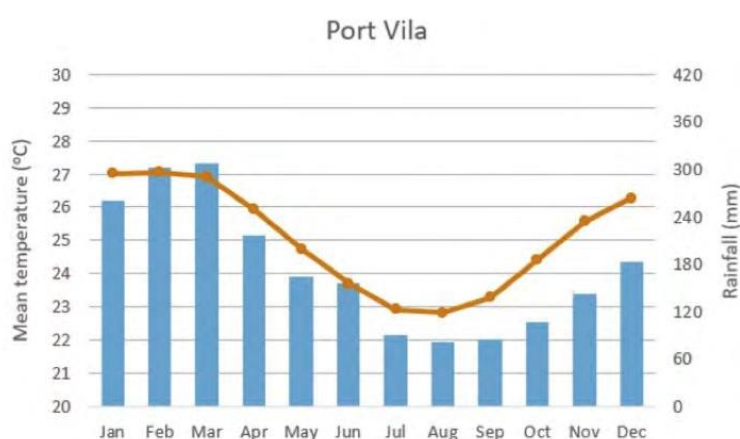


Figure 1. Mean monthly rainfall (bars) and temperature (dots and lines) for Port Vila for 1971-2002. Data source: VMGD/VanKIRAP

For Port Vila, mean monthly air temperatures ranged from around 23 to 27 °C during the period 1971–2000. Seasonal rainfall is strongly affected by the South Pacific Convergence Zone (SPCZ), while air temperatures are strongly connected with surrounding ocean temperatures [CSIRO, SPREP and VMGD 2023].

Increasing concentrations of greenhouse gases are changing the climate. Vanuatu has warmed by 0.7 °C since the pre-industrial period (1850–1900), hot days have increased, cold days have decreased, and sea level has risen. However, there has been little change in annual average rainfall, or dry spells

Tropical Cyclones

The proportion of severe tropical cyclones (winds greater than 17.5 m/s) has increased over recent decades in Vanuatu, consistent with expectations due to climate change. The severity (i.e. wind speed intensities) of TCs passing near Vanuatu has increased by ~15 % over the period 1996–2021 compared with 1971–1995 [8], due to an increase in greenhouse gases.

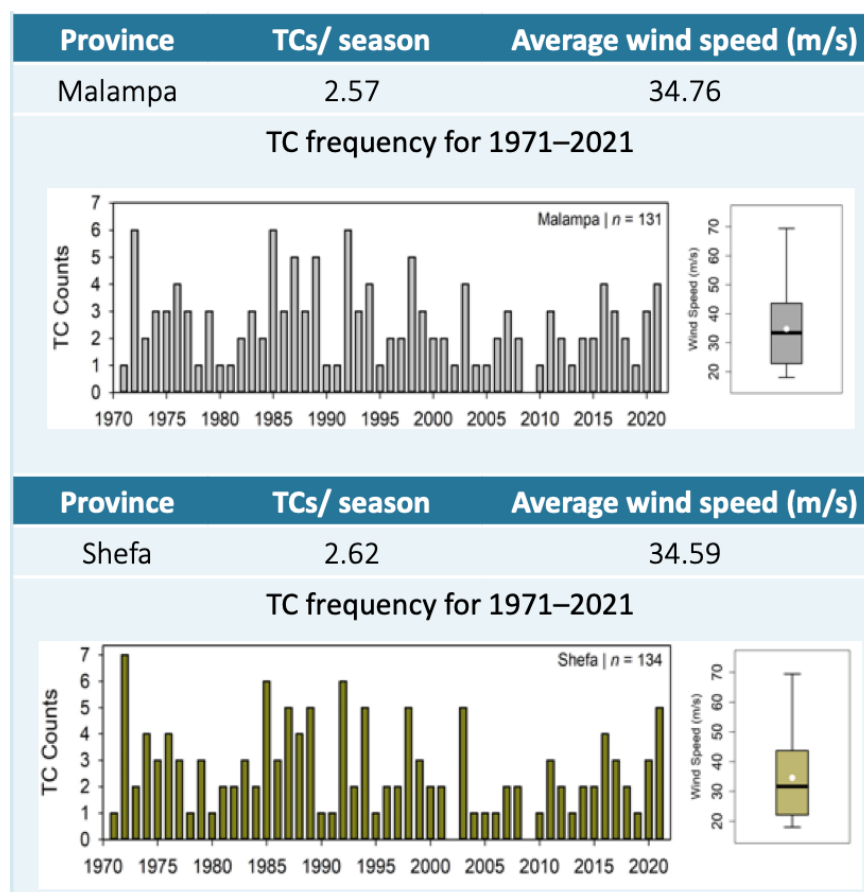


Figure 2. Tropical cyclone frequency in Shefa and Malampa province from 1971-2021.

Ocean Temperature

In Vanuatu annual average sea surface temperatures (SST) range from about 25.5 °C to 28.5 °C from south to north (Figure 3). For Vanuatu Central, SST ranges from 26.5 °C to 27.5 °C. Through the period 1982–2021 the SST has been warming in Vanuatu Central, with Pango shown here as an example (Figure 3; top). While the number of marine heatwaves (MHWs) is around 25 per year on average, the total number and severity of MHW events has been increasing (Figure 3; third from top), and this is evident across the region more generally (Figure 3; bottom).

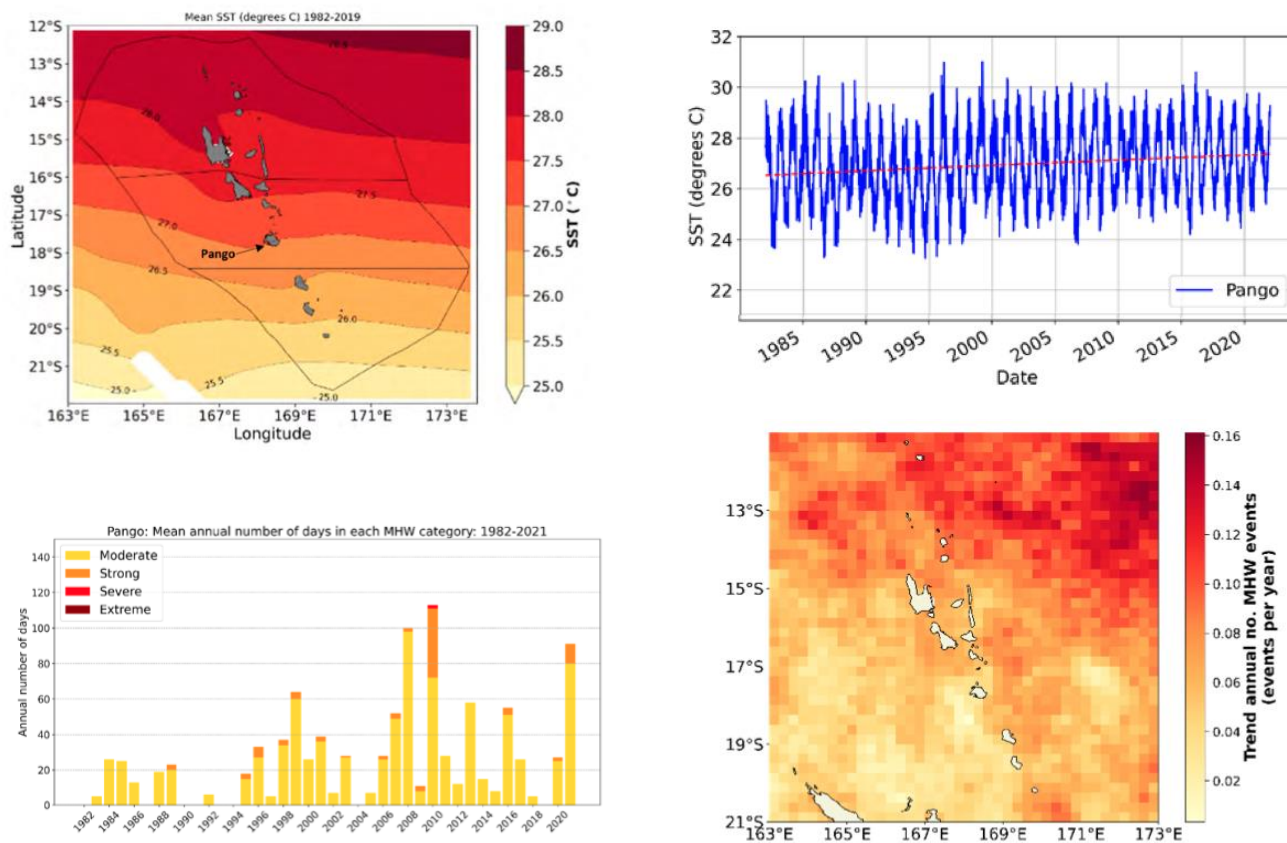


Figure 3. Vanuatu mean SST (°C) (1982–2019) (top left). SST (°C) timeseries from 1982–2021 for the Pango region (blue line; top right). Annual number of days in each marine heatwave category over the period 1982–2021 (bottom left). Trend in annual number of MHW events (bottom right). Events are defined as: a discrete, prolonged and anomalously warm water event which lasts for five or more days, with temperatures warmer than the 90th percentile. Source data: NOAA OISST v2-1 SST

Future Climate Projections

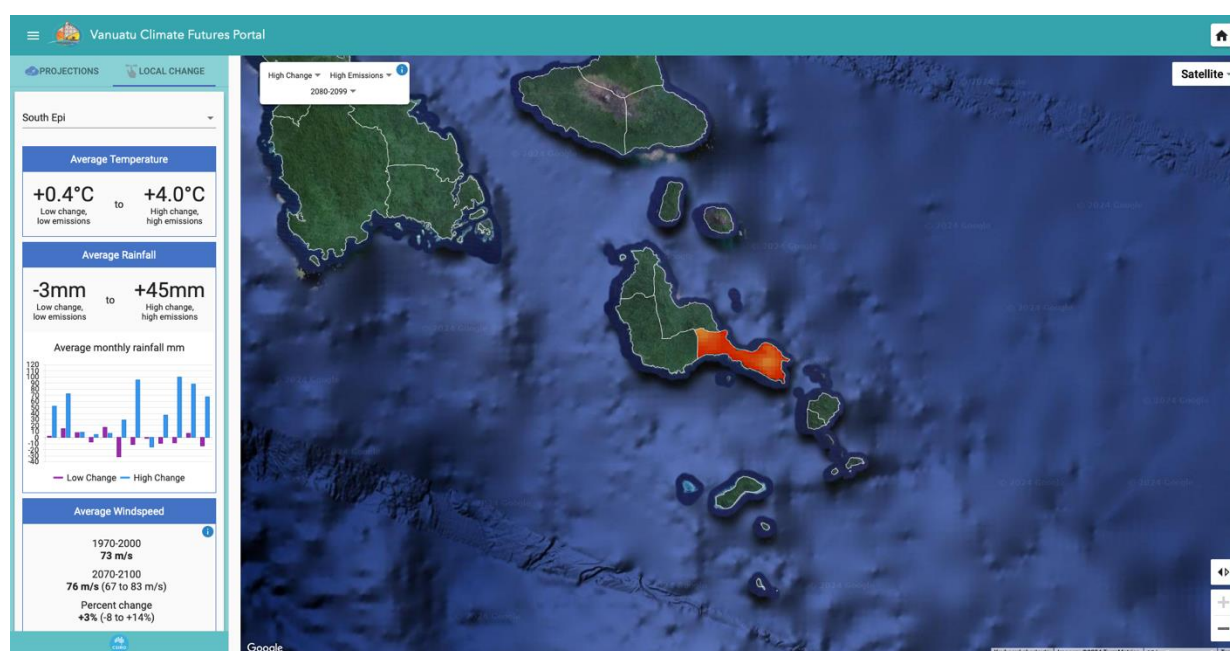


Figure 4: Local change for South Epi under high change, high emission. Source: VanKIRAP Vanuatu Climate Futures Portal <https://www.vanclimatefutures.gov.vu/>

The summary of local change for South Epi, indicates a potential temperature increase of about +4.0 degC. Average rainfall will also increase by 45mm under a high change, high emission scenario. The average wind speed will increase up to 14% towards the end of the century.

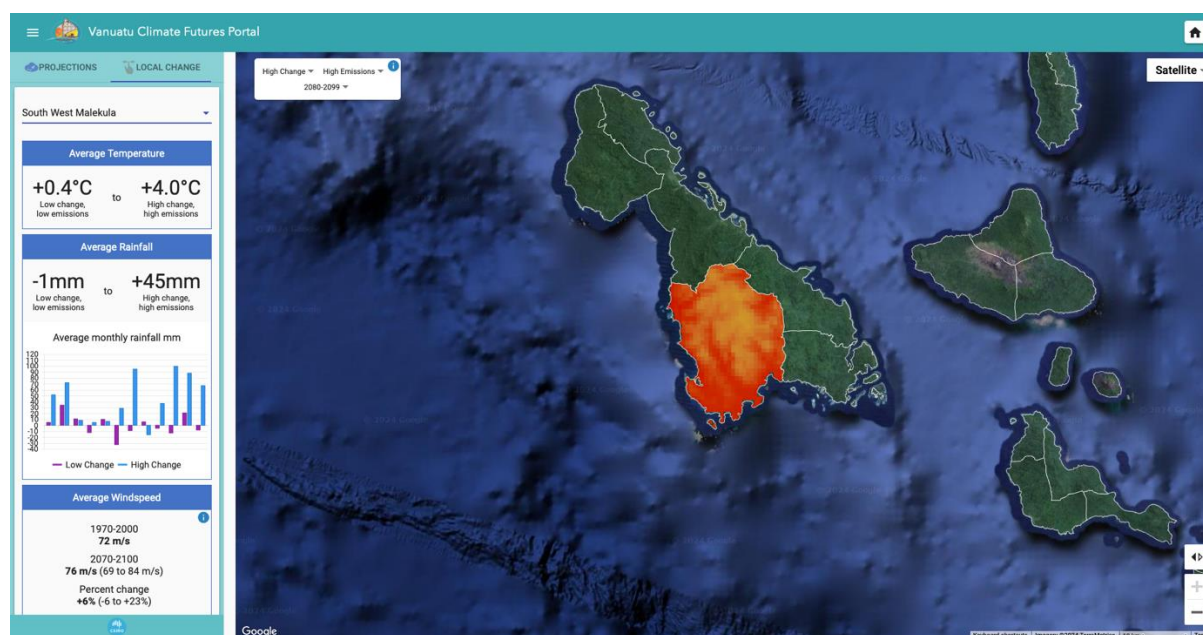


Figure 5. Local change for Southwest Malekula under high change, high emission. Source: VanKIRAP Vanuatu Climate Futures Portal <https://www.vanclimatefutures.gov.vu/>

The summary of local change for Southwest Malekula (including Tomman island), shows a potential temperature increase of about +4.0 degC. Average rainfall will increase by 45mm and average winds speed will increase up to 23% by the end of the century, under a high change, high emission scenario.

Ocean Acidification

Ocean acidification is the long-term decrease in seawater pH that results from the absorption of excess carbon dioxide (CO₂) released into the atmosphere by human activities, primarily through the burning of fossil fuels, deforestation, and cement production (Friedlingstein et al., 2019). The global ocean has absorbed approximately 30% of the total greenhouse gas emissions over the last 250 years, helping to slow the impacts on climate change (Doney et al., 2009). However, as CO₂ is absorbed by seawater it reacts with water to form carbonic acid. This process increases the acidity of seawater and lowers the saturation state of calcium carbonate minerals. If the saturation state becomes sufficiently low, the dissolution of unprotected calcium carbonate shells and skeletons is expected.

At the current rate of CO₂ emissions, the global surface ocean pH is projected to decline to 7.8 by 2100 (Hurd et al., 2018). The chemical changes associated with ocean acidification, in particular the lowering of saturation states of calcium carbonate minerals, have been shown to have detrimental effects on the calcification, growth, and mortality of calcifying marine organisms, such as shellfish and corals. The lower saturation state makes it energetically much more costly to maintain shells and skeletal structures and has particularly adverse impacts on larval and juvenile development (Waldbusser et al., 2015). Other chemical aspects of ocean acidification have been shown to impact fish behaviour and metabolism (Heuer and Grosell, 2014). While many phytoplankton species may not be negatively affected by ocean acidification, or may even benefit from increased CO₂, various zooplankton species that feed on them have been shown to be negatively affected (Wang et al., 2018). Collectively these interactions may alter ecosystems and affect food web dynamics (Doney et al., 2020). Ocean acidification is just one of the many aspects of global climate change. The effects of ocean acidification may be exacerbated by compounding stressors, such as ocean warming, pollutants, increased

storm run-off, and overfishing. Since anthropogenic CO₂ emissions are the primary cause of ocean acidification, action to address ocean acidification should be considered one pillar of climate change efforts. Ocean acidification Although the full ecological impacts remain to be determined, ocean acidification is predicted to have wide-reaching impacts on marine ecosystems, food security, cultural identity and values, livelihoods, water quality, tourism, and recreation. Therefore, it is imperative that local mitigation and adaptation approaches are implemented to address this threat.

1.3 Fisheries Resources

This section provided review of fisheries resources in Vanuatu based on available literature. Fisheries resources of Vanuatu is broadly divided into six main groups:

- a) large pelagic fishes or tuna and tuna like species
- b) small pelagic species – bonito, flying fish and bonefish
- c) deep bottom fishes or poulet
- d) shallow water reef fishes
- e) lagoon and lake fishes and
- f) invertebrate resources

These resources groups are important for food security and livelihood of coastal communities in Vanuatu. For finfish, all edible finfishes are of potential commercial value in Vanuatu which is further categorised into low, medium and high value species. High value would be poulet, medium value would be for tuna and tuna like species and low value would be all reef fishes and freshwater fishes. For the invertebrate resources, some sea cucumber species such as sandfish, black teatfish and white teatfish would be of high commercial value while the rest of the invertebrates species would be of low to medium value. (Bell and Amos 1994). Each of these groups were assessed from people's local knowledge from fishing experiences and described here and compare to what is documented in the literature.

Finfish Resources

Shallow water reef fishes; Underwater assessments conducted since the 1980s at Gaua 1980s in Vanuatu Islands from north to south recorded 469 species of shallow-water finfish species (Done and Navin (Eds), 1990). These species were identified under 25 genera including 10 of Pomacentridae, 5 Scaridae, 3 of Labridae, 3 Acanthuridae, 2 Siganidae and 2 Chaetodontidae (Williams, 1990). This assessment showed that fish communities are more or less similar to reef communities in the Great Barrier Reef and there was no latitudinal variation in species diversity between fish communities on platform reefs and fringing reefs. The study and noted rich diversity of the Scaridae family (parrotfish), at Cooks Reef and the Eastern side of Santo Island. Information from other studies recorded fish diversity for reef fish in Malekula sites of Maskelynes and Uripive that Efate sites of Paunagisu and Mosos. Similar assessment at Wiawi in 2021 recorded 85 species and 26 families and dominated by surgeon fishes and parrotfishes with no take zone recording much higher abundance with 67% of all fish recorded compared to 33% for managed and open areas.

