COMMUNITY VULNERABILITY & ADAPTATION ASSESSMENT & ACTION REPORT

CBDAMPIC VANUATU

Canadian International Development Agency / Agence canadienne de développement international

Canada

SPREP

Prepared by Brian Phillips

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Executive Summary

Vanuatu is among countries in the Pacific region that are most vulnerable to the risks of climate change, climate variability and sea level rise. With the livelihood of its people and economy interwoven, shaped and driven by climate sensitive sectors, the effects of climate and sea level change are already very real and pose a tangible threat to the future socio-economic wellbeing of the country.

Hence, adaptation to climate change, variability and sea level change is an urgent need. By reducing the vulnerability of Vanuatu's communities now to current climate related risks should place the country in a better position to cope with future climatic changes and to build sustainable Ni-Vanuatu communities.

The Canadian International Development Agency (CIDA),recognising the need and responding to the call of Pacific Island Countries to move on from the predominant focus on vulnerability to climate related risks into the arena of climate change adaptation, initiated the 3 year Capacity Building for the Development of Adaptation Measures in Pacific Island Countries (CBDAMPIC) project in close collaboration with the South pacific Regional Environment Programme (SPREP). Implemented in 4 countries (Cook Islands, Fiji, Samoa & Vanuatu), the project endeavours to develop and implement a capacity building programme that will reduce climate related risks at the national and community level.

In Vanuatu the CBDAMPIC project is piloted at three selected sites, including Lateu Community in the Torres Group of Islands, Luli Community on Paama Island, and Panita Community on Tongoa in the shepherds Group.

This report presents the results and recommendations of Community Vulnerability and Adaptation (CV&A) Assessments and Action conducted in three pilot communities in Vanuatu in an endeavour to empower local communities to identify, analyse and develop ways and means of increasing their local adaptive capacity to current and future challenges and opportunities related to climate change.

SUMMARY OF RECCOMMENDATIONS

Under current baseline climatic conditions the three pilot communities, Lateu, Luli and Panita, have been experiencing among other climate related problems, flooding or inundation by the sea, difficulty in accessing adequate drinking water and sever coastal erosion threatening human lives and coastal infrastructure respectively. In the face of future climate and sea level change the degree of the vulnerability of these communities is most likely to heighten significantly.

The summary of problems that are climate related hindering people's livelihood at the pilot communities is presented in the table below;

Fig: 1. **Pilot Community Prioritised Climatic Problems**

Pilot Site	Prioritised Problem	Climate Related Causes
Lateu, Tegua Island	Flooding/Inundation of settlement	Sea Level Change
Luli, Paama Island	Lack of sufficient water	Frequent and prolonged droughts
Panita, Tongoa Island	Coastal land loss/recession	Sea Level Change

For Lateu community, the only settlement on the island of Tegua in the Torres Group to the extreme north of the Vanuatu chain, the principal causes of their problems are;

1. Regular inundation of the village compound by the sea and
2. Limited rainwater catchment and storage capacity

Both problems create significant health problems, threaten the very existence of the community and exacerbate already difficult socio-economic conditions.

Lack of reliable underground and surface water, limited rainwater catchment and storage capacity coupled with prolonged droughts and regular acidic volcanic fallout, which affects rainwater catchment and agriculture production, contribute to Luli's problems on the windward east coast of the island of Paama.

Panita on the other hand is loosing significant portions of its coastal area to coastal erosion, cyclones and storm surges, which are increasingly threatening human lives and village infrastructure.

Having prioritised problems, pilot communities developed and prioritised adaptation recommendations to increase their adaptive capacity to current future climate change. The implementation of adaptation measures in the pilot sites will entail multi-sectoral inputs from various relevant stakeholders and in-kind contribution by the communities.

Fig: 2. Pilot community prioritised adaptation recommendations

Pilot Site	**Community Adaptation Recommendation**
Lateu, Tegua Island	Relocation of settlement including Aid post, rainwater catchment and storage facilities and church to problem free area
Luli, Paama Island	Establishment of Water supply/Catchment system
Panita, Tongoa Island	Relocation of settlement and rainwater catchment facilities to higher ground

For the Lateu community relocation is the prioritised adaptation option. Relocation of Lateu will entail the relocation of 8 households and kitchens, 1health aid post, 1 Anglican church house and the construction of 6 new rainwater tanks and catchment facilities and the establishment of a communications system to increase the community's accessibility to information and thus enable them to make informed decisions in decreasing their vulnerability. Proposed sites for relocation 100 – 200 meters inland and flood free have already been earmarked for the new settlement pending the necessary Environmental Impact Assessments. The estimated cost of implementation is in the range of Vatu 5.1 million or USD 43'911.

The Luli community have prioritised the establishment of rainwater catchment and storage facilities per household in the settlement. This will significantly alleviate water shortage problems for more than 100 people including villagers of nearby Lulep. The estimated cost of implementation is in the range of Vatu 6.2 million or USD 53'476.

The prioritised recommendation for Panita on the island of Tongoa is the relocation of the whole settlement and rainwater storage facilities. This option will entail the relocation of 16 households and rainwater storage facilities to a proposed relocation site 400 meters from the current site on high ground of about 100 meters above sea level. This adaptation option will involve a total of 200 people living on Panita. The estimated cost of implementation is in the range of Vatu 4.7 million or USD 41'014.

With the pilot site adaptation recommendations having emanated from the respective communities' collective discussions, consultations and analysis involving all stakeholders of the communities (men, women & youths), the solutions very much reflect the genuine adaptation needs of the pilot sites. Having developed and determined their adaptation priorities themselves to safeguard their future wellbeing in the face of climate and sea level change gives the pilot communities a very strong sense of ownership over their proposed projects. Coupled with the sectoral assistance of various institutions, this will be a significant driving force to the sustainability of the adaptation projects beyond the project implementation period.

TERMINOLOGIES USED

Temperature - the degree of hotness or coldness of a body or environment (corresponding to its molecular activity)

Precipitation - the quantity of water falling to earth at a specific place within a specified period of time

Cyclone – An atmospheric closed circulation rotating counter-clockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.

Storm surges - An abnormal rise in sea level accompanying a cyclone or other intense storm, and whose height is the difference between the observed level of the sea surface and the level that would have occurred in the absence of the cyclone. Storm surge is usually estimated by subtracting the normal or astronomic high tide from the observed storm tide.

Floods - a condition of partial or complete inundation of dry land caused by the overflow of the natural boundaries of a body of water or the unusual and rapid accumulation of surface water runoff.

ABBREVIATIONS USED

HWM (High Water Mark) - The mark left by the tide at high water. Also the line or level reached, usually the highest (also known as high water line). A permanent mark which indicates the maximum observed level of tide.

CV&A TEAM MEMBERS

Brian PHILLIPS (CBDAMPIC Coordinator, Vanuatu National Meteorological Services)
Silas ROBSON (Climatologist, Vanuatu National Meteorological Services)
Salesa KANIAHA (Climatologist, Vanuatu National Meteorological Services)
Frazer BULE (Principal Agriculture Officer, Department of Agriculture)
Annick STEPHENS (Vanuatu National Council of Women rep. & Food Security Officer, Department of Agriculture)
Linda M. OLUL (Department of Lands, GIS Unit)
Shirley LABAN (Environmental Health Officer, Department of Health)
Nelly WOULOSEJE (Environmental Health Officer, Department of Health)
Trinison TARI (Environment Unit)
Douglas NGWELE (Vanuatu Association of Non-Government Organisations, VANGO)
Bob KUAO (Vanuatu Association of Non-Government Organisations, VANGO)
Phyllis GANILEO (Wan Smol Bag Theater)

Members of the National Advisory Committee on Climate Change who provided comments

Ernest BANI: Head, Environment Unit & Chairman of the NACCC
Jotham NAPAT: The Director, Department of Meteorology
Jimmy ANDENG: The Director, Department of Economic and Social Development (DESD)
Frazer BULE: Principal Agriculture Officer, Department of Agriculture
John HENRY: National Disaster management Office (NDMO)
Leo MOLI: Head, Energy Unit
Leslie MOSES: Department of Land Survey
Annick STEPHINS: Vanuatu National Council of Women (VNCW)
Kaltuk KALOMOR: Vanuatu Quarantine and Inspection Services Department

SECTION 1: BACKGROUND

1.0 Project Background

The Capacity Building for the Development of Adaptation Measures in Pacific Island Countries (CBDAMPIC) is an adaptation project funded by the Canadian International Development Assistance (CIDA), and executed by SPREP in 4 Pacific island countries: Cook Islands, Fiji, Samoa and Vanuatu. The CBDAMPIC project is an important first step in addressing adaptation in these 4 countries and will have useful input in terms of knowledge and information building on adaptation to the adverse impacts of climate change in the Pacific island region and in other regions of the world. In Vanuatu the CBDAMPIC project is being piloted at three selected sites namely, Lateu Community in the Torres Group of Islands, Luli Community on Paama Island, and Panita Community on Tongoa in the shepherds Group of Islands (fig 1.0).