Recent assessments at Wiawi reef in 2021 recorded 85 species of fish in 26 families at Wiawi. The most dominant reef fish species record are surgeon fishes and parrotfishes and the “no-take” zone had much higher abundance of fish (67% of fish recorded) than the managed area. For threatened and special species 6 sightings of Bumphead parrotfish (*Bombometopon muricatum*) was recorded and there was no record of the threatened giant Maori wrasse (*Chelinus undulatus*) (Marine Spatial Planning Project, 2020). It is forecasted that Tomman Island would have a diversity is expected to be similar to Efate sites which are coral reef systems and none would be comparable to non-coral reef areas so the Nalema diversity assessment will be of interest.

Deep bottom fish resources is comprised of is well documented with 170 species in the Vanuatu Fisheries Atlas (Broard and Grandperrin 1994) and represented by three families Lutjanidae, Serranidae and Lethrinidae. The main species are *Lutjanus malabaricus*, *Etelis carbunculus*, *E. coruscans*, *E. radiosus*, *Pristipomoides*

filamentosus, *P. flavipinnis*, *P. multidens*, *Aphareus rutilans*, *Epinephelus magniscuttis*, *E. morrhua*, *E. septemfasciatus*. Other species include; *Aprion virescens*, *L. gibbus*, *L. bohar*, *L. rufolineatus*, *L. argentimaculatus*, *L. timorensis*, *Lethrinus variegatus*, *L. miniatus*, *Paracaesio kusakarii* and *T. zonatus*.

Large Pelagic fishes comprise three general groupings the larger pelagic fishes such as tuna and tuna like species, other oceanic pelagic species such as wahoo and mahimahi. Tuna is well known with 7 species recorded in Vanuatu waters; skipjack (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), mackerel tuna (*Euthynnus affinis*), dog-tooth tuna (*Gymnosarda unicolor*), and albacore (*Thunnus alulunga*), Big-eye (*T. obesus*) and frigate tuna (*Auxis thazard*). Other larger oceanic pelagic species present are the Dolphin fish (*Coryphaena hippurus*), rainbow runner (*Elegatis bipinnulatus*), blue marlin (*Makaira nigricans*), black marlin (*M. indica*), striped marlin (*Tetrapturus audax*), broadbill swordfish (*Xiphias gladius*), sailfish (*Istiophorus platypterus*), wahoo (*Acanthocybium solandri*), barracudas (*Sphyrna spp.*).

Small pelagic species recorded in Vanuatu waters comprise some 30 species compiled by (Bell and Amos) 2004 and the main species are sardines, scads, jack mackerel, bonito and flying fish. Small pelagic fishes are important in subsistence fishery and baitfish. While the Vanuatu resource base is not large enough to support a local baitfish industry, small pelagic is more important for food security. The bonefish (*Albula vulpes*) was reportedly present in some inshore lagoons areas and featured in the subsistence fishery in areas such as Aniwa Island, Maskelyne Island, Nalema brackish water Lake on Epi Island, Emae Island and also reported in Tsiri Lagoon in South West Bay but has not been recorded in the literature and is of interest for this assessment (Kalo Pakoa, personal communication).

Invertebrate Resources

Marine invertebrate resource is divided into four main groups; gastropods, bivalves, crustaceans and echinoderms. These species inhabit a variety of marine habitat from the mangrove swamp and the seagrass flat to the reef slope and deeper channels and are assessed by underwater visual surveys at daytime and at night for nocturnal species. Others such as cephalopods are cryptic and more difficult to assess by visual and can be captured from fishers catch data.

Gastropods: Larger invertebrates of commercial importance such as trochus and green snail are relatively well studied in Vanuatu (Bell and Amos 1994, Pakoa et al 2010, and Friedman et al 2008). Export of green snail (*Turbo marmoratus*) shell was not well managed that fishery collapsed in the 1990s resulting in zero exports since then. A moratorium on commercial trade of green snail was instituted in 2005 and until this day the resource has been recovering but yet to reach commercial fishery level. During the moratorium, several translocation of adult green snail were carried out with the support of the Japanese Government by the JICA Grace of the Sea project which contributed to new recruitment of the species in Efate and Offshore islands. Trochus shell fishery and export continued until around the mid-2000s when the export company experienced low supply of shells and difficulty of securing shells supply and increase in the trade of illegal undersize shells. At the same time the Department of fisheries recorded an increase in the occurrences of poaching of trochus shell by fishers, and increase number reports from reef owners for assistance. This issues were validated by low density of shells in several areas in the country indicating resource overexploitation. The processing factory finally closed in 2015 following damage by the cyclone but also court case against the company for breaching fisheries regulations which led to the closing of the processing factory in 2015. Trochus fishery is currently inactive for the last 9 years.

Sea cucumbers: Sea cucumber trade is an old activity but the diversity of resource was unknown until in 2015 and an assessment of sea cucumber resource in the Maskelynes Islands by the SPC Scicofish Project recorded 24 species in total and this is highest diversity ever recorded in the country (Pakoa et al 2014). Commercial harvesting of sea cucumber is now regulated by total closure of the fishery, allowance of only two traders in the industry and harvest regulated by quota allowance by species and by area based on an updated assessment information. However the fishery overall is fully exploited and 6 species of sea cucumbers in

Vanuatu have been listed by CITES as endangered including black teatfish (*Holothuria whitmaei*), White teatfish (*H. fuscogilva*), Prickly redfish (*Thelenota ananas*), Amberfish (*Thelenota anax*), Sandfish (*H. scabra*) and Golden sandfish (*H. lessoni*) (Figure 2). These species will be closely assessed in these four sites and their presence and absence will be officially recorded for the first time. Trials in the artificial farming of some of these endangered species are being carried out but to date none have been successful as an alternative option to stabilise resource depletion. This BIORAP assessment study will assist to document the presence and abundance of these endangered species in these sites.

Crustaceans: For crustaceans 4 species of lobster *Panulirus versicolor*, *P. longipes*, *P. penicillatus* and *Paripacrus caledonicus* and *P. penicillatus* is the main commercial species present in reefs around the country. There is an indication of presence of mangrove lobster (*Thalassina sp*) as observed in Tsiri Lagoon on Malekula (Pakoa personal communication) although this needs to be confirmed. Only one species of land crab *Cardiosoma hertipes* is recorded in Vanuatu (Bell and Amos 1994), however there is possibility for three more types or perhaps species may exist and need to be confirmed. Crustacean resource base is small and past trials for export trade have been met with supply issues as such products are not encouraged for commercial export trade in order to protect the small scale domestic market and local food security. A recent study on Aneityum Island (Pakoa et al 2012) provide good record of small scale exploitation to supply local tourist market. Some of the crustaceans that will be closely assessed include the four commercial lobster species, mudcrabs, land crabs, hermit crabs and other smaller crabs associated with mangroves and reefs.

Bivalves: Four species of giant clams are present in Vanuatu *Tridacna Maxima*, *T. squamosa*, *T. crocea* and *Hippopus hippopus*, the two true giant clams *T. gigas* and *T. derasa* have become locally extinct as evident only by its shell remains. The Government has embarked on recovering the two species by re-introduction of juvenile clams. A few species of *Anadarra sp* are present and limited to soft benthos habitat areas as on Malekula and three oyster species associated to mangrove forest of Malekula and Efate. Other assessments are being carried out by VFD on sea cucumber and information collected are being used for fishery purposes and the marine BIORAP team is well versed with this protocol. In the same manner, the resource stock for bivalve resources is small and is not encouraged for commercial exploitation purposes.

Sharks, marine mammals and reptiles

Sharks are common in coastal waters to the open ocean and in a range of depths. Five common sharks recorded as bycatch of coastal and nearshore fisheries in Vanuatu waters are cat shark (*Scyliorhinus torazame*), hammerhead (*Sphyrna sp.*) and shortspine spurdog (*Squalus mitsukurini*) and *Carcharhinus albimarginatus* (silver-tip shark) and an unidentified species. There are more ocean sharks that are caught by oceanic industrial fisheries and they include the CITES listed shortfin mako, threshers sharks and blue sharks. Sharks caught locally by artisanal fishery as bycatch is eaten as a source of food security by communities. Sting rays are also present in Vanuatu including eagle ray, manta ray and a few more species. Like sharks they are not targeted for fishery but are caught accidentally during fishing trips and kept for its meat. South West Bay Lagoon is known for the aggregation of rays and is often fished by the local fishers. Landing of shark in Vanuatu EEA by Tuna Longline fishery is prohibited.

Cowfish (*Dugong dugong*) is widely distributed in shallow, coastal tropical and sub-tropical waters from east Africa to the southwest Pacific. The Vanuatu cowfish population is stable and represent the easternmost limit of the dugong's distribution range (Marsh, 1983). Dugongs feed on seagrass as its main diet and their concentrations are associated with seagrass resources. In the Pacific region, they are present in large numbers in some parts of Papua New Guinea, New Caledonia and the Solomon Islands (Nishiwaki and Marsh, 1985), Yap and Guam, and Palau (Brownell et al 1981) and the world's largest populations of dugongs are found in Australia. *Dugong dugong* is prohibited species in Vanuatu under Fisheries Regulation and catching or injuring cowfish is prohibited.

Marine reptiles of Vanuatu include marine turtles (four species), sea snakes (a specie) and crocodiles (a specie). The five marine turtles are green turtle (*Chelonia mydas*), Hawksbill turtle (*Eretmochelys imbricata*), Leatherback (*Dermochelys coriacea*) and Pacific Ridley (*Lepidochelys olivacea*) (Bell and Amos 1994). Marine turtles are found across the islands but concentrations associated with seagrass bed areas. The main nesting beaches of Green turtle and Hawksbill are Moso Island, Efate, Bamboo Bay and Wiawi on Malekula and Votlo on Epi Island for leatherback and lalinda on Ambrym. Marine turtles are regulated species under Fisherie Act no 10 of 2014 permitting the catching of it for traditional use.

Threatened marine species

There are several causes of pressures on marine resources including environmental impacts leading to resources pressure and declines but overexploitation and lack of effective management interventions are the main causes of resource depletion as detailed: Table 2.

Table 2. Marine species that are under threat and requiring urgent management attention

Species	Scientific name	Threat to the species and population
Bumphead parrotfish	<i>Bolbometopon muricatum</i>	Small population and overfishing for food security and lack of effective management
Napoleon wrasse	<i>Chilinus undulatas</i>	Small population and overfishing for food security and lack of effective management
Bonefish	<i>Albula aligolepis</i>	Small populations and overfishing for food security and lack of effective management
Green snail	<i>Trubo marmorata</i>	Medium population and overfishing for shell export and lack of effective management
Trochus	<i>Tectus niloticus</i>	Overfishing for local consumption of meat and shell export and lack of effective management
Coconut crab	<i>Birgus latro</i>	Overfishing for local consumption and local market sales and lack of effective management
Land crab	<i>Scylla sp</i>	Overfishing for local consumption and local market and lack of effective management
Sandfish	<i>Holothuria scabra</i>	Small population and overfishing for beche-mer export and lack of effective management
Golden sandfish	<i>Holothria vesicolor</i>	Small population and overfishing for beche-mer export and lack of effective management
White teatfish	<i>Holothuria vusgogilva</i>	Moderate population and overfishing for beche-mer export and lack of effective management
Blackteatfish	<i>Holothuria witmaei</i>	Moderate population and overfishing for beche-mer export and lack of effective management
Prickly redfish	<i>Thelenota anananas</i>	Moderate population and overfishing for beche-mer export and lack of effective management

Hairy blackfish	<i>Actinopyga miliaris</i>	Small population and overfishing for beche-mer export and lack of effective management
Mangrove ecosystem	<i>All Mangroves species</i>	Mangrove deforestation and loss of habitat for marine live
Sea grass bed	<i>All Seagrass species</i>	Sediment runoff and damage to seagrass bed
Coral reef systems	<i>All Coral reef species</i>	Extraction of herbivorous fish and algal bloom which kill corals, sedimentation and loss of coral and global warming and coral bleaching and crown of thorns infestation.

Coastal marine habitat

The coastal marine ecosystem of Vanuatu vary in characteristics by areas and islands and is determined by geological formation of islands. The main coastal systems are coral reef, mangrove, rocky shore, and lagoon and lake ecosystem. Continues changes being experienced brought about by seismic activity, volcanoes and cyclones. Species richness is directly related to these types of systems (Veron (1990). Branching corals such as (*Acropora*, *Seriatopora*, *Pocillopora*), stinging corals (*Millepora*, *Strylaster*), organpipe corals (*Tubipora*), brain corals (*Goniastrea*, *Euphyllia*) and mushroom corals (*Fungia*) are important in the aquarium coral trade.

A small live coral export trade industry exist in the 1990s and exporting live coral and live rocks from Efate but the trade have since ceased. Vanuatu's reefs are highly exposed to the impact of natural disasters including disturbances from tectonic uplift and submergence, coral bleaching from sea surface temperature and crown of thorns predation can resulting in excessive loss of live corals (Veron 1990). Assessments of seagrasses in Vanuatu in 1990s (Chambers et al 1990) documented nine species but a complete scientific evaluation of seagrasses bed has not been conducted and the coverage and the level of threat remain unknown.

Water quality assessment is under the Department of Water Services who is responsible for all water quality assessments including water supplies, rivers and coastal marine water quality. Coastal water quality issues and pollution are more centered around the urban centres of Port Vila and Luganville townships. Waste water management are unregulated in Vanuatu and wastewater is disposed of directly to the coastal waters causing microbial and sanitary contamination of the surrounding waters. While these are anthropogenic sources, there is little study to assess the impact of coastal sedimentation and loss of coastal habitat supporting marine live. Increase severity of natural disasters caused by tropical cyclones, earth quakes and tsunamis continuously pose threat to the health of the marine ecosystems in Vanuatu.

1.4 Fisheries management and resilience

Fisheries development and management is under the responsibility of Vanuatu Fisheries Department under Fisheries Act No 10 of 2014. Coastal fisheries provide staple source of food security and sources of livelihood for coastal communities in Pacific Island countries, and securing a sustainable supply of fish is recognized as a critical priority for nutrition security. Offshore fishing on the other hand is exploited by foreign fishing companies who pay license revenue to the government. Designated Fisheries are management under specific fishery plans and associated regulations. Although the Act is not specific on community based management VFD support communities achieve fisheries management based on traditional marine tenure systems. Marine ecosystems and resources are naturally protected underwater during a tropical cyclone or draught and therefore are far less susceptible to severe environment shock during and become an important and healthy source of nutritional relief during disasters.

Land based systems and resources on the other hand such as gardens, food trees and are exposed and suffer considerable damage during disasters to the point of total collapse of food production, drinking water, cash crops and infrastructure support. In a study undertaken post Category 5 TC Pam in 2015 and prolonged El-Niño induced drought, communities across Shefa, Tafea, Malampa and Sanma rely on fisheries resources to cope with the impacts and a shift in diets to rice and tinned food (*Erickson et al 2017* and *Pakoa et al 2019*). Community based management activities such as protected areas become critically important source of food preserve and livelihood in times of food shortages post disasters. As an example, the opening and harvesting of beche-de-mer fishery as part of the TC Pam disaster relief in 2017 injected over 300 million into the local economy of affected communities in the country. Fisheries and marine resource management is at the center of disaster preparedness and relief strategies in remote Pacific Island communities. In addition to the resources, provision of fishing skills by fishers, gears, preservation facilities and catch data collection are important aspects of fisheries management that must not be left out of a community fisheries resilient support.

Management of coastal zone is cross cutting and require support from other government policies and strategies. These policies and plans support the need for the Development and application of tailored climate information in the Fisheries sector. These policies and strategies are summarized in detail in the Fisheries and climate information services in the policy review, action and communication plan (SPREP 2018) as listed:

- 1) Vanuatu National Fisheries Sector Policy 2016-2031 - Strategic Policy objective 5 (SPO 5)
- 2) Vanuatu National Roadmap for Coastal Fisheries: 2019–2030
- 3) National Strategy for Scaling Up Community-based Fisheries Management in Vanuatu
- 4) National Integrated Coastal Management Framework (NICMF) and Implementation Strategy for Vanuatu
- 5) National Ocean Policy (NOP) 2016
- 6) National Ocean Policy 2016 aims to build resilience in its marine ecosystems to climate change
- 7) Vanuatu Meteorology and Geohazards Department Strategic Development Plan 2014-2023 (VMGD SDP)
- 8) Vanuatu Framework for Climate Services (VFCS)
- 9) National Sustainable Development Plan (NSDP) 2016-2030
- 10) Republic of Vanuatu National Climate Change and Disaster Risk Reduction Policy 2016-2030
- 8) Vanuatu National Adaptation Programme of Action (NAPA)
- 9) Republic of Vanuatu Second National Communication to the UNFCCC (SNC)
- 10) Vulnerability of Tropical Pacific Fisheries and Aquaculture to Climate Change
- 11) Pacific Roadmap for Strengthened Climate Services (PRSCS)

1.5 Van-KIRAP Project

The Climate Information Services for Resilient Development in Vanuatu (CISRD) or Vanuatu Klaemet Infomesen blong redy, adapt mo protekt (Van-KIRAP) Project, is a four and a half year, full size Green Climate Fund project implemented through the Secretariat of the Pacific Environment Programme (SPREP). The Van-KIRAP Project is a national project implemented by the Vanuatu Meteorology and Geohazards Department (VMGD) and SPREP Climate Change Resilience Programme (SPREP CCR) as the Project Executing Agencies, and in partnership with multiple partners in Vanuatu, Australia and South Korea.

The Objective of the Van-KIRAP Project (PO) is to *“increase the ability of decision makers, development partners, communities and individuals across five target sectors (agriculture, fisheries, infrastructure, tourism and water) to plan for and respond to the long- and short-term impacts of climate variability and change”*. The Project is responding to priorities identified in the Vanuatu Framework for Climate Services (2016) and the VMGD Strategic Development Plan 2014–2023, developed through a nation-al consultation and design process.

SPREP as the Executing Entity for the Green Climate Fund (GCF) funded Climate Information Services for Resilient Development Planning in Vanuatu project (Van-KIRAP) is engaging the services of Bluecoast

Enterprise Limited in a consultancy arrangement for the development of the Community-based Fisheries Management Plans for Nalema, Epi Island and Tomman Island, Malekula, Vanuatu. KRA 4 – IUU fishing reduced through enhanced monitoring control and surveillance of both oceanic and coastal fisheries, improved legislation, access to information, and effective marine area management (FFA).

The fisheries and climate information services case study is one of the five target sectors covered by the Van-KIRAP project implemented by the Vanuatu Fisheries Department (VFD) of the Ministry of Agriculture, Livestock, Forestry, Fisheries and Biosecurity (MALFFB). Since 2020. The VFD is the implementation agency for the Fisheries Case Study target focal area but implementation of the project was delayed by disturbances of COVID 19 and natural disasters which progress.

In the absence of timely information on the impacts of climate variability and change, development sectors, governments and communities risk significant losses and damage from extreme events such as drought, heat waves, cyclones and flooding, and from slow onset changes, such as rising temperatures, sea-level rise and ocean acidification.²

1.6 Objective of this report

This report provide results of the baseline surveys undertaken in the two focal sites of Nalem and Tomman Island in December 2023 and January 2024 and previous assessments undertaken in 2020. Information and recommendations from this report will be used to develop community based integrated fisheries management plans for these communities. The report is also part of the deliverable of the contract signed between Bluecoast Enterprise Ltd and the Secretariat of the Pacific Regional Environment Programme (SPREP) on providing assistance to Vanuatu Fisheries Department to deliver the Fisheries Case Study work. Specifically the objectives of this baseline report are to:

- 1) Present the results of the baseline assessment surveys and community consultations conducted at the two project sites in December 2023 and January 2024 and result of assessments undertaken previously by the Department of Fisheries visit in 2020.
- 2) Provide recommendations and priority action activities for the two communities which will be addressed in the Community Based Integrated Coastal Fisheries Management Plan.
- 3) Identify important sites of biodiversity significance for community based conservation area development.

2. BASELINE ASSESSMENT METHODOLOGY

The community baseline assessment also referred to as community profiling adopted three methodologies used locally by the National Government led by the Department of Local Authority (DLA) to regularly update the community information for development, service delivery purposes and disaster monitoring services. There three methodologies adopted:

- (a) Vulnerability and need assessment (VNA)
- (b) Fishery specific surveys and
- (c) Agriculture specific surveys
- (d) Community transect walk

Vulnerability and need assessment (VNA):

VNA assessment is a participatory social engagement tool that elicits information in a group setting about communities in a comprehensive, multi-sector approach. VNA surveys allow for community members to identify for themselves any relevant vulnerabilities using their knowledge to contribute vulnerable baseline

information about their community and define priorities for development in a short span of time. The survey methodology was design by Department of Local Authority (DLA) to collect baseline information of communities in Vanuatu and the state of services and developments and needs in order to improve service delivery (Unpublished report, Department of Local Authority, Vanuatu Government).

Assessment is conducted in a meeting setting by asking a series of questions and putting fort discussions points. Facilitators help community members to arrive at a consensus where there is disagreement. The result often consists of estimations, from communities members to the best of their knowledge. While responses can contain some inaccuracies as respondents are not technical specialist, a large part of community responses are accurate information about a community and should be used and considered as approximation especially when it comes to quantity estimates. Community focus groups was used where necessary to better capture views of certain groups such as women, youth and association members on their specific activities, developments and views. Community leaders were the first to be engaged to give permission for the survey in the community, and respond to the questions on community governance issues.

Community Meetings is held at the nakamal or village meeting house. The chief of the village is informed about prior to the visit by area Council representative. The VNA community survey questionnaire is comprised of 15 main sections listed:

1. General information and checklist for community profile
2. Population data
3. Community leadership or governance structure
4. Economic resource profile
5. Wash –Water sanitation and hygiene
6. Upland resources – agriculture, livestock and forest resources and wildlife
7. Marine resources – fisheries and marine environment
8. Infrastructure
9. Climate change and disaster – disaster warning, long term changes
10. Community social issues – churches and land dispute issues
11. Government service delivery
12. Health care services
13. Education services and schools
14. Women’s group issues
15. Youth group (25 years and under) issues and needs

In addition, additional specific questions are asked for detail information and where data is available, copies of the data id provided.

Fishery specific surveys

Section 7 of the VNA survey form focus on Fisheries and Marine resources is expanded to cover fisheries specific questions on resources, development areas, management and monitoring and compliance activities and conservation to capture more information needed for development of a Community management plan. Communications and interviews are conducted in Bislama language and surveys are intended for use by non-technical Ni-Vanuatu facilitators. Where necessary population data, fish catch and size information and price information are collected where necessary. Fish catch data from TAILS database is obtained from the VFD Data Unit.

Agriculture specific surveys

Additional questions were included to capture detail information about agriculture, livestock, Forestry and Biosecurity. These additional questions were asked informally sometimes outside a meeting setting and respondents were more comfortable providing the answers.

Community transect walk

A walk through the village is undertaken at the end of the meetings to validate information provided and take pictures where necessary. This is done with respective village guide of an elder who is more familiar with the community. The community walk in Nalema and Tomman proved to be very useful in capturing a lot more information and feelings and enable visualization of the place and living condition of the community. The visits enable verification of information provided in the VNA assessment and people perception.

2.1 Project Sites

The original four sites were of Mystery Island, Aneityum, Epau, East Efate, Nalema, South Epi and Tomman Island, South West Malekula were selected for the implementation of the Fisheries Sector Case Study component of the Van-KIRAP Project. However, the unfortunate disturbances of COVID 19 lockdown and followed by natural disasters that affected the country had caused prolonged delay in implementation leading to decision to reduce the number of sites by half to be realistically achieved within the remaining project time frame. So that two final sites of Nalema and Tomman Island were selected by the project Steering Committee for the implementation of the fisheries case study work. Both Nalema and Tomman Island are new beneficiaries of the project.

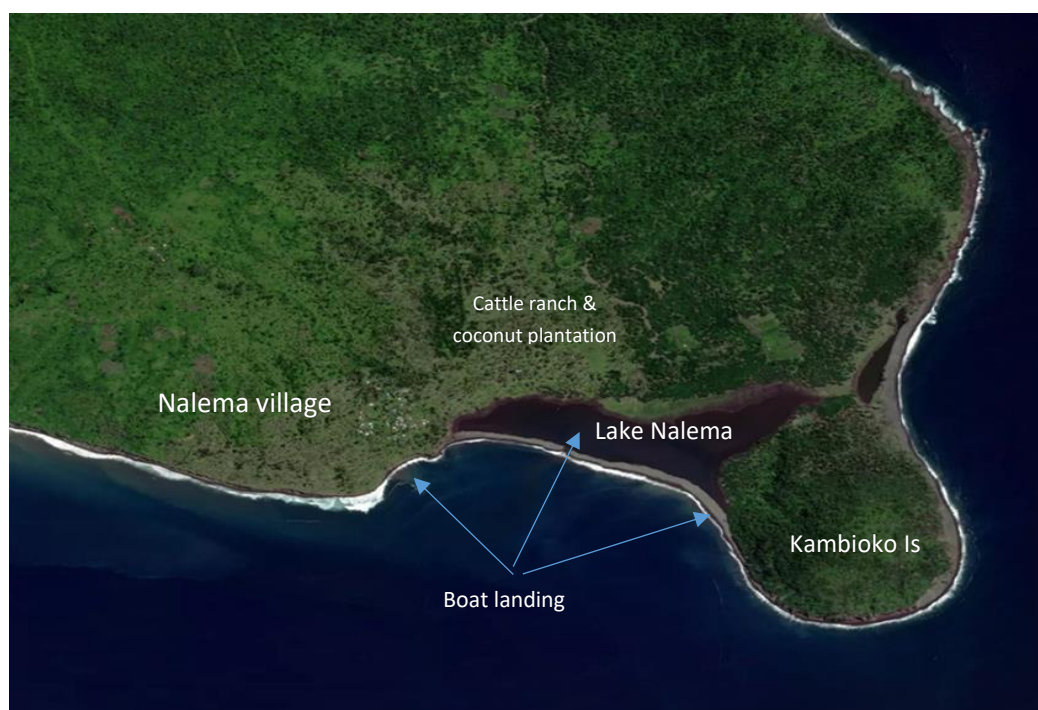


Figure 2. Nalema, Epi island, SHEFA province (Source: Google Earth).



Figure 3. *Tomman Island, South-west Malekula (Source: Google Earth).*

3. RESULTS OF BASELINE ASSESSMENTS AT NALEMA COMMUNITY

3.1 Community Governance

3.1.1 Nalema community setting

Nalema community is located in the southern end of Epi Island, Shefa Province with the population of around 135 people. The population of Nalema is smaller than it was before as residents move to Port Vila and some return to Tongoa but move between Lupalea village on Tongoa and Nalema for various reasons such as employment opportunities, family ties, and cultural events. The island is a remnant of the major Kuwae volcanic eruption sometimes in the 1400s which gave rise to. Other remnant Tongoa, Tongariki and Buninga and the uninhabited islands of Valea, Ewose, Laika and Tevala. The rocky shores and cliffs around these islands are reminiscent of this recent past geological formation. It is the only village in the southern end of the Island and pose a critically important habitats both terrestrial and marine making it an important are for conservation initiative.

The sharp drop off to the deep sea closes to shore provide productive fishing ground for pelagic fishes such as tuna and the like species and deep bottom fish resources (Cillaurren et al 2001). Nalema is the name of the brackish water lake ecosystem that was formed by stone deposit connecting Kambioko Island to the mainland in the east and west (Figure 1). The Lake ecosystem support marine biodiversity and source of fish for the people of Nalema for many years. Today the lake is under threat from human activities and natural causes. These impacts on the biodiversity and sustainability of food security needs of the community.

3.1.2 Consultation Meeting

Two meetings were held at Nalema community, first consultation visit held in 2020 by VFD team and second meeting held in January 11 to 12 2024. As a relatively small community the recent meeting was held at the village Nakamal with everyone present including 14 men, 7 women and 11 youths. Many villager members were not present since many did not get information of the meeting and have left to their various activities. Discussions were made informally on one to one basis with community leaders after the meetings and in Port Vila with some of the community members.



Figure 4. Nalema community consultations and baseline assessment surveys

3.1.3. Population

The village of Nalema was established in the 1980s by the people of nearby Tongoa Island from the villages of Lupalea and Ravenga. The tribes of Nalema have historical connection to the area during the migration era after the Kuwae volcanic eruption in 1452s (). During the colonial era much of the southern and western part of Epi Island was developed into large coconut plantations and cattle ranching and the native inhabitants were decimated. In the late 1970s when the traders left, the plantation owned land returned to the hands of the native tribes and the areas became underpopulated. Upon the request of the Chiefs of Epi, South Epi was repopulated by residents from the neighbouring islands of Tongoa, Tongariki, Buninga, Makira and Paama islanders who set up new settlements in South Epi from Nalema all the way to Sara to the west. For Nalema, the Burns Philip coconut plantation became abandoned in the 1970s, the native chief of Vilakara Village (Chief Supo) requested the decedents of the tribe in Tongoa to return to develop the land and the village of Nalema was born. The current population of Nalema community stands at 36 households and 135 people.

Table 1. Population break down for Nalema, South Epi

Villages	Men	Female	Youth	Disability	Total	Household
Nalema	72	64	-	1	135	36

3.1.4 Chiefly Governance

The chiefly governance of Nalema community and south Epi is the same as the chiefly system of Tongoa Shepherds Islands with three levels of chiefs with Paramount Chief on top, supported by Tribal chiefs supported by many subordinate chiefs and every else (Figure 4). Chief Johnny Tapangamarama of Lekokau

Nakamal is the Paramount chief of Nalema village and below him are Chief Tom Maroro of Legos Nakamal and Chief Tarisongo of Leborosakau Nakamal. Each of the Nakamal Chief have between 5 to 7 subordinate chiefs (smalle Chiefs) who perform specialise duties to their Chief. These chiefly titles are heredity following the patrilineal line and sometimes the lower title is rotated base on quality. The paramount or high chief of the area is Chief Supo of Vilakara Village and he is the overall chief who ordained Chief Tapangamarama of Nalema and allocate the land of Nalema to him.

Chief Tapangamarama own the administration of the village and he distribute land to all the lower ranking chiefs of the three Nakamals including his own. The chief has the overall authority over resources including all land, forest, rivers, coastline and coastal marine areas including the lake. The village chief then divide the land into three pieces for the three nakamal. Each head chief or tribal chief then subdivide land to each subordinate chiefs in his Nakamal to work and support the nakamal and perform custom lease to the head-chief and from the Head chief to the village chief. Chief Tapangamarama then perform custom lease to the chief to the Paraount Chief Supo. The village is a close knit community who work together well in their various activities. The work of the chief is active with meetings once a week depending on issues to be discussed. There are a few land dispute issues in the village but none have reached a nakamal meeting.

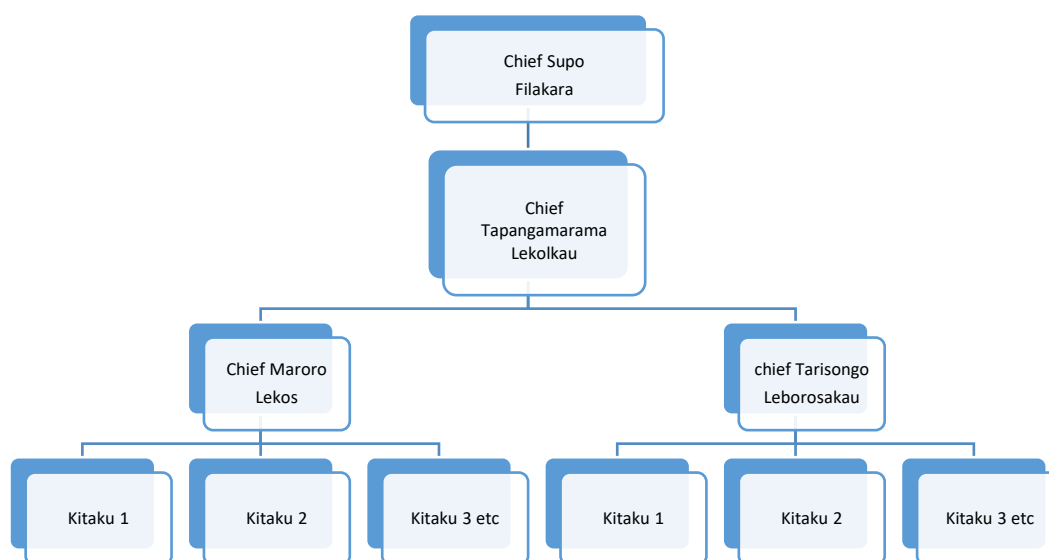


Figure 5: Chiefly governance structure for Nalema community

3.1.5 Provincial and Local Area Council

Nalema is in the Yarsu Area Council headed by an Area Administration base at Port Quimie and in direct contact Bay on west of the Island where there is a NBV bank branch, police and Court House. The nearest airport to Nalema is Valesdir Airport further to west of the island and too far to travel from Nalema. A new airstrip is being build at Port Quimie but is not operational yet. Sick patients from Port Quinine down to Nalema refer their sick patients to Silimauro Health Center, Tongoa and referral to Port Vila from Tongoa airport. Residents of the area also travel to Tongoa to sell their crops and fish and for banking services at Morua.

3.1.6. Church Governance (SDA Church)

Nalema community is exclusively Seventh Day Adventist (SDA) who worship on Saturdays. The church has its permanent church house managed by a resident pastor. While the work of the SDA church is alive and intact, the common believe that certain marine and terrestrial species are considered “unclean” for consumption has hindered any concerns for these species and could be linked to lack of care and management especially for the species regarded as unclean. Such a believe could contribute to the resources in that because there are no sense of appreciation, there is no sense of responsibility to manage it. Note this is my personal view based on discussions and experiences from Nalema residence (Kalo M Pakoa personal communication).

3.1.7 Non State Actors

There are no non-governmental organizations in the village but the Adventist Development Regional Assistance (ADRA) is the only organizations working with the community of Nalema on their Water supply development and funding of the school classroom. Nemea has one of the best water supply system in south Epi with high pressure and this is through the work of ADRA.

3.1.8 Community Groups

are six community development groups in the village for water, health, women, school, business, bazar and fisheries. These different committees work closely with local Council Officer to facilitate respective services to the community. Their roles and functions are as detailed below:

<i>Women group</i>	Nalema Women’s Committee own a house building often used as guest house by visitors, the committee also support mamas 20 vatu Bazar in the village every Tuesday and Thursdays.
<i>Health Committee</i>	Oversee operation of Aid post, Staff house and sanitation activities including upgrading of toiles, hand washing and solid waste disposal pit.
<i>Water committee</i>	Oversee water supply management and maintenance services and collection of water fees.
<i>School committee</i>	Welfare of school, teachers and students
<i>Business committee</i>	Welfare of businesses, pricing of goods
<i>Fishers Association committee</i>	In-charge of fishers and selling of fish, running of the fish market and development of fisheries sector.

3.2. Fisheries Resources and Development

3.2.1 Finfish resources of Nalema

Information on finfish resources were from fisher dependent information from interviews, fisher surveys and observations.

<i>Lake Nalema fishery</i>	Lake Nalema associated species include two species of bonefish (<i>Albula spp</i> and <i>Albula oligolepis</i>), 2 species of mullet, red snapper, goatfish, red mouth, sawfish, trevally, river eelfish, stingray and mud-slipper, mosquito fish <i>Tilapia mossambicus</i> . Tilapia was initially introduced for mosquito control. Poor seawater exchange, contamination from rotting
----------------------------	--

	leaves during flooding causing eutrophication and mass mortality, removal of mangrove habitat and heating during daytime, and overfishing combined to the loss of fisheries for bonefish, Tilapia, mullet and other species including invertebrates. Current wider and deeper opening of the lake entrance had improved exchange and may improve the health of the lake for high salinity tolerant species but will be devastating for low salinity species. Tilapia is a low salinity species and since seawater exchange started improving, tilapia had disappeared from the main lake and only present in the small lake to the east with small size fishes from continued fishing. The community noted sudden disappearance of large tilapia fishes from the lake. A species of freshwater eel fish was present in the lake but its current state is in question as it is also a low salinity species and will also be effected with salinity change. The same goes for white tupa (crab) and Kaldoni crab (mud crab (<i>Scylla serata</i>), the sock of this two cabs have diminished and the fishery has been lost. Other benthic invertebrate present are Serowok shell and two bivalve species but these need to be assessed and correctly identified. Birdlife include wild duck species that nest in the grass growing on the periphery of the lake but when the grass were lost to grazing, the wild duck no longer nest here, and there are report of these wild duck nesting in their gardens and bring their chicks to the lake to swim. Falcon and hawk also depend on the lake for feeding but are not visiting anymore because of current condition of the lake.
<i>Coastal rocky shore fishery</i>	Coral reef is naturally limited or absent at south Epi and Nalema so shallow water marine Biodiversity is limited to species adapted to rocky shore habitat system around Nalema coastline. The fishes of rocky shores are limited to some species of the following reef fish families including Acanthuridae – unicorn fish and the surgeonfish, Carangidae/Jacks, Haemulidae/sweetlips, Kyposidae/drummer, Lethrinidae/bream and red mouth, and Lutjanidae/reef snapper. The survey team did not undertake detail data collection on reef fishes found in Nalema and especially species associated with rocky shores and this will be the target for the fisheries monitoring program (TAILS). Green Limpert and Lapas (kai and tuaoa) are the main shellfishes of black stones and is harvested for food and for sale but its stock is subject to the condition of its habitat. Other inverts include sea urchin, bigeye (purea), <i>Tectus pyramis</i> (simiri) and sisa or nasisa. Assessment of these species is also needed to take stock of diversity of these species better for monitoring purposes.
<i>Small pelagic fishery</i>	The small pelagic fish found here are bonito, rainbow runner, scad, trevally, flying fish and bone fish. These are untapped resources waiting to be explored and developed as alternative fishery for Nalema community. Flying fish fishery exist is a popular fishery in Futuna Island and the know-how can be accessed locally. Inshore FAD development is key to aggregate fish to improve catchability.
<i>Tuna and tuna-like fishes</i>	The surrounding deep water around Nalema provide good fishing ground for troll fishery for tuna and tuna like fishes close by to the shore. The fishing method is h high fule consumption which can be expensive and FAD development is key to aggregate fish to improve catchability and reduce fuel cost. Development of several FAD in the area including offshore and inshore FADs and associated training on fishing technique.