Vanuatu is grateful to the Government of Canada for its assistance in the area of adaptation to climate change. The CBDAMPIC project is important for Vanuatu as it is a first step towards building capacity at the institutional and community level to better understand the adverse impacts of climate change and how coping capacity could be improved. Climate related disasters have been identified by various economic reviews as one of the main hindrances to economic development in Vanuatu and this will certainly continue and could predictably be exacerbated by climate change. As expected the degree and nature of vulnerability varies, in certain degrees, between islands but impacts would certainly be experienced in the livelihood of the people as well as climate sensitive sectors such as agriculture and livestock, coastal zones and reefs, water supply, health, forest and biodiversity.

1.1 Study Background

It is exceedingly obvious that adaptation is an unavoidable process particularly for small island countries who also for many reasons are the least able to adapt to extreme climate related events. Given this background, efforts are currently being undertaken at the international level to develop a way forward into piloting adaptation projects. Therefore, the Government of Canada has provided financial support to the Pacific to assist them develop practical and meaningful ways of addressing their vulnerabilities and be in a position to increase their coping capacities to climate related disasters. It is within this framework that this particular study was conducted in the three pilot sites.

1.1.1 Framework of Study

The Community Vulnerability and Adaptation Assessment and Action (CV&A methodology developed by SPREP was followed for all 3 Vanuatu pilot sites. CV&A is a systematic approach to assessing communities' vulnerability[1] to climate change. The starting point of any CV&A is the community and the primary focus will be to identify

[1] Vulnerability in this CV&A guidelines is defined as the susceptibility (degree of exposure) of a system to the effects of climate change and also its capacity to deal with the negative or positive effects of these changes (resilience).

and assess what climatic conditions, communities are vulnerable to in order to devise appropriate adaptive interventions[2].

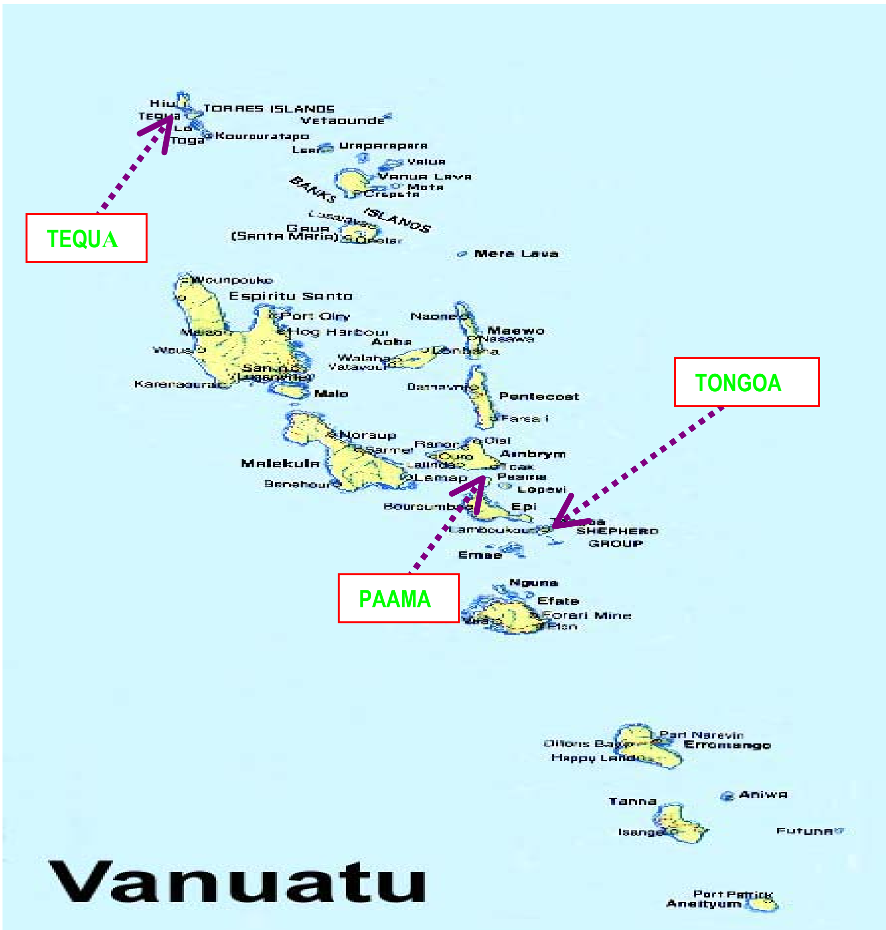

Fig: 1. The Republic of Vanuatu

The official CV&A team comprises professionals from various Government sectors and NGOs (see annex) including, the Department of Agriculture, Department of Health, Environment Unit, Department of Lands (GIS Unit), Department of Meteorology, CBDAMPIC Coordinator, Vanuatu National Council of Women, Vanuatu Association of Non-Government Organizations (VANGO) and Wan Smol Bag Theatre. Though limited, secondary data to assist with the assessments are sourced from this multi-sectoral core group prior to fieldwork.

With the dispersed nature of the islands and the high costs associated with traveling by air, the team was divided into 3 groups comprised of 4 officers to assess the three pilot sites. The team to Lateu on Tegua island comprised of Brian Phillips (CBDAMPIC Coordinator), Douglas Ngwele (VANGO), Phyllis Ganileo (Wan Smol Bag) and Zanna Brown (British Student on attachment with the CBDAMPIC Project). Frazer Bule

[2] Starting points to a vulnerability assessment vis-à-vis impact assessment are slightly different. See work carried out by Smit, B., and O.Pilifosova.2002. From adaptation to adaptive capacity and vulnerability reduction. In *Enhancing the Capacity of Developing Countries to Adapt to Climate Change*. eds S. Huq, J. Smith, R.T.J. Klein. Imperial College Press: London.

(Department of Agriculture), Silas Robson (Department of Meteorology), Linda Mala Olul (Department of Lands, GIS Unit), Annick Stephines (VNCW rep, & Department of Agriculture) conducted the assessment of Luli on the island of Paama, while Shirley Laban, (Department of Health) Bob Kuao (VANGO) and Silas Robson (Department of Meteorology) conducted the Panita assessment.

For all the sites, the CV&A assessments and consultations with the communities were conducted as follows;

1. Climate Change Awareness and purpose of CV&A explained – The awareness components are a continuous effort to increase the understanding of the communities on climate and sea level change and adaptation issues while the later is to ensure the community understands what is expected of them towards the development of the CV&A document and adaptation options.

2. Community is divided into groups of Men and Women where the identification, listing and prioritisation of climate related problems and effects on livelihood takes place with the assistance of CV&A teams – This ensures discussions and views of both men and women are taken into consideration.

3. Livelihood indicators are identified and inserted along with climatic problems identified in step 2 into matrix tables and ranked by groups according to effect on livelihood indicators. – This is achieved by using a simple ranking guide from 1 – 3 where 1 = no effect of problem & 3 = significant effect of problem on livelihood indicator.

4. The 3 most significant problems are then extracted from the matrix and inserted into problem trees to find their causes and effects

5. Current coping strategies of the problems are then identified and assessed through discussions with groups

6. Adaptation options are developed for the 3 most significant problems in groups

7. Groups come together and present results of discussions and prioritised problems and adaptation options

8. Community collectively prioritises 1 climatic problem and 1 adaptation option as the proposed adaptation project.

1.2 Climate Change and Variability: Background

In the absence of climate specific data from the 3 pilot sites, analogous data from Sola, (Vanua Lava), Lamap,(Malekula) and Bouerfield (Efate) are utilized to outline the basline climate of Lateu, Luli and Panita respectively (see annex for data).

Two distinct seasons influence the Vanuatu archipelago, a hot and wet season from November to April, known also as the cyclone season and a cold and dry season from May to October. Rainfall often peak during the earlier season as a result of heavy rainfall associated with cyclones or depressions in that period annually.

Lateu receives an annual average rainfall of 4001.1mm with an annual mean average temperature of 27.2°C. Generally the group is wetter then other islands in the archipelago as it is influenced by the Pacific Convergent Zone and the Inter-tropical Convergent Zone. Annual maximum temperatures for the pilot area since 1973 to 1998 show an annual increase of 0.0214°C with the warmest years recorded from 1995 to 1998.

Luli receives 2123.9mm of rainfall on average annually with an annual mean average temperature of 27.3°C. Long-term rainfall records show a decreasing trend at a rate of 10.731mm annually. On the other-hand, long term annual mean temperature records from 1961 – 2001 show a slight increase in trend at a rate of 0.0107°C.

Panita on the island of Tongoa receives an annual average rainfall of 2191.9mm with an annual mean average temperature of 28.8°C. Annual mean average temperature records from 1941 – 2001 show an increasing trend at a rate of 0.0185°C per year while annual precipitation records are decreasing in trend at a rate of 4.0603 mm from the period 1953 – 2001.

The IPCC Third Assessment Report projects with confidence global average temperature and sea levels would rise under all scenarios (IPCC TAR). Projected increases in global mean temperatures from 1990 to 2100 for a range of plausible greenhouse gas emission scenarios lie between 1.4 - 5.8°C with global mean sea level expected to rise 9 - 88 cm by the year 2100 (IPCC TAR). The IPCC TAR also notes that increase in tropical cyclone peak wind intensities and mean and peak precipitation intensities are likely over some areas (IPCC TAR).

To determine future climate scenarios for the 3 pilot communities in the face of climate and sea level change the following scenarios have been derived from the review of the IPCC Third Assessment Report, Working Group 1 which focuses on implications for Pacific Island Countries.

- Temperature – Projected to increase by 1.6 °C to the 2050s and a 2.5 °C to the 2080s
- Precipitation - 5% increase by the 2050s and 7% by the 2080s
- Tropical Cyclones - Increase in frequency and severity
- El Nino – Greater extremes of drying and heavy rainfall
- Sea Level – Projected to rise somewhere between 9 cm and 88 cm between 1990 and 2100

These scenarios will be used to discuss the future effects of climate and sea level change on Lateu, Luli and Panita communities in consideration of current or baseline climate conditions.

SECTION 2: RESULTS

2.0 Lateu Community, Tegua

The island has a small population of 176 people (with a growth rate of 0.37%, Spectrum software) and divided into two different settlements, Lateu and a smaller station. The main village of Lateu is located right on the edge of the coast less than 5 meters from the high water mark (HWM). The village comprises several houses built entirely of local materials (thatch, bamboo, palms) and two externally assisted buildings (aid post and rainwater catchment shed) of non-local/permanent material. Housing on the island contrasts significantly from other islands within the group in that they are not of firm construction. The houses are flimsy and incompact making them very vulnerable to cyclones. A small aid post on the island caters for minor medical problems while serious cases are referred to Loh or Santo. Communications facility is limited to one tele-radio that has ceased to function, hence constraining accessibility to information.

Subsistence agriculture is the main activity on the island while income is generated through the sale of coconut crabs. Economic avenues are very much limited due to limited resources, sever shipping infrequency and inadequate assistance from relevant authorities and sectors.

Fig: 2. Housing is predominantly made from local materials

2.1 Agriculture

A strong slash and burn shifting style agriculture is practiced on the island with fallow periods of 6-7 years. The sector is mainly subsistence involving a variety of crops including yam, taro, manioc and wild yam. Wild yam grows abundantly in the forest requiring no attention, while manioc taro and the common yam are cultivated and are the best-suited crops for the island growing well all year round and are the most resilient to extreme weather conditions and usually support the population in such incidences until other crops improve or recover.

Crop production has decreased significantly as a result of increased temperatures, more frequent and prolonged dry conditions and increased variability of rainfall. Pest activities have also increased with yams being the crop most affected by a tuba-eating beetle that induces rotting. Cyclone incidences however remain the major threat to the sector often severely damaging subsistence crops.

Annual average temperatures are projected to increase to 28.8 ^{o}C and 29.7 ^{o}C by 2050 and 2080 respectively under the selected climate change scenarios. With these projected elevation in temperatures, heat tolerance thresholds of crops are likely to be challenged and most likely induce heat stress, wilting and crop failure. Subsistence crop production may fall as a result and in turn threaten food security on the island. Impacts may be aggravated in the event of El Nino episodes, which are expected to cause extreme dry spells in future. Furthermore, in a warmer environment, people will be forced to reduce working hours to the early hours of the morning and the cooler hours of the afternoon and early evenings, hence reducing productivity.

Increased precipitation scenarios may increase annual averages by 200.1 mm by the 2050s and 280 mm by the 2080s. Prolonged wet conditions and warmer temperatures may create conditions favourable for pests and diseases, which may flourish and affect production and food security significantly.

The projected increase in cyclone frequency and intensity further heightens the vulnerability of the Agriculture sector. Destructive winds and heavy rainfall associated with cyclone events may result in widespread crop damage.

2.1.1 Coastal Zone and Settlement

The coastal zone is relatively flat and surrounds a succession of raised plateauxs that form most of the island's interior. Vegetation in uninhabited areas is intact and consists mainly of a frontline of sea-oaks, *Casuriana spp*, followed by other coastal species including *Hibiscus tiliaceus*. Mangroves occur in small patches inside the eastern bay of the island. Where there is human habitation, (eastern coast) vegetation is disturbed by patches of coconut plantations. Extensive areas of coastal marshes occur especially on the eastern coast. The coastal zone is generally well protected by uplifted dead coral barriers fringing the coast of most of the island. This significantly reduces coastal erosion from most of the coast. Some nice stretches of white sandy beaches with a lot of tourism potential exist within the island's bay. However, the sufficient assistance to develop the sector is lacking hence the area remains dormant.

The sector seats the two settlements on the island. The main village is located inside a bay on very flat land less than 5 meters from the HWM. Physical barriers are absent inside the bay and as a result erosion of more than 50 metres over the last 10 – 20 years (Chief S. Richmond pers. com) and permanent flooding of the village heightened during high tide, spring tide and consistent south easterly winds are acute problems increasingly threatening the settlement and human lives.

Fig: 3. Sleeping houses raised on foundation of rocks to accommodate flooding

Sleeping houses are built on foundations of accumulated limestone rocks to avoid flooding at high tide. Kitchens are a separate building from the sleeping house where fireplaces are raised on limestone rocks to keep them dry, as most kitchens are damp and get flooded at high tide. The village grounds are permanently wet, muddy and slippery from flooding and this is aggravated during periods of prolonged rain. Furthermore extensive salt marshes located behind the village contribute significantly to flooding in the event of heavy rain. Several permanent structures including a health aid post, cement water tank and rainwater catchment facilities 40-50 meters from HWM may have to be abandoned should conditions worsen as their brick and cement foundations are regularly surrounded by water.

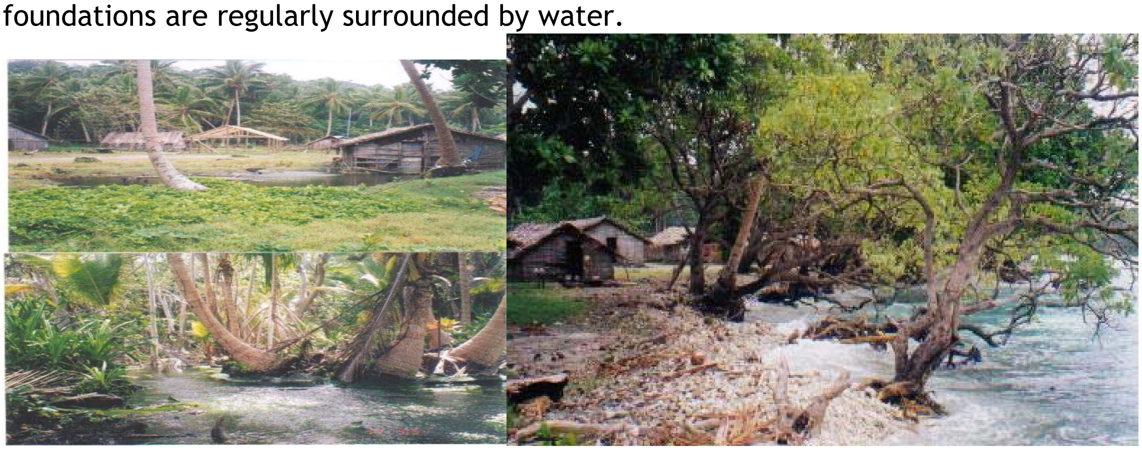

Fig: 4. The elevated water lens and coastal erosion are turning Lateu community into an aquatic environment.