<i>Deep bottom fishery</i>	South Epi is a rich fishing ground for deep bottom fishery, several species of the Lutjanidae family are present and caught here by the deep bottom fishing boats. However it is estimated that current effort is modest and the stock is untapped. Bait availability and accessible market remain a challenge. High preference to sell catch in the village at 500vt kilo with fuel supply instead of running to the market but this depend on private sector interest. FAD development and flying fish fishery development are needed to Improve bait availability to support poulet fishing.
----------------------------	---

3.2.2 Fisheries development

<i>History of fisheries activities in Nalema</i>	At the beginning when the people of Lupalea Village on Tongoa started to settle at Nalema, lake fishing was more important for bonefish and mullet and mud-crab or Caledonia crab. Fish would be baked in leaves and crab would be boiled and transported to Tongoa by ship or canoe and given as gift for people to eat. Bonefish and mullet would be caught by net and addition gears such as fishing line and spearfishing for bonefish. Catches at those days were larger adult fishes and same as mud-crab. At those days there are no tilapia and the lake was totally closed off from the ocean by there is saltwater seepages beneath the rock wall. Then later after Independence the community fundraise by selling cane rope harvested from Nalema and purchased their first fishing boat called Daio, a wooden Hartley bat built by Fisheries Boat Yard in Santo. The community set up their first fishing project called Daio Fishing Project and was fishing around Nalema and Tongoa and selling fish in Tongoa but they face challenge of shortage of fuel and long distance in getting the fish to the market which is very costly to them. Around year 2005 to round 2013, a private fishing boat owned by the Au Bon Marche Super Market in Vila (Lady Christina). The company provided free fuel and free ice to the fishers and in return purchased all fish (poulet and tuna) at 500vt per kilo. This was the best arrangement they made because the 500vt per kilo price, is a good money for them and they do not need to look for the market, fuel and ice and they longed for the similar arrangement today.
<i>Fishers Association</i>	Nalema Fishermen Association was established much later but was not effective until in 2016 the association was strengthened through the support of TC Pam recovery assistance from the KFW project and VFD.
<i>Registered Fishing boat</i>	Four fishing boat are licensed to fish with 2023 and 2024 fishing license since January 2024. Two boats are aluminium and 2 fibreglass all private owned boats. These boats also provide taxi services to Tongoa, within Epi and to Vila to supplement their income. These boat owners have gone through some training offered by VFD but would require another training by VFD.
<i>Fish market centre and deep freezer</i>	NFA now own a storage facility with two solar deep freezers which are in good condition and some eskys. NFA is buying and selling fish in the Village, also renting out use of the freezers for keeping of fish and selling fish in Nalema and other villages of South Epi, Tongoa and in Vila. NFA members are faced lack of bait and have been requesting for a FAD to assist with baitfish supply but there no FAD yet to date.

	Price for poulet in the village is 500vt kilo, Morua is 600vt kilo and in Vila is 1500vt kilo and reef fish is lower 300vt kilo and wahoo and tuna is 600vt kilo. Community prefer to sell thief fish to a buyer in the village as oppose to taking their catch to the market in Morua or Vila.
<i>Canoe fishing</i>	4 wooden canoe actively fishing and selling their catch to the Association or to the Promote wooden canoe fishing for small pelagic and upgrade to fiberglass canoe. Run trial canoe fishing for small pelagic and flying fishing and see support for two fibreglass canoe. Now that the anchorage is save in the lagoon, fibre glass canoe can be used here.
<i>FAD development</i>	There is No FAD deployed in Nalema and fisheries are using the one deployed at Taolia and another one at north of Nalema between Epi and Laika island but these are too far out and Fishers express their need for two or three FADs in the area to improve their production.
<i>Safe anchorage for boats</i>	The challenge for safe anchorage has been solved with wider and deeper opening of the entrance by the recent flooding, Boat can now move easy into the lagoon for anchorage. It is not known for how long this will last but the community has longed for a save passage for many years and now they have it should be kept this way.
<i>New fisheries interest</i>	Two resources present potential for new fisheries at Nalema, recreational fishery for bonefish inside the lake and flying fish fishery in the surrounding coast. Recreational fishery for bonefish is popular in Cook Islands, Kiribati and other places in the Pacific Islands and have become successful for tourists. Fisheries Department to assist with trial fishing for bonefish fishery for creation of recreational fishery to develop ecotourism at Nalema. Flying fish is important source f food security and for baitfish, Vanuatu Fisheries can assist with training of fishers to catch flying fish. VFD to seek technical support for these trials from SPC.
<i>Lake fishing for Tilapia fish or Namu</i>	Tilapia mossambicus once thrived in Nalema lake since it was introduced in the 1980s and that time it was considered unclean for food. When native fish diminished, the community rely on tilapia but the resources had disappeared from the main Nalema lake most likely because of rise in salinity due to improving circulation of ocean water. Fishing for Tilapia is done by women and school children and they indicated tilapia catch had greatly diminished and they now can only catch 10 to 20 fish per fishing trip today compared to over 100s in the past. The community wish is for Tilapia to disappear so that other species can thrive.

3.2.3 Fisheries monitoring, management and conservation

<i>Monitoring of fisheries through catch record</i>	There is no monitoring of fish catch at Nalema and catch data recording is not being recorded and there is lack of fish catch data at the moment for all fishing activities. Right from before since they settle here, fishing activities were happening but there is no record of catch, and information available today is based on local knowledge.
<i>Management bonefish fishery</i>	The community use to close bonefish fishing but this is temporary around 12 months. Harvest would be allowed and there are no catch limit or size limit management. All fish

	sizes are kept for food, this is the same for mullet and any other finfish species caught in the lake.
<i>Lake Nalema Management</i>	Lake Nalema ecosystem support many marine resources and an important source of protein security for the community of Nalema for many years. However, lack of management and protection of the lake ecosystem from forest clearing, grazing overfishing has contributed to the degradation of the lake and loss of fisheries resources.
<i>Tabu Area on the coastal areas</i>	There are not tabu areas set aside for management or preservation of fish stock. Recently two sites were identified for community marine protected area when VFD team visited in 2020 but these MPAs are still in discussion stage.
<i>Marine tenure system</i>	Lake Nalema and Kambioko Island is owned by a few chiefs but the Paramount chief traditionally have overall say over its management. With the current poor state of the lake, the chief already gave his support for the CCA.
<i>Poaching activities</i>	Fishing in Nalema in the lake and outside the reef is open access and there is no poaching activities. Community respect any tabu placed by the community on the Lake or species.
<i>SDA Church believe</i>	Certain animals such as mudcrab (Kaldonia crab) and crabs and lobsters are considered unclean by SDA church believes. Mud crab was plentiful in the lake and it was a common bycatch of gill netting for bonefish and mullet, fishers would be angry seeing these crabs on the net and would discard them by smashing the crabs onto rocks to die in an effort to lake off these unclean animals out of the lake and not seeing them again. The same was done on Tilapia as it is considered unclean for human consumption. It too would be caught in mass and discarded to die. The scripture below outlined the connection to their believe; <i>The biblical clean and unclean food laws (Gen 7:2, 8; 8:20; Lev 11:1–23, 41–47; 20:25–26; Deut 12:15–16; 14:1–21) are built on the following regulations: (1) clean land animals are those who chew and have a split hoofs; (2) unclean birds are only enumerated which means that birds of prey are forbidden to be eaten; (3) fish with scales and fins are permitted for human consumption; (4) all swarmer (including sea food like crabs or oysters) and insects are in the forbidden category except for four kinds of locusts (Lev 11:22).</i> The following animals and plants found in Nalema therefore would be considered unclean and as such would be accorded less care and attention: All land crabs, mud-crab, and Hermit crab. Lobster and fresh water prawn, Shellfish and limpet and urchins and others, Octopus, squid and candlefish, Stingray and sharks, Eelfish (freshwater and marine), Wild duck and Wedgetail shear water, Pig, Flying fox, Kava drinking, Tilapia mossambicus

Table 2. List of marine resources of importance to Nalema community, South Epi

Group	Language Name	Bishlama Name	Common trade Name	Scientific Name
Crustaceans	Eeu	Kokonat krab	Coconut crab	<i>Birgus latro</i>
Crustaceans	Tupa tau	Lan crab (mangrove)	Land crab	<i>Cardisoma spp</i>

Crustaceans	Tupa loa	Lan crab (mangrove)	Land crab	<i>Cardisoma spp</i>
Crustaceans	Rakuma	Land crab (dry lan)	Land crab	<i>Cardisoma spp</i>
Crustaceans	Ura	Lobsta	Lobster	<i>Panulurus spp</i>
Crustaceans	Katou	Nakato	Hermit crab	<i>Coebita spp</i>
Crustaceans	Kafe	Green crab	Swift footed rock crab	<i>Grapsus spp</i>
Crustaceans	Rakuma ni elau	Solwota krab	Reef crab	<i>Carpilus spp</i>
Crustaceans	Rakuma naleba	sofmad krab	Mud crab	<i>Sucella serata</i>
Finfish	Blak piko	Black piko	Rabbitfish	<i>Acanthurus spp</i>
Finfish	Blak tuna	Black tuna	unicorn	<i>Naso sp</i>
Finfish	Pocket naef	Pocket knife	Surgeonfish	<i>Acanthurus sp</i>
Finfish	Malakesa	Blue fis	Parrotfish	<i>Cloronus spp</i>
Finfish	Bunfish	Bunfis	bonefish	<i>Albula vulpes</i>
Finfish	Redmount	Brim	bream	<i>Abramis brama</i>
Finfish	Paruparu	Coral trout	Grouper	<i>Epinephelus spp</i>
Finfish	Paruparu	Deep sea loch	Grouper	<i>Epinephelus spp</i>
Finfish	Naikariri	Flaenfis	Flying fish	<i>Cypselurus naresii</i>
Finfish	Foika	Karong	Trevally	<i>Carangoides spp</i>
Finfish	Redmaot	Redmaot	Bream	<i>Luthrinus spp</i>
Finfish	Mahimahi	Mahimahi/kingfish	Mahimahi	<i>Coryphaena hippurus</i>
Finfish	Nafuma	Mangru	Scad makerel	<i>Decapterus macarellus</i>
Finfish	Malete	Malet	Mullet	<i>Mugillidae</i>
Finfish	wisketfis	Mustasfis	goatfish	<i>Parupeneus spp</i>
Finfish	Piko	Renbo piko	rabbitfish	<i>Acanthurus lineatus</i>
Finfish	Natai	Redpulet	Snapper	<i>Sargocentron spp</i>
Finfish	Naika nasakau	RiffFish	Asorted reef fish	<i>Reeffish species</i>
Finfish	Natai namorua	Deep sea snapper	Snapper	<i>Lujanidae</i>
Finfish	Tuna	Tuna like species	Tuna	<i>Thunnus albacares</i>
Finfish	Wahu	Wahu	Wahoo	<i>Acanthocybium solanders</i>
Finfish	Wahu	Wahu	Spanish mackerel	<i>Scomberomorini</i>
Finfish	Natai tare	Waet pule	Snapper	<i>Sargocentron spp</i>
Finfish	Natai miala	Red pule	Snapper	<i>Lutjanidae</i>
Finfish	Sokararua	Barakuda	Barracuda	<i>Sphyrna spp</i>
Mammal	Puloki natasi	Cowfish	Dugong	<i>Dugongidae</i>
Reptile	Fonu	Total	Turtle	<i>Chelonia mydas</i>
Reptile	Fonu	Total	Turtle	<i>Eretmochelis imbricata</i>
Shellfish	Siisa	Nasisa	Nerita	<i>Nerita polita</i>
Shellfish	Karau	Natalae	Giant clam	<i>Tridacna spp</i>
Shellfish	Painga kiki	Konshell	Cone shell	<i>Conus spp</i>
Cephalopods	Wita	Nawita	Octopus	<i>Octopus spp</i>
Cephalopods	Wita dule	Squid	Reef squid	<i>Sepioteuthis spp</i>
Shellfish	Painga	Pupusel	Triton shell	<i>Charonia tritonis</i>
Shellfish	Serowok	Serowok	Telescopium	<i>Terebra</i>
Shellfish	Kai	Shellfish	Limpet	<i>Lottia sp</i>
Shellfish	Tuaoa	Shellfish	Limpet	<i>Lottia sp</i>

Shellfish	Simiri	shellfish	Tectus	<i>Tectus pyramis</i>
Shellfish	Purea	Bikeye	Turban snail	<i>Turbo spp</i>
Urchin	Riwota	Urchin	Sea Urchin	<i>Heterocentrotus spp</i>
Shark	Pakoa	Shark	Shark	<i>Carcharhinidae/</i> <i>sphyrnidae</i>

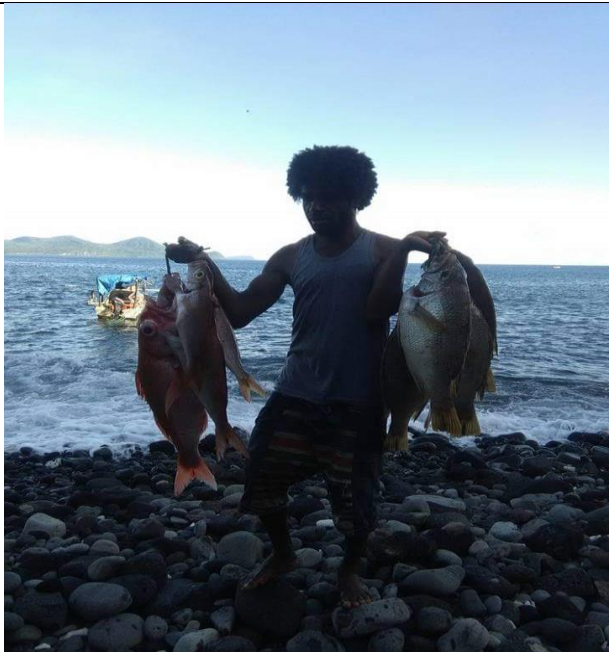
	
Deep bottom catch of poulet fish from Nalema area. Photo:	Two bonefish species (small scale bonefish-<i>Albula aligolepis</i> (top) and <i>Albula sp</i> (bottom) from – Phoro: Reuben Douglas
	
Largest <i>Tilapia mossambicus</i> female caught in Nalema lake Jan 2024 (note unidentified damage on the eye)	<i>Tilapia</i> fishing for food security (Pic Kalo M Pakoa) Jan 2024

Figure 6. Fishing activities at Nalema

3.3. ENVIRONMENTAL MANAGEMENT AND CONSERVATION

3.3.1 Nalema Lake ecosystem condition

<i>History of Terrestrial management activities</i>	There is no record of past plans and animal management at Nalema. There are reports of plentiful flying foxes and Nawimpa at surrounding forest including Kambioko Island. During our visit to this island we encounter Nawimba, flying fox and wild fowl but we saw no sign of koroliko and below the forest was clear of the understory forest and shrub trees an indication of goat damage in the past when the island was a goat grazing area for the people of Nalema. Koroliko bird colony would not survive with animals such as goat, pig or dogs. There is also a location north of the village on the hill known for the aggregation of flying fox during a time when they develop red eyes and become flightless and come very low to the ground. This phenomenon is not well known but some islander relate this to behaviour of animals to a upcoming tropical cyclone.
<i>Deforestation - settlement and coconut plantation</i>	Deforestation activities around the lake started when the village was developed in the 1970s. The village was first set up beside Lake Nalema and the surround forest was cleared for gardening and coconut plantation all the way inland and there are no buffer zoning around the lake. Then in around year 2000 the community initiated building of a aircraft runway on the side of the lake to allow Doctor Mark to visit them and provide medical treatment. This resulted in major clearing of mangroves and trees along the northern fringe of the lake for the landing strip. These disturbances have caused significant disturbance of the lake to reduce in size and become shallower. Removal of vegetation and larger trees around the lake led to drying of the soft bottom habitat from hot sun causing mortality of species and the substrate become hardened and un inhabitable by benthic species.
<i>Cattle grazing</i>	The people of Lupalea village in Tongoa and Nalema are cattle grazers. Cattle grazing started in the 1980s after around 10 years of settlement at Nalema when coconut plantations become matures. The whole areas was fenced off for the community coconut plantation and cattle ranch. As there is no fencing of the lake, cattle grazing go right to the lake. The community own some 400 heads of cattle which use to soled life to commercial farmers for fattening in Vila before sale. This had stopped when the cattle quality dropped in the years 2000 to present.
<i>Flooding</i>	Flooding was minimal in the past when the upland forest was still intact. Now that cattle ranch had taken over the flood plain, farming is taking place on the hills behind and causing increase run off and more regular flooding. The original village near the lake was flooded sometimes in the 1980s and the community was relocated to the hill at the west of the lake which is the present location of the village.
<i>Boat landing and Opening of the channel</i>	Safe anchorage was the main difficulty for the community. In the past Nalema lake was closed off by the rock wall and there are only two landing in front of the village and at Kambioko but they are not safe, one in front of the village is always rough and the one at Kambioko was sis sheltered but very far from the village. Villagers had to walk across the long stone wall to the village. Later when the stone wall open from flooding, boat started to move into the lagoon but this opening depend on waves and flooding to open or close the passage. Until recently flooding from TC Lola opened up the passaged widely and deeper providing for the first time safe anchorage inside the lagoon. Boat can now move easy into the lagoon for safe anchorage. It is not known for how long this will last

	but the community has longed for a save passage for many years and now they have it the chief and the people desire to keep it this way.
<i>Mangrove replanting</i>	Attempt to replant mangroves was initiated by the village and some mangrove trees were already planted and growing well. During the visit in 2020 one of the mangrove had established and growing well and another 10 seedlings recently planted and growing well (Figure 5). This time round during the visit this year (2024), these young mangrove trees have disappeared or damaged by the recent flooding.
<i>Sand mining</i>	Nalema is known for its black volcanic rock boulders and its black sand beach is limited in front of the village and at Kambioko and is mined for construction of local housing and community buildings and school. River sand and gravel deposit is also available such as deposit from the recent flood but this has to be used or saved quickly before it turns into soil. Most houses in the village are corrugated iron and timber and demand for sand and gravel is low but this will increase following population increase.