 

Fig: 5. Coastal erosion 2002 (trees fallen and dead)   Fig: 6. Fireplace raised with rocks

The settlement is very vulnerable to storm surges and tidal waves owing to its very low elevation, its very short distance from HWM and the predominantly flimsy local material (bamboo & thatch) utilised for housing. Unlike other islands in the group, housing on Tegua differs greatly. Very few buildings sport a thick woven bamboo wall. Most consist of a single wall of crushed bamboo poles and thatched roofing that is very vulnerable to cyclone events. A tidal wave incident triggered by an earthquake in 1998 (Chief S. Richmond pers com) washed through the settlement destroying the whole village. Storm surges associated with cyclones pose a significant threat to the low-lying area.

Fisheries on the island are abundant and lobsters are harvested from the surrounding reefs and marketed to the main commercial centres, Port Vila and Luganville (Santo). No form of conservation is imposed on the marine resources, as exploitation is low. The economic potential of the sector is high however the appropriate assistance, facilities and marketing avenues are lacking for its development. The geographic isolation of the island group from other main islands and essential services further compounds the situation.

Projected elevation in sea level by 88 cm is most likely to enhance coastal erosion and inundation on parts of the island. The projected elevation superimposed with normal 1meter diurnal high tides, coupled with 4 meter average storm surge heights would mean areas and infrastructures under 3-4 meters above sea level could become significantly affected by tidal activities in future.

Given the baseline conditions of the sector,

- coastal erosion may become more acute and undermine already thin existing coastal vegetation buffers and significantly increase the vulnerability of village infrastructure to tidal activities
- flooding may heighten and extend farther inland
- settlement is likely to become unsuitable for human habitation

Tectonic subsidence may further enhance the impacts of sea level change in the sector.

With the projection of annual rainfall averages set to increase by 200.1 mm by the 2050s and 280 mm by the 2080s. Projected increases in precipitation are likely to compound the inundation problem in the coastal sector significantly. The existence of salt marshes or extensive water bodies in the sector may further aggravate the problem and may heighten flooding impacts.

Increased temperatures are most likely to induce coral bleaching of reef systems that may trigger a decline in productivity levels and affect the physical functions of the systems. Furthermore bleaching effects could be enhanced in the event of El Nino episodes. Socio-economic activities associated with the systems could also become affected.

2.1.2 Water Resources

Rainwater is the islands principal source while coastal springs exist as an alternative. Roof catchment for the resource is provided by the community church and an externally assisted rainwater roof catchment shed and the rain water is stored in two separate cement water tanks with holding capacities of >1000 litres. The roof of the islands small aid post is also utilised to capture rainwater. Roofing on the island is predominantly thatch, hence roof catchment for rainwater is very limited. Rainwater is utilised for most domestic purposes while coastal springs serve as a source for washing and bathing.

Fig: 7. One of three rainwater catchment and storage facilities

Increased temperatures coupled with incidences of the El Nino episode may result in possible water shortages given the high dependence on rainwater. Capacity to capture and store water will greatly determine the islands future vulnerability to water shortages.

With annual average precipitation expected to increase by 200.1 mm and 280 mm by the 2030s and 2080s respectively, the abundance of rainwater may prevent or alleviate any water shortage problems depending on future water catchment and storage capacity.

Under the projected sea level rise scenario, coastal springs may become difficult to access due to increased inundation by sea level rise and increased salinity levels. This may mean increased pressure on rainwater resources.

2.1.3 Living Conditions

Under current climatic conditions, Malaria and water washed skin infections especially among children are the most common health problems. These health problem stem from the regular flooding or inundation of the village compound, coupled with existence of extensive swamp areas, which create favourable conditions for mosquitoes and water borne infections. During the 1999 La Nina episode, water related diseases and infections peaked significantly with 45 reported cases of pneumonia among infants from 2 months to 4 years of age and 22 cases of Malaria among infants from 1 – 4 years and more than 5 years of age (see annex for health data).

The projected climate conditions associated with global warming especially increases in humidity and precipitation coupled with likely increase in the frequency and intensity of cyclone events may create conditions conducive for many diseases and disease vectors. The emergence of new diseases and re-emergence of those that are dormant is highly likely.

Malaria, endemic to Vanuatu and a significant health problem for many years peak during the wet season, November – April. The projected enhancement of precipitation by 109.6 mm and 263 mm by the 2030s and 2080s respectively could provide favourable conditions for malarial vectors and increase the vulnerability of populations to the disease. Furthermore Dengue fever, Filarisis, Onchoceriasis and Trypanosomasis could increase or surface as a result of favourable vector conditions.

Fig: 8. Other Diseases Likely to Increase or Surface on Tegua.

Water Borne Diseases	Water-washed Diseases	Water Contact Diseases
• Diarrhea • Dyphoid • Dysentry • Amoebiasis • Shigella • Cholera • Giardiasis • Hepititis A • Leptospirosis • Gastroentritis	• Scabies • Yaws • Trachoma • Conjunctivitis • Skin sepsis/ulcers • Tinea	• Otitis externa • Schistosomiasis • Guinea worm

2.2 Luli Community, Paama

The majority of people practice a largely traditional subsistence agriculture and fisheries. Income within the island is generated through the domestic sale of garden produce and fisheries. Transport constraints make access to outside markets difficult. Apart from the semi-subsistence agriculture several small retail shops operate on the island.

Landslides are a major threat to Luli in the events of heavy rainfall and cyclones. Steep terrain rise immediately behind the flat coastal strips where most settlements are concentrated. Agricultural activities concentrate on these steep slopes, which are characterized by loose unstable volcanic soil that is able to soak in heavy rain. The resultant weight of the soil coupled with an earth tremor after prolonged rainfall may trigger slides. Subsistence gardens and most settlements on the island are located on slide prone areas. Tremor induced landslides on 26 November 1999 destroyed 417 gardens and buried several homes (Higgins et al 1999).

Fig: 9. Landslides are a threat to agriculture and village infrastructure

2.2.1 Coastal Zone/Resources.

Being young, the island lacks a consistent well-developed reef system. Its few reefs are mostly submerged and scattered along the leeward south-western coast. Fisheries is rich and provides a continues supplement to the island diet. Apparently deep-sea fisheries is abundant, however transport constraints make marketing resources outside the island difficult.

Luli is located about 80 meters from the shoreline of a boulder coast and boarded on both sides by steep terrain that extend to the shoreline forming bold coasts on either sides of the settlement’s shoreline. Coastal erosion is minimal, however physical erosion occurs where the coast is bold. Tremors and slides exacerbate this effect resulting in the loss of large areas of solid barriers.

The settlement and surrounding agricultural area is exposed to relatively high salt spray, which exacerbates significantly during cyclone events. Salt spray kills off subsistence crops threatening food security and corrodes rainwater catchment materials heightening difficulties in accessing drinking water. Loss of significant original vegetation buffers over time has compounded the problem. Locally initiated measures to reinforce the buffers by replanting pandanus and other salt tolerant species are at their infancy.

Fig: 10. Boulder coast of Luli on eastern coast

Projected increases in precipitation could induce or increase the incidences of landslides, which are likely to impact severely on settlements, infrastructure and human lives. Given the loose soil profile, under a scenario of increased rainfall, slides could be triggered more often or in the event of tremors and discharge their loads on the settlements. Runoff from the cultivated slopes to the sea could decrease reef health through smothering and reduce their ability to adapt naturally to temperature and sea level changes.

2.2.2 Water Resources.

Rainwater is the principal water source of the island utilised by 84% of households. Surface water is meagre and often difficult to tap, largely due to the mountainous terrain.

Being on the windward side of the island, Luli encounters severe water shortages in periods of prolonged drought. The only accessible source is rainwater however, the settlement is exposed to salt spray and volcano induced acid rain, which render iron roofing impractical for both housing and rainwater catchments. Hence water shortages are common. Extreme cases of droughts in the past saw people travelling by canoe as far as Liro on the western coast to fetch water. The small settlement depends entirely on a single underground rainwater well. Surface water exists up the steep terrain however attempts to tap it have been futile.