3.3.2 Upland Environment and Biodiversity

<i>Nawimba</i>	Yes - sighted at Kambioko Island forest and along the hills surrounding the coconut plantation, need to undertake Birdlife surveys to collect baseline information.
<i>Flying fox</i>	Yes - sighting at Kambioko Island and along the hills surrounding the coconut plantation. According to the Chief Maroro (Personal communication Nov 2023), there is a special site on the hill north of Nalema, is where flying fox came to rest for up to a month, it is known that flying foxes become sick of red eye and could not fly. This phenomenon also report on Laika and Tevala islands but is not well known. It could be related to reaction of incoming cyclone. Assessment of the aggregation is needed to ascertain the behaviour.
Wild duck	Yes – an unknown species of wild duck live in the lake but is not properly identified. The wild duck nest in the grassland in front of the lake towards the village and also at Nagisu Namenau at south West of the village. Species of the grass is unknown and duck population is rarely seen in the lake following it habitat loss, it has been reported to nest in gardens upland and occasionally bring its chicks to the lake to bath.
<i>Wild fowl</i>	Yes – present ay Kambioko hill and surrounding hills
<i>Parrot types</i>	Yes, but no sign of it during our visit and no sign of feeding of fruit trees such as nadao (local lechee).
<i>Koroliko (WTSW)</i>	There was report of Wedge tailed shearwater (Koroliko) nesting at Kambioko hill but are unsure if the colony is still there. We visited the hill but it has been a goat grazing area since the 1990s. Goat population was thieving but for some reason the started to die until the population diminished. Remaining signs of goat grazing on the understory forest remains showed the bird colony would not have survived. Now cattle grazing continue about halfway up the hill.

<i>Community Conservation Area</i>	There are no existing community conservation area or Marine protected area at Nalema and the community receive no advice or support on environmental management and conservation. Recently forestry Department conducted forest assessment in Nalema area but that is a research work and there is not awareness on forest management. The community is aware of the need to protect their environment and will agree with external support to set aside the lake and surrounding land to become a protected area under the DEPC Community Conservation Area.
---	--



Mangrove deforestation and cattle grazing,



Mangrove replanting, photo dated May 2020



Larger mangrove tree standing (distant) while young trees lost by recent flooding - prove established mangrove replanting can effectively rehabilitate the lake ecosystem. Photo: Kalo M Pakoa Jan 2024

Figure 7. Present condition of Lake Nalema, South Epi

3.4. AGRICULTURE, FORESTRY, LIVESTOCK AND BIOSECURITY

3.4.1 Agriculture sector

<i>Important crops for food security</i>	Water taro, yam, bananas, kumala, Island cabbage, water melon and coconut. Flooding such as the one experienced recently (cyclone Lola) destroyed their gardens causing shortage. Farming away from flood plain or farming of perennial crops outside cyclone season Farming of long term crops in higher grounds.
<i>Farming system and improvement</i>	Subsistence farming and shifting cultivation remain a norm, there is no training on improved farming system on slope land. Need for training on improved farming techniques in upland areas
<i>Copra production</i>	Copra is a traditional cash crops but low copra price had discourage production and their plantation is lettered with dry coconut. The community is looking forward for Government to improve copra price so that can produce copra. They can also assess opportunity for virgin coconut oil production and sale of dry coconut to Vila market.
<i>Cocoa</i>	Cocoa price had risen again and cocoa production will resume. Improve cocoa farms and harvest and expand new farms if there is sufficient space.
<i>Kava</i>	A few kava farmers in Nalema, since they are non-kava drinkers, they should make good commercial kava farm on slope areas as supplement to vegetable farming on the flood plain.
<i>Vanilla</i>	This is a new crop, a single vanilla farmer is active at Nalema and Epi island as a whole A vanilla farming workshop is being organised by TVET Centre to take place at Nalema for the first time hope of attracting new farmers of Epi and shepherds and sponsored. Encourage vanilla and paper farming away from flood prone areas.
<i>Farmland space</i>	Much of Nalema flood plain is taken up by coconut plantation and cattle ranching. Farmland is at the periphery of the ranch to the hillsides and within the cattle ranch for

	vegetables, altogether there is enough land for farming. Improve farming practices on slopes
--	--

3.4.2 Forestry sector

<i>Forestry Project support:</i>	No forestry projects in the area, the Red Plus forest assessment also cover Nalema area but that's all they know of government support. Need forest assessment and nursery development.
<i>Native forest resources:</i>	Some native forest resources being harvested for timber including whitewood, natavoa, bluewota and some hardwood trees and they is a need for forest resource assessment to take stock of valuable forest Need to identify valuable forest resources of Nalema area resources.
<i>Planted forest:</i>	No information on planted forest at Nalema. Need to assess opportunity of setting up nursery for replanting of forested areas around Lake Nalema and other areas.
<i>Mangrove forest:</i>	Lake Nalema mangrove system is degraded with deforestation and cattle grazing. Reforestation is a priority. Replanting of mangrove forest of lake Nalema
<i>Timber production:</i>	20 Chainsaws at Nalema but mostly for family use, some are timber millers but the production is unknown. Need for timber resource assessment for livelihood development need. Need for assessment of timber resources at Nalema area

3.4.3 Livestock sector

<i>Cattle:</i>	Nalema cattle ranch hold some 400 heads of old local breed gone wild from traders they are owned by different households. Live cattle sale to larger cattle owners use to be conducted before where the animals are taken to Port Vila for fattening for sale but this had stopped most probably because of unhealthy stock. A new pasture improvement plot was set up by Livestock Department in 2021 but Pasture improvement and partitioning into paddocks is important to improving production of cattle
<i>Poultry:</i>	Many households have free range chickens for food security and extra for sale. There are over 500 chickens and 4 ducklings at Nalema. Small scale poultry farm for chicken and duck need to be developed for alternative protein source.
<i>Goat:</i>	A total of 30+ remain in Nalem and owned by a few farmers. Goat ranching at Kambioko hill was important in the past but the stock have die out. Loss of understory forest is evident of goat activity in the area. Goat husbandry need to be better controlled as a source of income.

3.4.4 Biosecurity and pests

<i>Taro beetle</i>	Taro beetle is native pests that have been in Epi for many years and it affect Taro tubers and effected the marketability of the produce. Training on biological control of taro beetle is needed from Biosecurity.
<i>Fall armyworm</i>	This dangerous worn was discovered also in Nalema and has affected whole range of crops including leaves of kava, taro, island cabbage and full range of crops. Need for Biosecurity advice on control measurers
<i>CRB</i>	Not a problem in Epi but Effort must continue to be made to prevent it spread out of Efate.
<i>Fire ants</i>	No experience of fire ants yet. Prevent introducing fire ants to the area.
<i>Wild pig damage</i>	Wild pig damage to gardens and taro beetle damage to water taro and yam are of concern and report of the new worm raise major concern and wild fowl damage newly planted crops. Biosecurity advice on pest control using environmentally sound means.
<i>Big leaf fine</i>	Big leaf fine is the main invasive plants in Nalema and South Epi region. Big leaf is a national problem which require national program, it also good for cattle grazing and is not a problem in the native forest areas.

3.4.5 Disaster preparedness and sea level rise

<i>Continuous erosion and changes of coastline</i>	Earthquakes, tropical cyclone and wave actions continually destabilize the steep cliffs of Nalema causing landslides and erosion of the land. Unlike low lying islands, there are no practical mitigation measures to control erosion of cliffs. Nalema flood plain is highly at risk for flood prone, the village was initially build by the lake but was relocated to higher ground after their first experience in the 1980s. Intense flood disaster caused by heavy rain during the cyclone Lola last year caused loss of gardens and food shortages.
<i>Community disaster Committee</i>	CDC is established and has been working disseminate information and advice prior to disaster, assess damages and report to area Council and NDMO, and assist relief supply sharing.
<i>Cyclone shelter</i>	None in the community, use primary school building and church building for shelter during cyclone. Need a disaster shelter.
<i>Land slide</i>	Major Land slide on the northern slopes and flooding damage gardens and fencing and loss of crops. Farming in upland areas during cyclone season.
<i>Drought</i>	Droughts have caused reduced water flow but water supply continue to flow. Wells and tanks provide additional source of drinking water. Water supply line survived the recent flooding and land slide
<i>Sea level rise</i>	Coastal erosion at Wintua is encroaching Wintua airport runway and could worsen in future.

<i>Flooding and sedimentation</i>	Flooding and sedimentation during heavy rain has contributed to the degradation of the Lake ecosystem and causing mass mortality of fish and invertebrates resources. Change in farming practices in upland areas.
<i>Deforestation of mangrove</i>	Deforestation of mangrove and seagrass bed at Lake Nalema has affected quality of the habitat for breeding of certain species, feeding and shelter for juvenile fish and invertebrates. Reforestation of mangrove trees and seagrass is priority.
<i>Diet of people</i>	After disaster and loss of crops, rice become a critical food item in the diet of the people of Nalema. Consumption of rice with locally available greens and fish and meat make a good balance diet.
<i>Safe landing</i>	Safe landing of boat has been an issue for Nalema, the main landings are unsafe and very risky even during calm seas, Lake Nalema provide safe anchorage and there is an entrance in the southern barrier for boat access but this is highly subject to wave action resulting in the closing and opening of the passage. When the passage is blocked, boats have to be lifted and walk over the rocks to the lagoon or waited for high tide to go inside which is a difficult task, sometimes they beached at Kambioko but it is far from the village and not safe. The passage is currently wide open about 10 meters wide and deeper as a result of the recent flooding of Cyclone Lola and is the best condition for boats move in and out of the lagoon for safety. The chief express his happiness of this opening and would like to maintain it for the safety of their boats and people.
<i>Sea level rise</i>	Drought and damage to water supply. Flooding and sedimentation during heavy rain has contributed to the degradation of the Lake ecosystem and causing mass mortality of fish and invertebrates resources. Change in farming practices in upland areas

3.5 INFRASTRUCTURE AND PUBLIC UTILITY SERVICES

3.5.1. Energy sources and lighting

<i>Kerosene</i>	Kerosene has been phased out and no longer sold in the village.
<i>Solar panel</i>	Solar panel and solar lighting is the only source of lighting in the community. Almost all households have small solar panels for phone charging and lighting. Solar is low cost, environmentally save and a better option.
<i>Fuel oil</i>	Shipment of 44 gallon (200L) drums or plastic containers to the island has reduced following the fuel depo development at Panita, Tongoa. The depot supply fuel to south Epi and surrounding islands.
<i>Fuel wood</i>	Fuelwood is the main source of household energy for cooking, heating and boiling water and is sourced from the plentiful forest trees in Nalema.
<i>Sunlight</i>	Sunlight remain the most accessible used energy for drying cloths, drying of pandanas, peanut, cocoa, and sometimes copra.

3.5.2 Water supply sources (WASH)

<i>Water supply by gravity</i>	Nalema is rich in fresh water sourced from the upland stream by gravity pull providing accessible fresh water supply for the communities. The pressure of the water is so much that all households in the village, schools have access to water. High pressure often causes damage to the piping, as such much of the water is used to feed cattle and much of it flow into the ground. Need to open the outlet to relief pressure and lessen risk of damage to pipes.
<i>Water committee</i>	There is a water committee in the village but the committee experience the same difficulty with collecting water fees. Each household is charged VT 150 per months but water users have not been paying their monthly fees and the water committee lack the funds to maintain water supply piping. Water source is unprotected and intrusion by wild animals such as pigs and cattle is a common incident affecting water quality. To be strengthened to collect water fees to fund maintenance costs.
<i>Water supply issues</i>	Unprotected source present water quality issues, high pressure is a problem causing damages to the piping, human damage was experience in the past but is no longer an issue today, pipes often blocked by dirt, and ineffective water committee. Effective water committee and fee collection to fund maintenance cost.
<i>Rain water tank</i>	2 rain water catchment tanks and 4 wells in the village for drinking, a tank for school and another for community, the wells are private but shared by family members. Prior to the water supply development, these catchment tanks provide the only means for drinkable water. Maintained for alternative drinking water in cases of contamination of main water supply
<i>Changing rainfall</i>	More rain nowadays and more heavy than in the past for instance the heavy rain during cyclone Lola caused major flooding of the flood plain in Nalema causing disaster on gardens.
<i>Water shortage</i>	Water shortage is not an issue anymore but low water flow is noticed during droughts. Water catchment tanks must be maintained for dry times.

3.5.3 Sanitation and waste management

<i>Toilet</i>	Pit toilet and VIP are popular but the village water committee had resolve to move to VIP for all household by this year. In addition there are 2 water seal toiled and there is still no flash toilet but there is potential for this with good water supply pipe. Move to Water Sea and flash toilet with good water supply
<i>Hand washing</i>	Hand washing was effective only during COVID 19 period, although community encourage everyone to continue hand washing. Encouraged to continue
<i>Solid waste disposal</i>	A few solid waste pits for some households and the sanitation committee encourage every household to have its own solid waste pit. Complete household pits

3.5.4 Infrastructure, shipping and airport

<i>Road and vehicles</i>	Nalema is not accessible by road and no vehicles in the area. Footpaths are popular linking villages and settlement up to Fila Kara Village. Road to be developed from Vilakara to Nalema
<i>Boats transport</i>	Banana (fibreglass and aluminium) boat is the main form of transport in Nalema in Epi, Tongoa and to Port Vila since COVID 19 lock down disruption of shipping and air Vanuatu services. Travel and movement of cargo by small boats is becoming common.
<i>Boat anchorage</i>	Boat anchorage is a challenge, the opening of the southern stone wall provide a good entrance into the lake for safe anchorage of boats.
<i>Interisland Shipping services</i>	Nalema receive weekly shipping services to Port Vila with two to three vessels visits, three ships make weekly visits to Tongoa and Epi, the shipping services is sufficient to service the community.
<i>Safe anchorage</i>	Entrance to the lake is wide enough for boat entry and should be maintain as the main safe encourage passage for boats.
<i>Airport</i>	Valesdir airport is the airport for South Epi but is far costly, the nearest airport is in Tongoa which is half an hour away for medical evacuation. The new Tomali airport is still under construction and the Nalema airfield servicing Dr Mark'splane is unsafe and has been closed safety concern according to the chief. Tomali airport to be completed and Nalema airstrip development to be abundant.

3.5.5 Telecommunication and radio services

<i>Radio</i>	Radio use is unpopular with only 4 radios in the village, popularity of mobile phones and poor radio reception has been the main cause of uptake of radio services. VBTC to improve its shortwave reception to rural areas
<i>Mobile phone</i>	Mobile phone services is available for both mobile telephone network and is the main source of communication through talking, text messaging, email, messenger and Facebook. Daily news of radio Vanuatu and daily post is received via mobile phones through online Radio, facebook news update and daily post news on line.
<i>Snail mail letters</i>	Snail mail and sending of cash in envelope by snail mail is no longer popular today, it is still used when sending money by hand delivery.
<i>Telephone reception</i>	Telephone reception for both service providers are good in Nalema giving the community choices of communication.

3.5.6 Education and Health services

<i>Nalema Primary school and pre-school</i>	Nalema Primary school and pre-school is the only school with 50 students this year up to class 6. School leavers progress to Port Quimie and Nabangasale Junior Secondary School on Tongoa for their secondary education. Port Quimie and Napangasale Junior Secondary receive intake from Nalema for year 7. There are no students University & technical school at lease for the moment
<i>Aid Post</i>	Nalema Aid Post is manned by a staff from the community and help patients for mild sickness and injuries and facilitate referrals for serious illness and maternity patients to dispensary and Silimaui Health Centre on Tongoa or to Vila Central Hospital for serious cases. Costs for transport of patients is born by families. Aid at the time of the visit, the Aid Post is currently short of medicine supplies and waiting for its nest shipment to arrive in the first quarter of 2024.
<i>Dispensary</i>	The Dispensary is at Taolia village.
<i>Doctor Pilot (Doctor Mark)</i>	Dr Mark's service was received for a short period early 2002 and found to be useful where many illness including dentist services was delivered in the village but this services stopped because the temporary airstrip condition was unsafe for landing. The airstrip is currently closed and since the deforestation of mangrove for the runway had affected the lake, the chief had informed this landing strip will be closed for the replanting of trees in the area.
<i>Medical evacuation</i>	Medical evacuation is either from Valesdir and Tongoa airports but more ace to Tongoa for Nalema residents for close proximity. Private Boats are used to move patients to the Clinic and Silimaui Health Centre and medical evacuation. Currently medical evacuation costs is met by patients themselves. Subsidy to be provided for Health workers to travel cost for patients.

3.5.7 Business activities

<i>Copra market</i>	Copra is one of the main commodity produced in Nalema coconut plantation but the low price issue makes is unviable for production. Recent cyclone and flooding had also damage their copra drier and swept away many nuts into the ocean. Copra cutting also help to clean up the plantation for cattle ranching and community hope price will improve.
<i>Fish market</i>	A small fish market donated by KFW project as part of the TC Pam is run by the Nalema fishing association with 2 freezers for storage and marketing of fish in the village and export to Vila market. Need support for a few more storage facility but government to look into providing a bigger vessel to purchase fish from fishers in the village so that they do not need to get their fish to Port Vila.
<i>Livestock sale</i>	Cows are regularly sold on Epi and on Tongoa during feasts Need to improve pasture to fatten up the animal
<i>Boat transport services</i>	Four fishing boats that feed the market, fish is sold at Morua market and in Vila. These boats also fish and shellfish, fare to Tongoa is 8000vt per way.

Retail store	4 retail store and 1 cooperative store active in the village
Women's bazar	Women's bazar is undertaken on Tuesdays and Thursdays. Good income activity in the village, need to be continued
Solar deep freezers	2 donated by VFD (KFW project)
Bakery and doughnut	1 bakery and several donate cooking
Root crop sale	By ship to Vila and mostly at Marobe Market
Cacao market	Cacao beans are sold in Vila and Santo but farmers are yet to start harvest
Guest Houses	Women's building is often used as a guest house Proper guest house needed to be developed
Fuel retailer	3 x fuel retailer in the village, they buy fuel in drums or plastic containers and resold in the village.
Banking Services	NBV branch at Morua, Tongoa is the closest banking service accessed more regularly by South Epi residents. Banking service need to be opened in South Epi.