Fig: 11. Corrosion of roof catchment from salt spray and volcano induced acidic rain

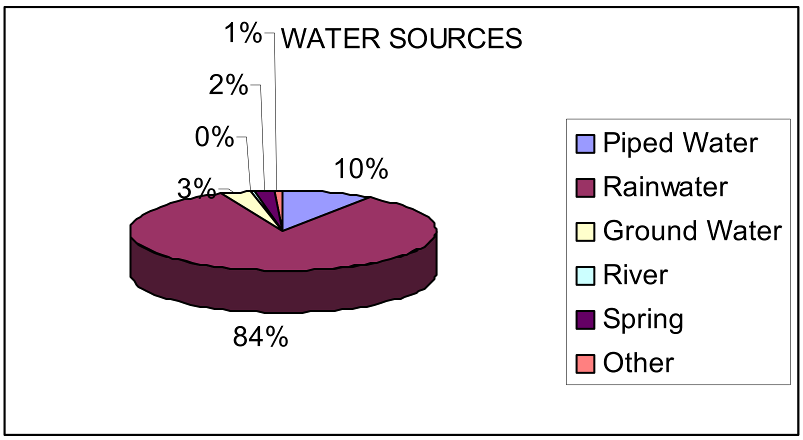

Fig: 12. Water source dependencies

Increased temperatures and prolonged drought conditions associated with El Nino conditions may trigger severe water shortages in Luli. Given their limited catchment and storage capacity, severe water shortages are likely under warmer temperatures.

Projected increase in average rainfall by 106.2 mm and 148.7 mm by the 2050s and 2080s respectively may boost water availability and alleviate water problems significantly, however this will depend entirely on the future rainwater catchment and storage capacity of the community.

2.2.3 Agriculture.

Agriculture is semi subsistence and largely rotational with a three to four year maximum fallow period. Since most of the relatively flat land is occupied by the settlement, cultivation is taken up in the sloppy steep terrain, which is highly prone to landslides. Slides in December of 1999 destroyed an estimated total of 417 gardens (Higgins et al). The soil is volcanic and fertile however it is very loose and susceptible to erosion. Stable crops throughout the island are yam (*Dioscorea sp.*), taro (*Colocasia* *sp.*) and Kumala (*Kumara sp.*), which are most suited to the soil. Vegetables grow very well on the island.

Kava (*Piper methysticum*) and Coconut are the major cash crops, though taro, yam and vegetables also generate income. Very old stands of coconut plantations take up quite a substantial area of the slopes. However, copra is no longer produced in large quantities because of low returns.

The island traditionally has always been practicing and still strongly maintains a slash and burn style agriculture with definite planting seasons that have been passed down for generations. A plot is always cleared and burned prior to planting. This practice is highly susceptible to changes in climate patterns especially rainfall variability where the burning of garden plots is impossible due to prolonged rain, hence delaying planting seasons and affecting production.

Cyclones are a constant threat to the sector affecting production and food security. Rats are a major pest to agriculture, attacking all crops, fruit and nut trees. The rodents are well established on the island since no active predators exist to control their numbers.

Annual average temperatures are projected to increase to 28.9 ^{o}C and 29.8 ^{o}C by 2050 and 2080 respectively. The elevation in temperatures could induce heat stress, wilting and crop failure. Crop production may fall as a result and in turn threaten food security. Impacts on the sector are likely to be exacerbated in the event of El Nino episodes.

The elevation of temperatures may also mean the reduction of working hours in the sector to the early hours of the morning and the cooler hours of the late and early evenings, which may lead to reductions in productivity.

Projected increases in precipitation may boost average rainfall by 106.2 mm by the 2050s and 148.7 mm by the 2080s. Given the loose characteristics of the islands soil profile, coupled with the concentration of subsistence cultivation on slopes, increased precipitation is most likely to result in increased incidences of landslides which may result in significant loses of subsistence gardens and threaten food security. Precipitation increase could also cause soil erosion and leaching of valuable soil nutrients. Furthermore prolonged wet conditions and warmer temperatures may create conditions favourable for pests and diseases, which may flourish and affect production and food security significantly.

Because of the strong traditional slash and burn agricultural system, shifts in rainfall pattern may significantly affect planting seasons causing delays in planting and harvesting thus affecting production.

Increases in cyclone frequency and intensity may also cause widespread damage and threaten food security on the island.

2.2.4 Non-climatic Stressors.

The Lopevi volcano located some 4 kilometers from the windward coast of the island is a major non-climatic stressor. It lies in the path of the south-easterly trades and as a result, the Luli community (located up wind) is constantly subjected to volcano induced slightly acidic rain.

The acidic rain destroys garden produce especially vegetables (ie: cabbage, lettuce) and fruit tree production. The tender flowering stalks of fruit trees at the beginning of their respective fruiting seasons are killed off by acid rain and this significantly affects fruiting. Volcano induced acid rain coupled with salt spray contribute greatly to Luli's acute water problem. Corrugated iron is impractical for roofing and rainwater catchments owing to the fast rate of corrosion.

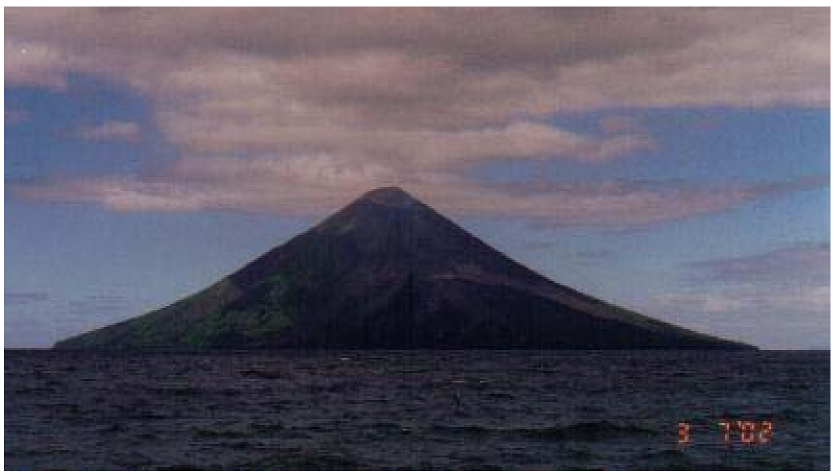

Fig: 13. Lopevi Volcano, a significant non-climatic stressor in the agriculture and water sectors

2.3 Panita Community, Tongoa

Panita lies on the southwestern coast of the island, seated on a cliff of unconsolidated volcanic material with the edge of the 2.5 hectare settlement about 31 meters from HWM. The population of the community is estimated at around 100 mostly engaged in semi-subsistence agriculture and fisheries.

2.3.1 Agriculture

Agriculture is rotational and semi-subsistence on the island with a lot of cash cropping. Subsistence cultivation mainly involves manioc, *Casava sp*, Yam, *Dioscorea sp*, Taro, *Colocasia sp*, bananas *Musa sp* and greens. Manioc, yam and taro have always been the islands stable food sources but in the last 5 to 10 years or so yields of the two earlier root crops have decreased significantly due largely to climate variability-persistent rain, cyclones and prolonged dry seasons. Taro varieties especially the Tongoan taro and the Fijian Taro, *Colocasia xanthasoma* seem well adapted and thrive in these climatic conditions.

Persistent rain and long periods of drought greatly affect agricultural crops. Prolonged rain and drought result in the rotting of crops including yam, manioc and kumala, while fruit trees undergo a significant fall in yields or cease to fruit altogether. Cyclones remain a constant threat to the productivity of the sector.

Under the selected climate change scenarios, annual average temperatures are projected to increase to 30.4 ^{o}C and 31.3 ^{o}C by 2050 and 2080 respectively. The elevation in temperatures could induce heat stress, wilting and crop failure. Crop production may fall as a result and in turn threaten food security. In the event of El Nino episodes impacts are likely to be worsened.

The elevation of temperatures may also mean the reduction of working hours in the sector to the early hours of the morning and the cooler hours of the late and early evenings, which may lead to reductions in productivity.

Increased temperatures may also affect growth, production and reproductive efficiency of livestock animals on the island by causing body temperatures to rise above optimal animal zones of comfort.

Annual precipitation averages under the selected climate change scenarios may increase by 109.6 mm by the 2050s and 263 mm by the 2080s. Projected increases in humidity and wet conditions may create favourable conditions for disease, weeds and pest activity in the sector, which could affect production significantly. Increased rainfall could also cause soil erosion and leaching of valuable soil nutrients. On the other hand more rainfall may boost the production of taro species on the island that are exhibiting sound growth under wet conditions.

With the projected increase in cyclone frequency and intensity the vulnerability of the sector is significantly heightened and threats to food security may be heightened.

2.3.2 Coastal Zone/Resources

The coastal zone of the island generally runs from either a sandy black volcanic beach or boulder beach of basaltic rocks, then progresses into an easily erodable bold cliff of loose volcanic soil. Because of its geological infancy reefs on the island are very few, underdeveloped and submerged. In the absence of an effective reef buffer the basalt boulders lining the coast of the island play a significant role in dissipating wave energy thus minimizing coastal erosion in some areas to a certain extent.

Erosion of the coast however, is a major problem and is severe and rapid along the coast of Panita. Anecdotal data (M. Rarua pers. com) indicates significant loss of coastal land or coastal recession over the past 50 years is in excess of 100 meters. Coastal erosion is heightened especially in the event of storm surges associated with cyclones, which generate waves that wash away the loose cliffs threatening vegetation and village infrastructure.

Additional to this, flooding of two creeks that run behind the settlement and out to the sea on either sides of the settlement is also threatening village infrastructure and human lives. Heavy and prolonged rainfall heightens the vulnerability of the settlements from flooding by the creeks.

Fig: 14. Severe erosion along the coast

Heightened sea levels as projected under the selected scenarios are likely to increase erosion of the coasts exacerbating recession along the coasts and loose cliffs of Panita. Given the immediate proximity of the settlement to the sea, infrastructure vulnerability is likely to increase significantly and relocation of the settlement may be necessary. Furthermore cyclones, which are projected to increase in frequency and intensity and their associated storm surges are most likely to aggravate erosion problems and heighten vulnerability of coastal infrastructure and human lives.

2.3.3 Water Resources

Panita is part of 86% of the island's population that depend on rainwater. Rainwater is captured via iron roofing (roof catchment) and stored in drums, tanks and wells. All wells are made of cement and are often built underground with general holding capacities of over 1000 litres. Water storage tanks or wells are either made locally from cement or fibreglass tanks are bought and shipped from Vila. Holding capacities of both ranges from 300-500 litres. Access to rainwater resource in Panita is relatively good however prolonged drought often brings about water shortages forcing villagers to resort to an underground water well or to fetch water from Lupalea.

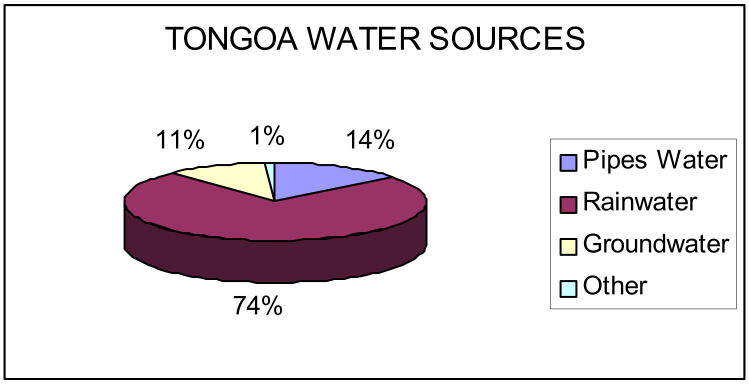

Fig: 15. Tongoa water sources

Projected increases in temperatures coupled with dry spells associated with El Nino episodes could bring about severe water shortages in water scarce areas like Panita.

With annual rainfall average projected to be boosted by 109.6 mm and 263 mm by the 2030s and 2080s respectively, the resource may become abundant and alleviate shortages, however the capacity to capture and store sufficient water in water scarce areas will greatly determine vulnerability to shortages in future.

2.4 Vulnerability identified and prioritised

Identification is carried out jointly by communities and facilitators, determining risks associated with climate change that the communities face in their daily lives, using the participatory learning-by-doing (hands on) approach. The identification process is a combination of awareness raising and information exchange between communities and facilitators (CV&A teams).

Fig: 16. Summary of Identified Vulnerabilities

Pilot Community Identified Vulnerabilities (* = Low Vulnerability, ** = Medium Vulnerability, *** = High Vulnerability, **** = Critical Vulnerability)

Pilot Community	Vulnerabilities Identified	Who is Vulnerable?	Vulnerability Level	Causes of Vulnerability
Lateu, Tegua	Dwelling houses and kitchen inundated due to rise in water table.	70-80% of village and population affected.	****	• Flooding/Inundation of settlement by the sea • Sea Level Change • Tectonic subsidence • Short and intensive rainfall due to Climate variability • Flat & low elevation of village site • Location of village on coast • Close proximity to water bodies • Low topography of village • Cyclones • Storm surges & waves
	Insufficient drinking water	100% of population	***	• Climate variability • El Nino • Limited roof catchment • Limited water storage facilities • Prolonged dry seasons droughts
	Lack of timely meteorological advice on seasonal changes and extreme events. Have to rely on traditional knowledge.	100% of population	****	• Geographical isolation • No communication facilities available • Lack of access to climate and weather forecasts/Communication

	Increase in water borne disease e.g. Malaria	20% - 30% of population	***	• Flooding • Close proximity to water bodies • Lack of adequate medical supplies • Lack of consistency in medical supplies

Pilot Community	**Vulnerabilities Identified**	**Who is Vulnerable?**	**Vulnerability Level**	**Causes of Vulnerability**
Luli, Paama	Lack of water for daily consumption	100% of population affected	****	• Geographical location • Salt spray effect on roof catchment and metal storage facilities • Volcanic fall out corroding roof catchment and metal storage facilities • Very little underground water potential • Limited catchment & storage facilities
	Land loss and loss of agricultural crops	20% of land affected and 70% of population affected	****	• Land slides due to loose volcanic soil structure • Short and intensive rainfall • Deforestation • Volcanic Ash/Acidic fallout • Little advice received from relevant authorities
	Lack of timely meteorological advice on seasonal changes and extreme events. Have to rely on traditional knowledge.	100% of population It will impact on planting patterns, preparations for cyclones etc.	***	• Lack of relevant assistance • Lack of access to climate and weather forecasts/Communication • No communication facilities •

	Medical complications and diseases e.g. malaria and child birth	70% of population	***	• Lack of health facilities • No proper road infrastructure to allow easy access to information and medical attention from other side of island

Pilot Community	Vulnerabilities Identified	Who is Vulnerable?	Vulnerability Level	Causes of Vulnerability
Panita, Tongoa	Decreased agricultural production	100% of population, agriculture & economic activities	***	• Climate variability; • Increased pest activity • Cyclones • Droughts
	Lack of sufficient water	100% of population	***	• Climate variability • Geography • High cost of roof catchment and storage facilities • Limited underground water source
	Land and Property loss	60% of population	***	• Short and intensive rainfall causing flooding • Deforestation in the higher catchments • Waterway/drainage not properly constructed • Medium/Low Topography of settlement • Location of settlement between 2 creeks
	Coastal land loss/recession	40% of population & 1 square Km of coastland threatened	****	• Cyclones • Storm surges and waves • Sea Level Change • Loose volcanic soil structure

Having identified their vulnerabilities the pilot communities then had a list of climate related problems. From the list of problems the communities then collectively prioritised 1 major problem for adaptation project consideration.

Fig: 17. Identified Vulnerability Summary

Pilot Community	**Vulnerabilities Identified**	**Vulnerability Level**
Lateu, Tegua	Dwelling houses and kitchen inundated due to rise in water table.	****
	Insufficient drinking water	***
	Lack of timely meteorological advice on seasonal changes and extreme events. Have to rely on traditional knowledge.	****
	Increase in water borne disease e.g. Malaria	***

Pilot Community	**Vulnerabilities Identified**	**Vulnerability Level**
Luli, Paama	Lack of water for daily consumption	****
	Land loss and loss of agricultural crops	****
	Lack of timely meteorological advice on seasonal changes and extreme events. Have to rely on traditional knowledge.	***
	Medical complications and diseases e.g. malaria and child birth	***

Pilot Community	**Vulnerabilities Identified**	**Vulnerability Level**
Panita, Tongoa	Decreased agricultural production	***
	Lack of sufficient water	***
	Land and Property loss	***
	Coastal land loss/recession	****

Fig: 18. Pilot Community Prioritised Vulnerabilities.

Pilot Site	Prioritised Problem
Lateu, Tegua Island	Flooding/Inundation of settlement
Luli, Paama Island	Lack of sufficient water
Panita, Tongoa Island	Coastal land loss/recession

2.4.1 Lateu Community.

For the diversity of climatic problems faced by the Lateu community, Poor Housing and/or Living conditions was prioritised as the principal problem impeding on their livelihood.