4.0 RESULTS OF BASELINE ASSESSMENT FOR TOMMAN ISLAND

4.1 Tomman Island community Governance

4.1.1 Community Setting

Tomman Island is an offshore Island at South West Malekula with a single village located on the north East coast. The old village is on the North Western side of the Island but relocated to the present locality following devastation by tidal flooding during a past tropical cyclone which destroyed the village. The current location of the village on the northeast side of the island is sheltered and with higher ground about 50m inland for safety during wave surges. A settlement of few families were in the old village until most of the families moved to the main village to take advantage of the economic activity such as small business and for easy access to the mainland for services.

The mainland areas opposite the island are Batbang Bay and Melip Bay to the North east of the island (Figure 3). Tomman Island is one of the 24 communities in the South West Malekula Area Council and has a population of more than 314 people. The South West Malekula Area Council has the biggest geographic area in Malampa Province. The economy of Tomman Island is based on copra, cocoa, fish, kava and root crops but shipment to the market remain a challenge. The rest of the island is used for gardening and the community source its food resources mainly from the island.

4.1.2 Community Meetings

A follow-up meetings was held at the meeting hall in Toman Island on the 11th December 2023. This is the second consultation visit of the project, the first meeting was held in 2020 by VFD team. A meeting was held at the village Nakamal with everyone present including 17 men, 10 women and 5 youths. Additional meetings were held chairman's of the various committees. And followed by Other one on wan meetings were held with various committee chairpersons. The main meeting was held at the community hall followed by several small

meetings with various committee including: Church Committee, Health Committee, School Committee, Business committee, Bungalow committee, Women committee, Water committee, Community Disaster Committee, Youth Committee, Wan Smol Bag monitor.

4.1.3 Population

Tomman Islanders are the original tribe of the island by history and they have lived on this island for generations until today. They currently hold the last remaining skull of the original tribe of the area known as the long head tribe, this skull was kept in a museum in the United States until last in July 2023 the skull was returned to the island with the help of the Cultural Centre and re-buried in the old village on the Este coast of the island. The current population of Tomman Island stands at 315 people altogether with 187 male and 128 female in 76 households. The number of disable people in the community stands at 25 including asthmatic patients. This population is for both Tomman Island and the mainland together.

4.1.4 Chiefly Governance

The community is further divided into 7 stations by families for better management of village responsibilities and activities according to the chief. For instance when building the community hall, each station have their days to work while other station members would attend to their household activities because all activities in the village are important to the life of the people. These sub-family stations are: Worles station, Kirobeneng station, Vunhaiham station, Lenbunmalan station, Lenbunbao station, Vatbuhang station, Yamhoran station. Chiefly governance is active with weekly meetings organized on Tuesdays. Extra meetings can be arranged in any other days of the week to discuss urgent matters of importance to the community that are brought to the attention of the Chief. Voluntary activities are organised by families such as building of holiday beach huts for family get together at Christmas and New Year. In regard to disputes, there exist disputes over customary land only but there are no chiefly title disputes because we do not have chiefly titles in Tomman Island custom governance system. One dispute involving the high Chief of the village has gone as far as the Supreme Court involving custom boundary of his tribal land on the mainland. While these disputes exists, they are peaceful and the community remain united.

4.1.5 Province and local Government

Tomman Island is within the South West Malekula Area Council, the largest Area Council in Malekula in terms of area and its main center is at Wintua. The SWAC office is staffed by an Area Administration officer and an Assistant Officer and an annual budget but is limited to visit every communities annually. Other government officers include one Agriculture Field Assistant, two nurses, teachers of Wintua School and the Air Vanuatu Airline Agent. The Area council's main function is to facilitate government services and support to communities and vice versa for government requests. There are in total 859 households in the area Council, more than 50% of these households plant and sell kava as their main source of income.

Road infrastructure is accessible in only six villages starting from Lawa to Wintua. Other isolated communities such as Tomman Island use boat transport to travel and transport their agricultural produce. South West Bay Airport is located on Wintua Village and is the main airport used in the area for air travel to other islands. There are 5 primary schools including Tomman island school, 1 junior secondary school and 1 rural training centre within South West Malekula. The only health centre is located on Wintua and is the main referral health centre for the two dispensaries and five Aid Posts within the area. South West Malekula Area Council Headquarter has its building on Wintua Village, including Police Post, Department of Livestock and Department of Agriculture.

4.1.6 Church Governance and non-Sate actors

Four denominations present in Tomman Island namely: Presbyterian, Seven Day Adventist (SDA), Christ Church, CMC and Pentecostal Church. Presbyterian and All the churches have their separate church buildings and aside from SDA, all other Churches worship on Sundays. Presbyterian is the first Church established on the island and have the biggest congregation than the other newer churches. These churches have their separate church committees and separate women committees namely – PWMU for Presbyterian, DOCAS for SDA and Ladies Ministry for Pentecostal Church. All five church groups cooperate well with each in the community and there are no reports of issues or conflicts amongst groupings.

There are no NGO personnels working and living in the community but there are NGO reps who come in and out to work with the community include Adventist Development and Relief Agency (ADRA), Japanese International Cooperation Agency (JICA) and Wan Smol Bag Theater. Both ADRA and JICA provided advice on water supply, JICA for development of proposed desalination plan and ADRA for water tanks and underground well and WSB on the turtle and marine resource management.

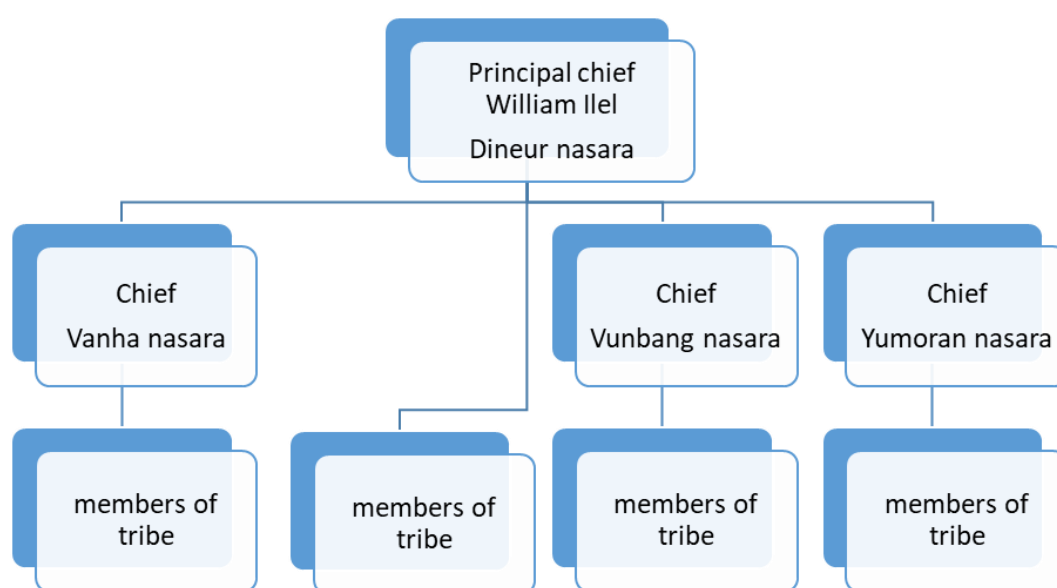


Figure 8. Chiefly Governance of Tomman Island community

4.1.7 Tomman Island Community Development committees

Compared to Nalema, Tomman is a much larger community and better organized with more community development committees to support the Village Council and the Chief as detailed. Effectiveness of these committees vary depending on services from corresponding government agencies, development partners and non-government partners.

<i>Women group</i>	Tomman Island Women's Committee - umbrella committee for women and 3 church committees - PWMU, Docas and Ladies Ministry. Umbrella Committee organize various trainings to empower women in business, hygiene, cooking, and weaving and marketing of products.
<i>Health Committee</i>	In charge of Aid post operation, organize staff house and oversee village sanitation activities such as toilet upgrade, hand washing and solid waste disposal.

<i>Water Committee</i>	2 Committees present, JICA Committee – consultation Desalination project ADRA Committee - Rain water tanks and underground water wells.
<i>School Committee</i>	Running of the school, teachers and students welfare
<i>Community Disaster Committee</i>	No committee yet as a result it has been slow to get disaster report to the Area Administration at Wintua and the community need to create this committee urgently to facilitate any disaster recovery support.
<i>Business Committee</i>	Businesses, pricing and other needs.
<i>Fishers Association Committee</i>	Fisheries development, management and conservation activities.
<i>Disability Committee</i>	Welfare of disable members of the community
<i>Tourism Committee</i>	Tomman island tourism and guest house activities.
<i>Youth Committee</i>	Community youth activities and welfare

	
Majority of houses are local houses	New community hall and evacuation centre
	
Open ground water well- main source of water	Tomman Island primary school & Kingda karten

Figure 9. Tomman Island community infrastructure and services

4.2 Fisheries resources and development

4.2.1 Fisheries Resources

<i>Tomman Island shallow reef fishery resources</i>	Tomman Island is surround is an old Island surrounded by well-developed fringing reef more developed in the north coral reef with reef flat, development boarding the Island and the deep sea beyond the reef slope around the Island. The reef ecosystem is comprised of developed reef and extended deeper reef system which extended toward the mainland in the north and narrow fringing reef around southeast, south and west of the island, reef slope and reef drop off to deep ocean beyond. These systems support reef related biodiversity that support shallow reef finfish and invertebrate resources. The reef system support full diversity of reef species groups like any other reef system in the country however the abundance of resources will not be the same. The full scale of finfish families are present including Acanthuridae – Unicornfish and the Surgeonfish, Jacks, Sweetlips, Drummer, Bream, Red mouth, reef Snapper, Parrotfishes, Grouper, Rabbit fish and full scale of small and large pelagic species.
<i>Invertebrate fishery</i>	Invertebrate include giant clams, sea cucumber, Trochus shell, turban shells and tectus species, urchins and other sea shells. Green snail is a protected species after its stock has been overfished and it is now under protection since 2005. <i>Turbo marmoratus</i> is being recorded to recover in other islands including Masklynnes and Wiawi and Uripiv but is yet to be recorded in west Malekula region. Location of this species in Tomman will confirm the species here. Lobster is also present and is being harvested for export to Port Vila market. Assessment via a marine BIORAP assessment of these species is also needed to take stock of diversity of these species better for monitoring purposes. There is report of coconut crab and land crab present but are never assessed to date to ascertain its population. Humphred parrot and Napoleon wrasse are present but rarely fish nowadays.
<i>Small pelagic fishery</i>	The small pelagic fish found here are bonito, rainbow runner, scads, trevally, flying fish and bone fish. These are untapped resources waiting to be explored and developed as alternative fishery for Tomman Island. Flying fish fishery exist is a popular fishery in Futuna Island and the know-how can be accessed locally. Inshore FAD development is key to aggregate fish to improve catchability.
<i>Tuna and tuna-like fishes</i>	The surrounding deep water around Tomman Island provide good fishing ground for troll fishery for tuna and tuna like fishes close by to the shore and including small pelagic fishes. The fishing method is high fuel consumption which can be expensive and FAD development is key to aggregate fish to improve catchability and reduce fuel cost. Deployment of several FAD in the area including offshore and inshore FADs and associated training on fishing technique.
<i>Deep bottom fishery</i>	Tomman and west Malekula is a rich fishing ground for deep bottom fishery, several species of Lutjanidae and the Serranidae families are present and caught here by the deep bottom fishing boats. However it is estimated that current effort is modest and the stock is untapped. Bait availability and accessible to market remain a challenge. Fishers had high preference to sell their catch in the village without having to go to town to reduce fuel cost and shipment cost with fuel

	supply instead of running to the market but this depend on private sector interest. FAD development and flying fish fishery development are needed to Improve bait availability to support poulet fishing.
<i>Sea Turtles</i>	A few mother turtles have made people come ashore to lay eggs along the northern beaches and through turtle monitor support these turtles were released and the nests also hatched and return to sea.
<i>Sharks</i>	Sharks is a bycatch of deep bottom fishing and troll fishing and often destroy fishing lines and baits which are costly. Shark caught are always kept for it meat which is normally shared in the village.

4.2.2 Fisheries development

<i>History of fisheries activities in Tomman Island</i>	Fishing has always been part of Tomman Island community ever since the islanders inhabit this island. Fish is an important part of the islanders diet for generations and is still is today although would not be the same as in the past. Since Independence until today Tomman island community have not receive any assistance from the Government compare to some other communities who would have the opportunity than the Tomman islanders. A few community members were able to buy boats starting with Hartley boats from Santo Boat yard. They would fish and sell fish at Lawa during the Village Fisheries Development program in the 1980s to 1990s. Privately owned boats are still used but demand is now shift to fibreglass boat. Fishing is now taregeting the market in Vila nowadays.
<i>Fishers Association</i>	There is a Tomman Island Fishermen Association Committee that was set up by the community but is not functioning well because there is no support from the government. The community is interested to receive government support to strengthen the TFA to organise capacity building and support with development activities.
<i>Registered Fishing boat</i>	Four (4) fishing boat are licensed to fish with 2023 and 2024 fishing license since January 2024 and the boats are all fibreglass boats. Another four boats are used only for Taxi services to schools, dispensary, to Wintua for services. The fishing boats transport their fishes to Malvakal for transhipment to Sakau for transhipment to Vila and also to Lakatoro at times and they also provide taxi services to supplement their income from fishing. High fuel cost and limited storage and market are the main challenges for increase production.
<i>Fish market centre and deep freezer</i>	8 x Deep freezers in Tomman Island and they are all private owned mostly for personal use. no community run fish market in Tomman Island but there are several middlemen fish buyers who purchased fish from fishers for export to Vila. These buyers have several solar deep freezers and esky to ship their fish and their sellers in Vila. The buying price of fish in the village is between Vt350 to VT400 kilo and selling price in Vila is from VT1,200-VT1,500vt kilo which is good. Community would prefer to sell thief fish in the village if they have this opportunity because getting to the

	market is a huge challenge – to Lakatoro fish market would cost over 24,000 vt charter by boat and to Sakao, Maskelynes will coast 10 000 vt.
<i>Canoe fishing</i>	Five (5) wooden canoe actively fishing and selling their catch to middlemen buyers. Canoe fishing is good for small pelagic fishing and fiberglass canoe is another option to assess to wooden canoe,
<i>FAD development</i>	No FAD deployed in Tomman Island to date and fishers express their desire for FAD development both for inshore and offshore to improve their production and reduce fuel cost in troll fishing.
<i>Safe anchorage for boats</i>	Tomman Island landing is in front of the island and very safe and there is no problem with landing, it only at the low tide that boat have to be taken out.
<i>New fisheries interest</i>	Flying fish and other small pelagic fishes including scad mackerel, bonito and rainbow runner are an important source of food security and for baitfish. Because they are seasonal stocks which mature quickly and dies out, the fishery must be developed. VFD can assist with training of fishers to catch flying fish and fishing around FAD.

4.2.2 Fisheries monitoring and enforcement

<i>Fish catch Monitoring – TAILS</i>	Two (2) Fisheries Monitors were trained and equipped with Table on the island but are not collecting community fish catch data, VFD will need to work with them to identify their issue and improve their work.
<i>Tabu Area on the coastal areas</i>	Nakamal before any work can begin. There are a few tabu areas set aside after a funeral but these are periodical and often are not effective. Recently Tabu has been placed on an area and is respected but this will last for 12 months only, after that its open access. A long term MPA management will be good for the island and community need to identify this site and propose it to the project.
<i>Marine tenure system</i>	The Land in Tomman Island is owned by four Nasara and these four Nasara will first agree on the proposal and ones that is clear, the project can proceed.
<i>Poaching activities</i>	Fishing in Nalema in the lake and outside the reef is open access and there is no poaching activities. Community respect any tabu placed by the community on the Lake or species.
<i>Church believe and impact on resource management</i>	Unlike in Nalema, there is no mention of one church members calling unclean food on any resources by the five churches in Tomman Island, it may be within the SDA but is not shown.
<i>Ciguatera fish poisoning</i>	Ciguatera fishing poisoning is an issue at Tomman Island but is never monitored to know the impact and whether is rising or not. With the growing environment changes, Ciguatera poisoning is expected to increase and therefore monitoring of affected people, symptoms, affected fish and timing of the sickness.
<i>Sand an gravel mining</i>	This is not an issue at this stage because extraction is minimal and does not impact the island.



Figure 10. Photos of marine and fishing activities in Tomman Island – Photos: Kalo M Pakoa

Table 3. List of marine resources of importance to Tomman Island community,

Group	Language Name	Bishlama Name	Common trade Name	Scientific Name
Crustaceans		Kokonat krab	Coconut crab	<i>Birgus latro</i>
Crustaceans		Lan crab (mangrove)	Land crab	<i>Cardisoma spp</i>
Crustaceans		Lan crab (mangrove)	Land crab	<i>Cardisoma spp</i>
Crustaceans		Land crab (dry lan)	Land crab	<i>Cardisoma spp</i>
Crustaceans		Lobsta	Lobster	<i>Panulurus spp</i>
Crustaceans		Nakato	Hermit crab	<i>Coebita spp</i>
Crustaceans		Slipa lobsta	Slipper lobster	<i>Parioacus caledonicus</i>
Crustaceans		Green crab	Swift footed rockcrab	<i>Grapsus spp</i>
Crustaceans		Solwota krab	Reef crab	<i>Carpilus spp</i>
Crustaceans		sofmad krab	Mud crab	<i>Sucella serata</i>
Finfish		Black piko	Rabbitfish	<i>Acanthurus spp</i>

Finfish		Black tuna	unicorn	<i>Naso sp</i>
Finfish		Pocket knife	Surgeonfish	<i>Acanthurus sp</i>
Finfish		Blue fis	Parrotfish	<i>Clorunus spp</i>
Finfish		Bunfis	bonefish	<i>Albula vulpes</i>
Finfish		Brim	bream	<i>Abramis brama</i>
Finfish		Coral trout	Grouper	<i>Epinephelus spp</i>
Finfish		Deep sea loch	Grouper	<i>Epinephelus spp</i>
Finfish		Flaenfis	Flying fish	<i>Cypselurus naresii</i>
Finfish		Karong	Trevally	<i>Carangoides spp</i>
Finfish		Redmaot	Bream	<i>Luthrinus spp</i>
Finfish		Mahimahi/kingfish	Mahimahi	<i>Coryphaena hippurus</i>
Finfish		Mangru	Scad makerel	<i>Decapterus macarellus</i>
Finfish		Malet	Mullet	<i>Mugillidae</i>
Finfish		Mustasfis	goatfish	<i>Parupeneus spp</i>
Finfish		Renbo piko	rabbitfish	<i>Acanthurus lineatus</i>
Finfish		Redpulet	Snapper	<i>Sargocentron spp</i>
Finfish		RifFish	Asorted reef fish	<i>Reeffish species</i>
Finfish		Deep sea snapper	Snapper	<i>Lujanidae</i>
Finfish		Tuna like species	Tuna	<i>Thunnus albacares</i>
Finfish		Wahu	Wahoo	<i>Acanthocybium solanders</i>
Finfish		Wahu	Spanish mackerel	<i>Scomberomorini</i>
Finfish		Waet pule	Snapper	<i>Sargocentron spp</i>
Finfish		Red pule	Snapper	<i>Lutjanidae</i>
Finfish		Barakuda	Barracuda	<i>Sphyrnaea spp</i>
Mammal		Cowfish	Dugong	<i>Dugongidae</i>
Reptile		Totel	Turtle	<i>Chelonia mydas</i>
Reptile		Totel	Turtle	<i>Eretmochelis imbricata</i>
Shellfish		Nasisa	Nerita	<i>Nerita polita</i>
Shellfish		Natalae	Giant clam	<i>Tridacna spp</i>
Shellfish		Konshell	Cone shell	<i>Conus spp</i>
Cephalopods		Nawita	Octopus	<i>Octopus spp</i>
Cephalopods		Squid	Reef squid	<i>Sepioteuthis spp</i>
Shellfish		Pupusel	Triton shell	<i>Charonia tritonis</i>
Shellfish		Shellfish	Limpet	<i>Lottia sp</i>
Shellfish		Shellfish	Limpet	<i>Lottia sp</i>
Shellfish		shellfish	Tectus	<i>Tectus pyramis</i>
Shellfish		Bikeye	Turban snail	<i>Turbo spp</i>
Urchin		Urchin	Sea Urchin	<i>Heterocentrotus spp</i>
Shark		Shark	Shark	<i>Carcharhinidae/ sphyrnidae</i>

4.3. ENVIRONMENTAL MANAGEMENT AND CONSERVATION

4.3.1 Terrestrial ecosystem condition

History of Terrestrial management activities	The people of Tomman until today are utilising most or all of their land resources. The island's forest provide all the wood and timber needs including hard wood such as Koiu, Natapoa, Bluewota, Tamanu. Namamau, Natagura and bamboo. Coconut timber are sometimes used for construction but there is enough resources to meet the needs of the community. Natagura and bamboo from Tomman Island for example are of a much superior quality - stronger and can last up to 30 years than those from the mainland. One thing they do not allow is commercial logging of trees on the island which make sense because their resource base is limited. So the people of Tomman Island have been managing their island environment and resources since generations. The only hill on the island and surrounding food hill is protected and is where the mature forest resources of the island is based. Fauna include birds such as Nawimba, parrot and flying foxes and coconut crab are based. But they request for assistance to assess and document their Biodiversity. The island old village remain intact and is kept as it is and now being open up for cruise tourist visit. There are no land dispute on the island because the four Nasara boundaries are clear and custom rules are updated to the new generation to continue the tradition and prevent disputes.
<i>Deforestation - settlement and coconut plantation</i>	The main deforestation activities on this island is for gardening and development of coconut and cocoa plantation and settlement but because of low lying island, there was no adverse impact on the coastal environment.
<i>Cattle grazing</i>	No cattle grazing on the island. Domesticated animals are banned on Tomman Island. Disaster caused by these animals in people gardens leading to shortage of food led to community decision to eradicate all domesticated animals on the island. There is a community cattle on the d but require constant maintenance especially after cyclone.
<i>Pig eradication</i>	Tomman Island is probably the first community in Vanuatu to successfully eradicate pigs on their island. Years ago pig disaster went to a point where it became too much to control that community agree to eradicate pigs on the island by killing and the resident went on to kill all the pigs, since then until today there are no more complaints about pig disaster, no need for fencing of gardens and people have enough food to eat.
<i>Flooding</i>	Flooding from wave surge is common for Tomman island because for low lying coastal areas. The old village was relocated to the present location in the 1970s after a cyclone disaster induced wave serge that washed away the old village west of the island. The recent cyclone Lola also washed aware some houses and inundate fresh water wells near the beach. Although not too serious it indicates severe wave surges can be damaging to settlements.
<i>Mangrove strand</i>	Ata single mangrove strand on the east coast of the village and deserve protection at least.

<i>Sand mining</i>	Sand mining is happening on a smaller scale for local villages needs and the sand and gravels are plentiful and enough to use. Most houses in the villages are local materials indicating demand for sand is minimal for now.
--------------------	---

4.3.2 Upland Environment and Biodiversity

The islands terrestrial biodiversity naturally would be limited to birdlife, flying fox, some smaller reptiles and some native insects as details.

<i>Nawimba</i>	Yes – Nawimba present on the forested hill and large trees all over the island but need to be assessed to identify its population.
<i>Flying fox</i>	Yes – present on the Island and appear more during fruiting trees such as mangos, nadao, breadfruit, orange etc.
<i>Wild duck</i>	None on the island but on mainland near Ngatpang Lake
<i>Wild fowl</i>	None on the island but on the mainland
<i>Parrot types</i>	Yes, lorikeet but stock take assessment needed to ascertain the status
<i>Koroliko (WTSW)</i>	none
<i>Insects</i>	These is the native red ants common on the island and there are no fire ants on the island.
<i>Coconut rhinoceros beetle</i>	Not on the island yet but the community do not want this pest on the island as it would devastate their coconuts.
<i>Community Conservation Area</i>	None at the moment, need to discuss more with them if they want one of they stay with “Tabu” system. Hill side, food hill to the sea is potential area for the ridge to reef CCA.

4.4. AGRICULTURE, FORESTRY, LIVESTOCK AND BIOSECURITY

4.4.1. Agriculture

<i>Important crops for food security</i>	Taro, yam, banana, Manioc, kumala, Island cabbage and coconut. Seasonal fruits include orange, avocado, breadfruit, nangai, mango, Nadao. After the cyclone when these crops are down, rice is now the main stay for many families and these are from families in Santo, Lakatoro and in Vila.
<i>Farming system improvement</i>	Subsistence farming and shifting cultivation remain a norm, crops like banana tend to stay longer in a place once planted and keep producing. Cooking banana does need more attention compared to other varieties. No training has ever been done on improved farming system and improve varieties on the island, this may be necessary for awareness and training on cyclone resistant crops.

<i>Copra production</i>	Toman Island's second main cash crops is copra, many farmers have stop producing due to low prices and longing for Government to improve the price again. Their plantations are now littered with dry coconut and nafara.
<i>Cocoa</i>	Many households have cocoa and coconut plantations together and just in December the community receive information the price of Cocoa had risen again to around 60,000vt per tonne from the Lakatoro based buyer which good news . Cocoa production will now resume with this good news.
<i>Kava</i>	Modt families have kava for home use but a few plant for commercial sale in Vila but direct shipping to Vila is a challenge.
<i>Vanilla/paper</i>	None on the Island
<i>Farmland space</i>	There is enough land on Tomman Island for everyone, families who moved to mainland are now back to Tomman Is to escape wild pig disaster in their gardens. There is also enough land on mainland to accommodate increased population in future.

4.4.2. Forestry sector

<i>Forestry Project support:</i>	No forestry projects in the area and a need forest assessment and nursery development support for tree planting for their future use.
<i>Native forest resources:</i>	Native forest resources include Koihu, Tamanu, Natavoa, bluewota and Namamau and bamboo and Natagura. Forestry inventory a need for the island. These local trees have been harvested for timber including koiu, natavoa, and bluewota for church building and meeting hall and on private modern houses. Villager elders spoke highly of bamboo (weaving bamboo) of Tomman Island to be of
<i>Bamboo</i>	Two types on the island soft one and strong one, strong one is used for walls. The islands Bamboo (medium size) is stronger than the same one on the mainland, bamboo wall can last 30 years while on mainland bamboo wall only last up to 10 years. Protection of bamboo and Natagura of Tomman Island as a special variety. Some buyers in Vila and Santo have ordered the bamboo and natagura from Tomman and s it is now a source of income.
<i>Natagura</i>	Planted and sometimes grow wild. Community also spoke highly of their Natagura thatch roofing, much stronger than the mainland one and can last up to 20 years double that of the mainland.
<i>Namamau</i>	Planted by birds. Namamau tree grow well on the island and is one of the common wood used for local houses as post and frames. Once a young seedling grow it is pruned right from the early stage to produce long thin and straight pole that has many needs in a local house.
<i>Planted forest:</i>	No planted forest on the island.

<i>Mangrove forest:</i>	A small stands on te island but is not allowed to be cut down.
<i>Timber production:</i>	Timber cutting for commercial gain is not allowed on the island, there is a saw mille on the island but is only for personal needs for house but has left the island. There are many small chainsaws but these are for family use, some are timber millers but the production is unknown.
<i>Forest conservation</i>	Hill and surrounding coast my need to be set up as a conservation area for the community to preserve the native species there. Terrestrial BIORAP needed to assess current status of the forest resource.

4.4.3 Livestock sector

<i>Cattle:</i>	Tomman Island community cattle ranch is on the mainland and hold some 100 to 150 heads. Maintenance of the ranch is a big job and especially as a community ranch. In addition the fencing suffer damage by the recent cyclone and has yet to be repaired, the livestock as a result are currently roaming outside and have been disaster to gardens on the mainland. Repair of the fencing and pasture improvements are needed to improve their beef production.
<i>Piggery</i>	Since the pig eradication on the island, the people of Tomman no longer feed pigs. So they done have pigs at the moment.
<i>Poultry:</i>	Many households have free range chickens for food security and extra for sale. There are over 600 chickens on the island. Small scale poultry farm for chicken and duck need to be developed for alternative protein source.
<i>Goat:</i>	Not goat feeding at Tomman Island

4.4.4 Biosecurity and pests

<i>Taro beetle</i>	Taro beetle is native pests on the island for many years but is not damaging on crops. Training on biological control of taro beetle is needed from Biosecurity.
<i>Fall army worm</i>	No sign of this pest on the island and mainland
<i>CRB</i>	No CRB
<i>Fire ants</i>	No fire ants yet
<i>Wild pig damage</i>	Wild pig damage to gardens on the mainland is a concern, they are killing piges but the pig population is more than people and difficult to reduce its population.
<i>Big leaf fine</i>	This is a problem in the mainland, not on the island.

4.4.5 Disaster preparedness and sea level rise

<i>Revive use of local signs of telling the coming cyclone</i>	Elders to organize signs of protecting coming cyclone, draught or earthquakes. As tsunami such as high fruiting of navele, naus, avocado or mango.
--	--

<i>Move to higher ground</i>	Wave surge and flooding had caused displacement of the people of Tomman Island to present location. Current village has higher ground at the back which is very safe and while many households are already on higher ground, there are several households still build in front of the beach, these homes were flooded during the recent cyclone Lola, the house need to be move to higher ground at the back.
<i>Community disaster Committee (CDC)</i>	CDC committee to be established as matter of to facilitate advices and provide reporting to government and disseminate information and adviceto the community, area Council and NDMO and relief supply sharing etc.
<i>Cyclone shelter</i>	Community hall is good cyclone shelter.
<i>Safe drinking water for cyclone an draught</i>	Protect some of the wells behind the village for use during disaster and cover it up. Community tank to be reserved for disaster use.
<i>Sea level rise</i>	Relocate houses by the beach to higher ground.
<i>Food security during disaster</i>	Preserve local food such as fermented manioc for use during disaster, plant crops like taro Fiji and wild yam which are not damaged by cyclone.
<i>Set up MPA to preserve fish for food security during disaster</i>	Set up MPA down south of the island up to the hill, or other suitable site as preserve of fish and shellfish for disaster use.
<i>Fish market, solar freezers, boat and training and FAD</i>	Establish fish market with deep freezer to store fish for food security after disaster and for sale. Deploy FAD to be used for fishing post disaster for food security.
<i>Safely store boat and engine during cyclone.</i>	Boat is the very tool to use to catch fish, last thing is to allow damage to your boat so keep it safe.

4.5 INFRASTRUCTURE AND PUBLIC UTILITY

4.5.1 Energy, lighting and heat sources

<i>Kerosene</i>	Kerosene has been phased out and no longer sold in the village.
<i>Solar panel</i>	Solar panel and solar lighting is the only main source of lighting in the community. Almost all households have small solar panels for phone charging and lighting. Solar is low cost, environmentally save and a better option.
<i>Fuel oil</i>	Fuel (benzene and diesel) is sourced from Wintua Fuel depot at Wintua and small retailers source their supply from there.
<i>Fuel wood</i>	Fuelwood is the main source of household energy for cooking, heating and boiling water and is sourced from the plentiful forest trees on the island.
<i>Sunlight</i>	Sunlight remain the most accessible energy for drying cloths, drying of panamas, peanut, cocoa, and sometimes copra.

4.5.2 Water supply (WASH) and Sanitation

<i>Water Committee</i>	Two water committee exist, one for the proposed desalination plant to be funded by JICA in 2020, no progress to date on this project. Village water committee has worked with Water Services Department and ADRA to pipe underground source for the whole village, this too has not progressed as yet. No water fee at this stage but when these development materialise, water fees will be charged by the committee. ADRA assistance is more realistic for them and they are still waiting.
<i>Open underground wells</i>	Main source of water for cooking, washing and drinking since generations. There are many underground wells in the village which are free to use by all households but households go to the nearest wells to their house. No major problem with these wells except for salt intrusion for wells closer to the beach at high tide, wells further inland are not affected by intrusion but there may be contamination from pit toilets although this is not confirmed. Water quality analysis needed, Follow-up plans with ADRA
<i>Rain water tank</i>	Two (2) rain water tanks in the village, one for school, and 2 for community kept as reserve water for drinking when well water are contaminated or during draught.
<i>Water shortage</i>	Water shortage is not an issue but water quality may be an issue is noticed during draughts.
<i>Toilet</i>	Pit toilet and VIP are popular but the village water committee had resolve to move to VIP for all household by this year. In addition there are 2 water seal toiled and there is still no flash toilet but there is potential for this with good water supply pipe. Move to Water Sea and flash toilet with good water supply
<i>Hand washing</i>	Hand washing was effective only during COVID 19 period, although community encourage everyone to continue hand washing. Encouraged to continue
<i>Solid waste disposal</i>	A few solid waste pits for some households and the sanitation committee encourage every household to have its own solid waste pit. Complete household pits

4.5,3 Infrastructure, shipping and airport

<i>Road transport services</i>	Tomman Island is accessible by boat only. Road end at Wintua, far away to Tomman mainland but hopefully a new road will be made.
<i>Boat transport service</i>	Banana (fibreglass and aluminium) boat is the main form of transport in West Malakula in Genera. Travel and movement of cargo by small boats is becoming common, for instance fish from Tomman is transhipped in Malvakal to Sakau and transhipped second time to Vila.
<i>Inter-island Shipping services</i>	Tomman Island use to receive cargo ships in the past but these stopped making it difficult. Mv Charlie Brum came around once and everyone was there to see the ship.

<i>Safe anchorage</i>	Entrance to the lake is wide enough for boat entry and should be maintain as the main safe encourage passage for boats.
<i>Airport</i>	Wintua id the nearest airport in South West Bay but is far costly, the nearest airport is in Tongoa which is half an hour away for medical evacuation.

4.5.4 Telecommunication and radio services

<i>Radio</i>	Radio use is unpopular with only 4 radios in the village, popularity of mobile phones and poor radio reception has been the main cause of uptake of radio services. VBTC to improve its shortwave reception to rural areas
<i>Mobile phone</i>	Mobile phone services is available for both mobile telephone network and is the main source of communication through talking, text messaging, email, messenger and Facebook. Daily news of radio Vanuatu and daily post is received via mobile phones through online Radio, facebook news update and daily post news on line.
<i>Snail mail letters</i>	Snail mail and sending of cash in envelope by snail mail is no longer popular todays, it is still used when sending money by hand delivery.
<i>Telephone reception</i>	Telephone reception for both service providers are good in Tomman Is giving the community choices of communication.

4.5.5 Education and Health services

<i>Tomman Primary school and pre-school</i>	Tomman Primary school and pre-school is the only school with 50 students this year up to class 6. School leavers progress to Caroline Bay and Melip or Wintua school.
<i>Aid Post</i>	Tomman Island Aid Post was damaged and was not replaced, community has planned to build last year but didn't happen, now it has to be build this years. Now a new building is to be build and staff house.
<i>Dispensary</i>	The Dispensary is at Caroline Bay, Travel to Caroline Bay and to Wintua by sea is a challenge at times, during rough seas, boats cannot cross to the mainland to seek medical service Set up Tomman Aid Post in 2024
<i>Medical evacuation</i>	Medical evacuation is transported by sea to Winter Health Centre and if serious referred direct to Vila.
<i>Referral</i>	Serious patients are referred to Carolyn Bay dispensary or to Wintua health Centre. Serious patients are referred to Norsup Hospital in Lakatoto.

Ciguatera fish poisoning	No information collected on ciguatera fish poisoning, the sickness was there for many years but it Was not monitored, very important to monitor it to identify changes in species and types of symtom and sickness.
--------------------------	---

4.5.6 Tourism development

Cruise ship visits	Several cruise ship visits to South West Bay and Tomman Island community were involved in some activities but the activities are not well organised so that the full community participate and sell any products. Something that will need more training and education in future.
Custom village Tour to the island	Tomman Island custom village on the island had received several visits by tourist from cruise ship during visits. The tour was set up with the help of the Cultural Centre field worker but again whole community was not part of the tour activity something that will need to be further worked on. Last year the skull of the last remaining long head tribe of Tomman Island kept in an American Museum was returned to the island and buried at the old village where the custom village tour is held.
Handicrafts	Women are making handicraft especially mats and fans for sale but trainings are need to make products that are more appealing to visitors and tourist, men and boys also need to undergo training to produce wooden handicrafts as souvenir for tourist.
Food	Food preparation for visitors is a skill that need to be achieved to be able to introduce an improvement. Training need for women and girls.