The problem stems from multiple climatic and non-climatic conditions. Severe coastal erosion of about 50 meters over the last 20 years encroaching into the village and sea level have raised underground water lenses flooding and creating permanent and regular standing pools of water throughout the village compound. The situation is aggravated during spring and neap tide events and high tides associated with consistent south westerly winds. Heavy rainfall and cyclones aggravate flooding significantly.

The result is a flooded village resulting in poor and unhealthy living conditions. The periodic flooding of dwellings by the various climatic and tidal parameters deteriorates housing rapidly, it prevents or completely stops mothers from cooking on the ground (fire place) and results in endless damp and wet sleepless nights. The flooding triggers the overflow of pit toilets, it contaminates the settlements only underground water well and creates conditions favourable for water borne diseases, which have increased significantly including malaria, diarrhoea and skin infections especially among children. (see annex for problem trees)

2.4.2 Luli Community.

Lack of water was highlighted and prioritised by the Luli community. Prolonged droughts, limited rainwater catchment and storage facilities and volcanic fallout were among the major causes of the problem.

The soil structure of the island does not allow water storage hence groundwater is lacking in the pilot community leaving rainwater as the only source of water. Prolonged droughts, coupled with the community's limited capacity in rainwater catchment and storage result in severe water shortages. Corrosion from salt spray and acidic fall out from the nearby Lopevi volcano render iron roofing impractical for rainwater catchment further compounding water problems for Luli.

2.4.3 Panita Community

Panita's significant land loss along its coast due to coastal erosion, which continually threatens the settlement, was the prioritised problem. In the last 50 years the coastline has receded more than 100 meters and the threat to settlement infrastructure is significant. Sand mining and removal of coastal vegetation are also contributing to the problem. Coastal erosion is heightened during cyclone events when waves associated with surges wash far beyond the HWM and undermine the loose structure of the cliffs that seat Panita. Waves washing into areas of the village are becoming common during cyclone events and greatly increase the vulnerability of the settlement.

2.5 Past, current and future coping ability assessed

Owing to among other factors, geographical isolation, information inaccessibility and lack of capacity to address these prioritised problems, the 3 communities have improvised in devising and developing coping strategies to minimise the effects of the problems encountered.

Fig: 19. Lateu Summary of Coping Capacities

Pilot Site	Prioritized Problem	Coping Capacity
Lateu, Tegua Island	Flooding/ inundation of settlement	• Foundation of houses raised with rocks to accommodate inundation or flooding • Shift/move house to safer location • Regular change of thatch and posts of houses • Use of bush and sea shore as toilet when pits overflow • Put up with conditions/problem • Raise fire places with foundation of rocks • Cook in sleeping houses • Wait for water to recede • Share dry cooking/fire places with other households • Treatment & medication from aid post • Village clean up campaigns • Boil drinking water • Use of traditional/ custom medicine • Use of coastal springs • Coconuts • Attempt to clean and use dirty and saline ground water well source

The coping strategies developed by the Lateu community are aimed at addressing the results of the principal problem of flooding or inundation and its other associated effects. These strategies are barely attempts to cope with the effects but are far from solving the real problem.

Though sleeping quarters and fire places are raised on foundations of rocks the settlement is still being inundated, ground water contaminated, pit toilets over flowing and water borne diseases and infections are still emerging. The strategies devised have minimised the effects of flooding to a small extent enabling the community to cope but the problems still exists and could be heightened in the face of future climate and sea level change, hence a more concrete solution that addresses the root cause is critical.

Fig: 20. Luli Summary of Coping Capacities

Pilot Site	Prioritized Problem	Coping Capacity
Luli, Paama Island	Lack of sufficient water	• Fetch water from nearby village or water source of nearby village up the hill • Use of coastal spring water • Drink coconuts • Use coconut husks to clean plates • Switch to roast/oven prepared diet

Coping mechanisms in Luli are basically autonomous adjustments especially during dry seasons or prolonged periods of droughts, which serve as short-term measures to conserve water. Water shortage however continues to be a problem as there is yet no long-term solution that addresses salt spray and volcanic fallout. Hence, the current coping ability of the community cannot cater for the community's future need for water in the face of climate and sea level change.

Fig: 21. Panita Summary of Coping Capacity

Pilot Site	Prioritized Problem	Coping Capacity
Panita, Tongoa Island	Coastal land loss/recession	• Limit coastal sand mining • Stop removal of coastal vegetation • Relocation of 1 household

With the sea encroaching on the settlement and floods threatening on land, the village is fighting a losing battle. Coping strategies stopping sand mining and vegetation removal from the coast is the least Panita can do. These however have not and are not likely to curb erosion of neither the coast nor flooding from heavy rainfall.

2.6 Vulnerabilities Statements

Under the selected climate and sea level change scenarios the vulnerabilities of the 3 pilot communities in relation to the prioritised problems are most likely to heighten significantly given the degree of their past and current coping abilities.

Lateu's flooding problem is most likely to be enhanced significantly under the scenario of increased rainfall coupled with future sea level change. This will heighten coastal erosion, incidences of water borne diseases and infections, further complicate housing and living conditions and erode the community's socio-economic livelihood.

Water shortages may continue to plaque Luli under the selected climate and sea level change scenarios. The resultant enhanced hardship, health and socio-economic effects will impact greatly on the lives of the people.

Given the significant threats posed under current climate conditions through rapid erosion of the coastline and flooding from heavy rainfall, Panita's vulnerability is most likely to increase under the selected climate and sea level change scenarios.

The need for adaptation in all 3 pilot communities is therefore paramount to ensure their continued existence and to safeguard their socio-economic wellbeing there after. In light of the performance of past and present coping abilities, the need to develop and prioritise appropriate adaptation measures that address the root cause of the problems faced by communities under current climate conditions and furthermore cater for future climate and sea level change is recognised.

2.7 Adaptation Options

Adaptation is a process or measure that reduces vulnerability. Given the identification and prioritisation of problems and the assessment of past and current coping abilities, adaptation measures need to be developed for implementation by the communities to minimise, reduce or stop the vulnerabilities identified.

Discussions were facilitated by CV&A teams enabling the communities to develop best solutions to the challenges identified.

2.7.1 Adaptation options identified and characterised

Fig: 22. Lateu Adaptation Option Summary

Pilot Site	Adaptation Option
Lateu, Tegua	• Relocation of settlement (including aid post, church and rainwater catchment and tank) and increase number of rainwater tanks and catchment facilities • Shift pit toilets away from flood prone area • Enhance aid post medical supplies/stock all consistently • Relocation of settlement and establishment of 1 new underground water pump and 6 rainwater tanks at new site • Construct more rainwater tanks • Secure rainwater tanks to keep rats away • Improve current ground well

Both groups of men and women from Lateu community proposed the relocation of the whole settlement and increasing rainwater catchment and storage capacity. After preliminary consultations with the community in 2001, the community has collectively identified and proposed 2 potential sites for relocation pending visibility studies. Other possible solutions include;

- shifting pit toilets away from the flood prone area to prevent contamination of ground water and avoid health problems
- Improve or clean under ground source for use during droughts
- Enhance medical supplies or stock to the aid post to ensure relevant medication is available at all times

Fig: 23. Luli Adaptation Options Summary

Pilot Site	Adaptation Option
Luli, Paama	• Establish water supply system for community • Increase rainwater catchment and storage capacity • Clean existing wells and tanks • Secure rainwater tanks to keep dirt and pests away

The significant need for a water supply system and an increase in the number of rainwater catchment and storage facilities were common in Luli's men and women's group. Other options were small-scale measures that could be implemented entirely by the community.

Fig: 24. Panita Adaptation Options Summary

Pilot Site	Adaptation Option
Panita, Tongoa	• Relocation of settlement to higher ground • Construction of sea wall along the coast • Construction of a bridge over creeks

With the threats experienced by the community under current climate conditions, relocation of the whole settlement to a higher and safer location, construction of a sea wall along the coast to curb coastal erosion or keep the sea at bay and construction of a bridge over creeks threatening the village during heavy and prolonged rain were the proposed adaptation options.

2.7.2 Adaptation options evaluated

Having identified adaptation options with communities, an evaluation of the solutions is necessary to determine the best and most appropriate, practical and cost-effective possible solution to addressing the challenges.