4.5.7 Employment opportunities

Government	2 graduates working in government
UNELCO	1
Air Vanuatu	1
Teacher	2
Health worker	1
Cultural Center	1
RSC and SWP	A total of 10 members of the community travel to work in New Zealand and Australia, all are male with only 1 female

4.5.8 Business activities in Tomman Island

<i>Retail shops</i>	5 x retail shops at Tomman Island, including a school canteen
<i>Bakery and doughnut cooking</i>	1 bakery and several doughnut cooking
<i>Banking</i>	NBV branch at Lakatoro which service the whole island. Need for a NBV Bank branch at Wintua Money lending scheme
<i>Boat taxi</i>	Five (5) boats all fibreglass boats are license for Taxi services only.
<i>Boats fishing</i>	4 fishing boats but three only are licensed to fish, they fish for their own and buy for the others to export it to Vila market, can also do taxi trips out of normal routine trip.
<i>Cacao sale</i>	Cacao beans is produced from the island and mainland and sold to the Exporter at Lakatoro or taken direct to Santo, the prices has gone up again now and is attractive to sell to Lakatoro.
<i>Copra sale</i>	Copra production has dropped due to price issues. Need to improve price
<i>Deep Freezers</i>	Five (5) solar deep freezers on the island all private owned, for private use and rented out for saving food at 50vt and 100vt a night depending on size of package.
<i>Fish market</i>	No community fish market but fish buyers purchase fish from fishers in the village at 450vt/kg for reef fish, skipjack - 600vt/pce, bonito – 200 vt /pce, aggregate the catch and export it to Vila market. The esky were transported to Sakao Maskelynes through Malvakal where the cargo is transhipped to another boat to Sakau. Esky is then transferred to Big Sister to Port Vila. Fisheries association need support from government for deep freezers and a bigger vessel to assist fishers would be ideal. Selling fish to Lakatoro market is also expensive about VT27,000 freight and transport by road to Lakatoro.
<i>Fuel retailer</i>	3 x fuel retailer in the village, they buy fuel in drums or plastic containers from Wintua Fuel Depot and re-sell in the village.
<i>Guest houses</i>	Two (2) guest houses running but only one is working well and receiving guests. The guest suffer some damage from the cyclone but is back up and running.
<i>Livestock sale</i>	No pigs on the island, pigs were eradicated many years ago because of damage on food crops. Cattle ranch on mainland but cyclone damage on fencing is too much work and the stock have escaped.
<i>Root crop sale</i>	Not common, most root crop is for subsistence use

6. CONCLUSION

The two sites are characteristically different in their marine and terrestrial environment, human habitation and state development and government services. Tomman Island being a small offshore Island of a larger island of Malekula, relatively older geologically and possess well developed coral reef system surrounding the

volcanic island and with a larger population who originally live on this island for thousands of years. Nalema on the other hand is part of a larger island of Epi that is geologically young and possess no coral reef system on the coastline is constantly affected by wave action and weathering and the community is relatively new and with a much smaller population. In terms of shallow reef resources, Tomman Island possess full scale of coral reef resources than Nalema. Another differences is that Nalema possess a marine lake ecosystem which provide a source of food security.

The similarities are that both communities are isolated and have the same disadvantage of lack of road access and rely heavily on sea transports both on banana boats and inter-island cargo vessels and the challenges of bad weather affecting movement is the characters of both communities. Both communities emigrate between two islands - Tomman Islanders own land on the mainland and move between the island and mainland and Nalema residents also move between Epi and Tongoa Island where the Nalema residents come from and are still part of the Lupalea community. Copra is one of the main commodity for the two communities and the poor copra price has affected their copra production. Both are fishing communities where fish protein is very important in their diet but fisheries management has been a weakness and government intervention is needed. Lastly both communities experience the same level of environment impacts and deserve the support of the project to address resource management and adaptation measures to the impacts of climate change and ocean acidification.

The priority activities highlighted for the VANKIRAP project implementation for the two site will focus around marine environment and fisheries related activities. Some of these interventions are already being addressed by the Agency responsible although more improvements are needed and the sea surface temperature monitoring work will be a new addition. Setting up of community conservation area will be an additional intervention and for Nalema rehabilitation of the lake system with mangrove reforestation as one of the important positive intervention towards reducing ocean acidification. Considering the short term of this project it may not be possible to fully implement these priority actions but other future projects can pick up on some of these interventions to progress these national priority activities.

7. RECOMMENDATIONS

6.1 Recommendations for Nalema Community

1) Setting up of Nalema Community Conservation Area

Lake Nalema ecosystem is in a much poor condition as a result of both human activities and natural impacts due to climate change. This has affected biodiversity of the lake and loss of resources and fisheries. Protection of the lake system is important to recover the ecosystem and resources. It is recommended that the area be developed into a Community Conservation in a ridge to reef manner covering Kambioko Island and the major interventions include

- a. Community agreement on conservation area (CCA)
- b. Demarcation of the CCA boundary covering the lake
- c. Fencing of the lake area
- d. Replanting of mangroves
- e. Replanting of sea grass in the lake
- f. Conducting marine and terrestrial BIORAP
- g. Restriction on cutting down of existing forest
- h. Ban on all fishing in the lake
- i. Control on tilapia population in the lake
- j. Awareness and outreach
- k. Ban on certain gear use in the lake in future

- l. Close the airstrip at Nalema for light aircraft
- m. Develop Lake management guideline in the Management plan

2) Marine protected area:

Setting up of marine protected area in the area identified by the community to preserve fish and shellfish, interventions include activities such as:

- a. proper identification of the area (s)
- b. mapping of the area (s)
- c. baseline assessment
- d. education and awareness

3) Fisheries Development and Management

Nalema is already a fishing village with four licensed fishing boats, in the past up to 8 fishing boats are base at Nalema, the additional boats belong to fishers from Tongoa but these Tongoa fishers have move back to base in Tongoa. Nalema fishers association need further support to expand fishing and production of fish at Nalema.

Priority interventions in fisheries are as follows”

- a. Setting up of FADs for offshore and inshore to support canoe and boat fishing activities.
- b. Support association with more solar freezers
- c. Training in fishing technology, fish handling and marketing
- d. Provision of a fishing boat to support the NF association.
- e. Development of small pelagic fishery including flying fish for food and baitfish.
- f. Conduct bonefish recreational fishing trial and training
- g. Conduct flying fish trial and training

4) Fish monitoring and enforcement

- a. Setting up of fish catch monitoring using TAILS electronic catch recording
- b. Training of fish monitor
- c. Appointment of a Fisheries Authorized officer
- d. Monitoring of ciguatera fish poisoning
- e. Monitoring of fish and invertebrate in the lake after CCA setup
- f. Enforce fisheries regulation where necessary
- g. Monitoring of threatened species
- h. Monitoring of spawning aggregation

5) Sea surface temperature monitoring:

Sea surface monitoring is important to record marine environmental data such as clarity, temperature and sedimentation and tidal changes and its impact on fishing activities. Recommended interventions include:

- a. Deployment of sea surface buoys
- b. Training of local person to monitor the instruments
- c. Collection of data from these instruments
- d. Monitoring of the movement of warm pool and its impact on resources.
- e. Maintenance of the instruments
- f. Make this information available to community to assist their fishing operations

6) Recording of vernacular names and traditional knowledge:

Traditional knowledge is critical to the transfer of good practices to the next generation but these knowledge is slowly being lost as modern knowledge become more important, use of technology and lack of recognition of local knowledge and experiences. Recommended intervention include:

- a. Compilation of nomenclature of flora and fauna including vernacular names.
- b. Use of vernacular names in ten village nakamal.

- c. Teaching of these vernacular names in the primary and kindergarten school
- d. Publishing of a book on vernacular names in Nakanamanga dialect

7) Seven Day Adventist Church:

The SDA church teaching of uncleanness of certain resources have contributed to lack of concern and appreciation of the resources leading to lack of management of certain resources and the demise of certain species. It is important that community be taught to love and respect all creations of God including all fishes of the sea, birds and animals of the land and their environment as the bible book of Genesis Chapter 26;

²⁶ Then God said, ^a“Let us make man^g in our image, ^bafter our likeness. And ^alet them have dominion over the fish of the sea and over the birds of the heavens and over the livestock and over all the earth and over every creeping thing that creeps on the earth.”

Recommended interventions include:

- a. Pastor to include prayer support for the environment all animals on land and in the sea and encourage its congregation to care for all animals both clean and unclean as GODS creation and must be kept in good condition for the next generation.
- b. Discourage the idea that unclean animals do not deserve our care.
- c. Church to organise congregation to take part in mangrove replanting in the lake.
- d. Church to encourage its congregation to respect the environment as a whole.
- e. SDA church to pray over all environmental activities

8) Livestock development:

Nalema community own a sizeable catch ranch with around 400 cattle heads but the cattle stock are in poor condition which mainly related to insufficient food. While good water supply is available for drinking, there is obviously not enough pasture because of overgrazing. Active pasture areas has been greatly reduced by overgrowth of vegetation which is common in locally owned cattle ranches. Recommended interventions are:

- a. Cleaning and felling of larger trees in the ranch to allow pasture growth and increase pasture area.
- b. Dividing the area into paddocks for ease of management
- c. Seek financial support to fund ranch improvement activities
- d. Reduce cattle stock to recommended stocking density
- e. Training of your people in cattle ranching
- f. Assess the option of working with a private cattle farmer to improve the ranch.
- g. Seek support for small livestock farming of goat and local poultry base on local chicken breed or improved breed.
- h. Seek support from the Livestock Department.
- i. Build a proper cattle drinking well to make use of the water supply.
- j. Grazing around the lake be reduced by fencing to prevent further degradation

9) Agriculture and Biosecurity:

Nalema land is productive for root crops and vegetables such as taro, yam, cabbage and water melon, banana coconut, and fruit trees such as breadfruit, navele and nadao and kava and Vanilla. Production of these crops need to be improve and the recommended interventions are:

- a. Seek government to improve the price of copra to encourage production
- b. Seek advice for alternative marketing of dry coconut as they are plentiful and is being wasted.
- c. Increase kava farming for commercially purposes only.
- d. Improve cocoa production and increase with new farms depending on land area.

- e. Increase vanilla farming depending on land area
- f. Avoid farming of longer term crops on the flood prone areas
- g. Improve taro and peanut production for marketing to Port Vila market.
- h. Adopt environmentally sustainable pest control on crops.

10) Forestry development:

Forestry resources is plentiful in Nalema but is not assessed, proper assessment of the forest resources is needed to quantify timber stocks and recommend replanting activities if needed

11) Water and Sanitation:

The Water supply system in Nalema is working well but maintenance remain an issue when piping break down. Continuous maintenance is important to ensure good supply of clean water: Recommended interventions are:

- a. Strengthen Water Committee to improve monthly water fee collection to meet maintenance cost.
- b. Encourage households move into water seal and flush toilets.
- c. Community members to be responsible not to damage water pipe.

12) Infrastructure (road, landing, airstrip):

Absence of road is a challenge during bad weather when it is unsafe for boat travel. The two landing in front of the village and at Kambioko are not save to use and opening of the lagoon opened a new and safe anchorage.

- a. The road system need to be extended right to Nalema village.
- b. Boat and shipping services provide services for now but road is important during rough seas,
- c. The opening of the Western stone wall provides natural passage into the lagoon for safe anchorage by boats and landing of cargos, the passage should be kept as it is.
- d. The small airstrip build for Dr Mark landing is unsafe and is not environmentally sound and should be closed.

6.2 Recommendations for Tomman Island Community

13) Marine protected area:

The marine manage areas or '*Tabu*' areas are temporary short term measures and are not effective in protecting the resources against overexploitation. Setting up of permanent marine protected area is important as a long term management tool for reef fisheries. Identified by the community to preserve fish and shellfish, interventions include activities such as:

- a. Proper identification of the area (s)
- b. Mapping of the area (s)
- c. Education and awareness about these MPAs
- d. Conduct marine BIORAP surveys

14) Fisheries Development and Management

Tomman Island is a fishing village with four licensed fishing boats, and four taxi boats several canoes. The Fisheries association seek further support to expand fishing and production of fish for local food security and for export to Lakatoro and Port Vila market. Priority interventions in the fisheries sector are;

- a. Setting up of FADs for offshore and inshore area to support canoe and boat fishing activities.
- b. Setting up of a fish holding and market facility to support the association with solar freezers
- c. Training in fishing technology, fish handling and marketing

- d. Improve fish catch monitoring using TAILS electronic catch recording by mentoring existing monitors
- e. Appointment of a Fisheries Authorized officer.
- f. Provision of a fishing boat to support the Fishers association.
- g. Development of small pelagic fishery including flying fish for food and baitfish.

15) Fish catch monitoring

- a. Ensure the fish catch monitoring work effectively
- b. Appointment of a Fisheries Authorized officer
- c. Monitoring of ciguatera fish poisoning
- d. Monitoring of fish and invertebrate in the lake after CCA
- e. Enforce fisheries regulation where necessary
- f. Monitoring of threatened species
- g. Monitoring of spawning aggregation

16) Sea surface temperature monitoring:

Sea surface monitoring is important to record marine environmental data such as clarity, temperature and sedimentation and tidal changes and its impact on fishing activities. Recommended interventions include:

- a. Deployment of sea surface buoys
- b. Training of local person to monitor the instruments
- c. Collection of sea surface data by VFD and Meteo and advice on its dissemination
- d. Monitoring of the movement of warm pool and its impact on resources.
- e. Maintenance of the ocean surface buoys and instruments
- f. Expand outreach with this information to the community to assist their fishing operations

17) Biological rapid assessment;

Baseline assessment of the islands biodiversity is important now to facilitate effective measurement of changes in the environment being brought about by climate changes and associated disaster impacts. These baseline assessment is recommended for both marine and terrestrial environment. Recommended interventions are:

- a. Marine BIORAP assessment and reporting paying particular attention on threatened species such as napoleon wrasse (*Chelinus undulatus*), bump head parrotfish (*Bolbimetopon muricatum*), land crab and coconut crab and spawning aggregation of fish.
- b. Terrestrial BIORAP assessment for plants, birds and flying foxes, insect and pests species and invasive species.
- c. Assessment and documentation of native agriculture crops which is also export which faces the threat of climate change
- d. Documentation of vernacular names of all marine and terrestrial flora and fauna.
- e. Assessment of the state of reef habitat including percentage coverage of corals, algae and invertebrates.

18) Recording of vernacular names and traditional knowledge:

Traditional knowledge is critical to the transfer of good practices to the next generation but these knowledge is slowly being lost as modern knowledge become more important, use of technology and lack of recognition of local knowledge and experiences. Recommended intervention include:

- a. Compilation of nomenclature of flora and fauna including vernacular names.
- b. Use of vernacular names in the village nakamal.
- c. Teaching of these vernacular names in the primary and kindergarten school
- d. Publishing of a book on vernacular names in Tomman Island dialect

19) Church Groups:

Church groups in Tomman Island can make an influence in helping the community to take care of their environment and resources. It is important that community be taught to love and respect all creations of God including all fishes of the sea, birds and animals of the land and their environment as in the bible book of Genesis Chapter 26;

²⁶ Then God said, ^a“Let us make man^b in our image, ^bafter our likeness. And ^alet them have dominion over the fish of the sea and over the birds of the heavens and over the livestock and over all the earth and over every creeping thing that creeps on the earth.”

Recommended interventions include:

- a. Pastor to include prayer support for all animals on land and in the sea in its Saturday or Sunday worship on conservation to encourage its congregation to care for all marine and terrestrial resources as the creation of GOD and to keep it in good condition for the next generation.
- b. Church to organise congregation to take part in beach clean-up and replanting of trees on the coast to prevent erosion.
- c. Church to encourage its congregation to respect the environment as a whole.
- d. Church to be part of all environmental activities in Tomman Island.

20) Livestock development:

Tomman Island community cattle ranch on the mainland need to be improved with water supply and pasture improvement to improve cattle quality and prevent cattle damage to gardens. Recommended interventions are:

- a. Repair of fencing
- b. Cleaning and felling of larger trees in the ranch to increase pasture growth.
- c. Dividing the area into paddocks for ease of management
- d. Seek financial support to fund ranch improvement activities
- e. Reduce cattle stock to recommended stocking density
- f. Training of your people in cattle ranching.
- g. Assess the option of working with a private cattle farmer to improve the ranch.
- h. Seek support for small livestock farming of goat and local chicken from livestock officer at Wintua.

21) Agriculture and Biosecurity:

Tomman Island land is productive for all agriculture crops – Cash crops are coconut and cocoa, and root crops such as taro, yam, and cabbage, banana, and fruit trees such as breadfruit, navel, orange, mango and nadao. Production of these crops need to be improve and the recommended interventions are:

- a. Seek government to improve the price of copra to encourage production
- b. Seek advice for alternative marketing of dry coconut as they are plentiful and being wasted.
- c. Increase kava farming in mainland for commercially purposes.
- d. Improve cocoa production in existing farms.
- e. Promote vanilla and pepper farming on the island
- f. Adopt environmentally sustainable pest control on crops.
- g. Improve handicraft such as bamboo weaving and mat weaving.

22) Forestry development:

Forestry resources is plentiful in Nalema but is not assessed, proper assessment of the forest resources is needed to quantify timber stocks and recommend replanting activities if needed

23) Water and Sanitation:

Tomman Island community depend on underground water from open wells. Salt intrusion is the only issue mentioned for wells near the beach Continuous maintenance is important to ensure good supply of clean water: Recommended interventions are:

- a. Strengthen Water Committee to improve monthly water fee collection to meet maintenance cost.
- b. Encourage households move into water seal and flush toilets.
- c. Community members to be responsible not to damage water pipe.

24) Infrastructure:

A boat ride to Wintua airport and Caroline Bay is sometime challenging during rough seas. Recommended intervention:

- a) Road development linking Wintua to Melip Bay will increase access on the mainland. While the island will still use boat to go cross to the mainland, it will be shorter, safer and less costly to Wintua compared to current boat fare of 7000 vt.
- b) Shipping services to west Malekula need to be improved to open up access to Port Vila market for agriculture products and fish.

25) Tourism development:

The island of Tomman is already attending to participate in ecotourism with the opening of ancient a custom village tour at it old village site. This is a good start and the community need to expand this into a whole is a whole island tours with the involvement of the who community and development of other activities such as traditional items, handicraft making and local food preparation.

8. REFERENCES

Cillauren E., G, David and R. Grandperrin 2002. Coastal Fisheries Atlas of Vanuatu” A 10 year Development assessment. IRD

CSIRO, SPREP and VMGD (2023). Vanuatu Central: sub- national historical and projected climate overview. A report to the Van-KIRAP project. Commonwealth Scientific and Industrial Research Organisation (CSIRO), Secretariat of the Pacific Regional Environment Programme (SPREP) and Vanuatu Meteorology and Geo-hazards Department (VMGD), CSIRO Technical Report, Melbourne, Australia.

Moore B and B. Colas. 2016. Identification guide to the common coastal food fishes of the Pacific islands region. SPC

Kalo Pakoa, Satoshi Nagashima, George Amos, Vasemaca Malverus, Takuya Takayama, Akiya Seko4 and Hiroaki Terashima. 2019. The role of fisheries resources and community-based coastal resource management activities during a natural disaster – Case study of Vanuatu after Tropical Cyclone Pam. SPC Traditional Marine Resources management and Knowledge Information Bulletin #40 .

Hampus Eriksson^{a,b,}, Joelle Albert, Simon Albert, Regon Warren, Kalo Pakoa, Neil Andrew. The role of fish and fisheries in recovering from natural hazards: Lessons learned from Vanuatu. Environmental science and policy 76 (2017) 50-58

SPREP. 2018. Vanuatu Klaemet Information informesen blong redy, adapt mo Protekt (Van-KIRAP) – Fisheries and climate information services (CIS): Policy review, Action and Communication plan.

Kalfatak D and Jaensch V. 2014. Directory of Wetlands of Vanuatu. SPREP.

Anon. 2020 Vanuatu Traditional knowledge national indicator booklet. SPREP

Anon. Upland Management and Climate Change Adaptation Plan for five communities in Epi Island