Fig: 25. Lateu Adaptation Option Evaluation Summary (*=Low, **= Medium, ***=High)

ADAPTATION OPTION	COST	BENEFIT	COMMENT
A. Relocation of settlement (including aid post, church and rainwater catchment and tank) and increase number of rainwater tanks and catchment facilities (6) and establish 1 underground water pump	**	***	This option addresses the principal problem of flooding and its various associated effects and further caters for safe and sufficient drinking water. It also caters for future climate and sea level change. This option of relocation will be the first of its kind and lessons learnt will be valuable to other communities. Furthermore the cost of implementation would be low and the end result highly beneficial to the community.
B. Shift pit toilets away from flood prone area	*	*	Option B only addresses an effect of the main problem of flooding. Although it addresses a health issue it does not consider long term climate and sea level change impacts on village infrastructure and human lives
C. Enhance aid post medical supplies/stock consistently	**	***	Option C would be more effective if it were to be implemented in association with option A.
D. Improve current ground well	*	**	Though the option is addressing an effect, it fails to address the main problem and does not consider future climate and sea level change
E. Secure rainwater tanks to keep rats away	*	***	This option will be more beneficial if it is implemented in association with option A to ensure safe drinking water

Adaptation option A is an all-encompassing measure that addresses the main cause (flooding) of various climatic challenges faced by the Lateu community. Most importantly, long-term climate and sea level change is taken into consideration in that relocation to a new site will rid the community of current problems and in the long run comfortably accommodate future changes. Implementation costs would be in the low to medium range given the funding assistance of relevant national sectors and moreover the simplicity and predominantly traditional nature of the village infrastructure. The end result will be highly beneficial and ensure the socio-economic wellbeing of the community. With their increase in understanding of climate and sea level change and significant commitment towards a safe future, the community has collectively agreed and selected two potential sites for relocation pending relevant impact assessments. Hence, adaptation option A, which was emphasised strongly in both the men and women's group is the best and most appropriate, practical and cost-effective measure to address Lateu's problem. Such a measure will be the first of its kind in Vanuatu and the experiences gained will be invaluable to the rest of the archipelago especially in the area of climate change adaptation involving a small island and small population.

Fig: 26. Luli Adaptation Options Summary (*=Low, **= Medium, ***=High)

ADAPTATION OPTION	COST	BENEFIT	COMMENT
A. Establish piped water supply system	**	***	This option most importantly guarantees a constant availability of water and furthermore it entirely ensures against the negative effects of volcanic fallout and salt spray. Implementation cost is low to medium with high benefits to the community.
B. Increase rainwater catchment and storage capacity	**	***	Option B is a low to medium cost measure that will immensely benefit the community but only in the short term. It does not guarantee against volcanic fallout and salt spray effects. Maintenance to guard against volcano and salt will be too costly for the community.
C. Clean existing wells and tanks	*	***	This option only addresses the quality of the water and current catchment and storage facilities but fails to address its consistent availability
D. Secure rainwater tanks to keep dirt and pests away	*	***	This option only addresses the quality of the water and current catchment and storage facilities but fails to address its consistent availability

Compared to all other measures from Luli, option A, addresses both volcanic fall out and salt spray effects in that a mostly plastic piped network often buried will be transporting water to the community. The option also takes future climate and sea level change into consideration through the provision of a consistent supply of water in all seasons.

The establishment of piped water supply systems by the Rural Water Supply section of the Vanuatu Government's Ministry of Lands is not new and the experience and lessons gained elsewhere will benefit Luli tremendously in the setting up of their network. The establishment of such systems also involves community training in management, operation and maintenance of the network giving them control and ownership of their system.

A detailed survey of such a project has been conducted by the Rural Water Supply section, which details design, cost, government and donor contribution, (see annex). Implementation costs would be in the range of Vatu 1 million. Option A therefore is the best and most appropriate, practical and cost-effective measure to address Luli's challenge.

Fig: 27. Panita Adaptation Options Summary (*=Low, **= Medium, ***=High)

ADAPTATION OPTION	COST	BENEFIT	COMMENT
A. Relocation of settlement to higher ground	***	***	The associated cost of this option is in the medium to high range, but option is also highly beneficial to the community. Relocation will cater for both current and future climate and sea level change. The option will be one of the first of its kind and lessons learnt will be valuable to other communities
B. Construction of sea wall along the coast	***	*	This option will be extremely costly and may curb erosion but does not consider flooding from creeks in association with future climate change
C. Construction of a bridge over creeks	***	*	The option could alleviate flooding problems and if implemented with option B could benefit the community

Given the 3 adaptation measures, option A is the best and most appropriate, practical and cost-effective measure to address Panita's problems. The option will completely rid the community of its current problems and furthermore it considers future climate and sea level change. Relocation will also improve the community's access to education, health and communication services. Being one of the first relocation of its kind in Vanuatu, lessons learnt will be valuable to other similar programmes involving a big island and a high number of people.

Support for the option was strongly emphasised by both men and women's group and moreover as a community. A proposed site for relocation about 2 hectares and 100 meters above sea level has been allocated by the community which indicate their commitment and determination to move. Estimated implementation costs would be in the range of Vatu 2.5 million.

2.7.3 Approach to adaptation implementation

According to the adaptation option analysis, and the expertise of the multi-disciplinary core team comprised of Agriculture, Health, Environment, Meteorology and NGO specialists who have a lot of knowledge in working with communities, the following adaptation options were prioritised for the 3 Vanuatu CBDAMPIC pilot sites;

Pilot Site	Adaptation Option for Implementation
Lateu, Tegua	• Relocation of settlement (including aid post, church and rainwater catchment and tank) and increase number of rainwater tanks and catchment facilities
Luli, Paama	• Establish water supply/catchment system for the community
Panita, Tongoa	• Relocation of settlement to higher ground

In the case for Vanuatu with regards to the implementation of the prioritised and selected adaptation projects and given the multi-sectoral make up of the core team and the National Advisory Committee on Climate Change (NACCC), co-funding and technical support will be sought or sourced from the relevant sectors represented or otherwise to assist with on the ground implementation of the projects. This will reflect Government commitment in the area of climate change adaptation and its pursuance for national sustainable development at all levels.

2.7.4 Environmental Impact Assessment (EIA)

As is a requirement by all Government related projects, EIA will be carried out on projects that it is presumed would impact on the environment. However, it would also be important here in the case of projected climate change to know how the climate would affect the project in the future. Therefore, an EIA will be conducted on all the projects to be undertaken during this exercise.

2.8 Implementation plans for the 3 community pilot projects.

Fig: 28. Lateu Community Relocation Project Implementation Plan

Lateu Community Relocation Project Implementation Plan	
Climate Change Problem	Poor housing and unhealthy living conditions due to coastal flooding
Assessment	Community Vulnerability & Adaptation Assessment & Action
Selected Adaptation Measure	Relocation of settlement (including aid post, church and rainwater catchment and tank) and increase number of rainwater tanks and catchment facilities
Action Plan	
Proposed Actions	
A. Consultation with relevant sectors with regards to sectoral assistance B. Brief provincial authorities on adaptation project C. Conduct Environmental Impact Assessment (EIA) of proposed relocation sites D. Selection of appropriate site from EIA recommendation E. Purchase and shipping of working tools to community F. Construction of sleeping quarters & kitchens on approved site G. Relocate Aid Post to approved site H. Relocate Church to approved site I. Strategic location of pit toilets J. Construction of 6 rainwater catchment and tanks K. Water management workshop L. Installation of Rannet Radio Information System M. Monitoring	
Resource Requirements	
• Basic construction tools (saw, axe, hammer and nails etc) • Cement, timber, wire & iron roofing, guttering & spouts • Rural Water Supply Personnel	
Responsibilities	
A. CBDAMPIC Coordinator, Core team & NACCC **B.** CBDAMPIC Coordinator & Core Team **C.** Core Team & CIDA/SPREP **D.** Core Team & CIDA/SPREP **E.** Coordinator & Core Team **F.** Community **G.** Vanuatu Health Department *(funding)* & Community **H.** Anglican Diocese (funding) & Community **I.** Vanuatu Health Department (*funding & personnel)* & Community **J.** Rural Water Supply Section *(funding & personnel)* & National Disaster Management Office, CIDA & Community **K.** Rural Water Supply Section *(funding & personnel)* **L.** Meteorology Department *(CIDA & Met. Funding)* & Core Team **M.** Core Team	
Time Line	
March 2005 Completion	
Reporting and Monitoring	
Every Six months for 1 year and 1/ year thereafter	

Fig: 29. Luli Community Water Supply Project Implementation Plan

Luli Community Water Supply Project Implementation Plan	
Climate Change Problem	Lack of sufficient water
Assessment	Community Vulnerability & Adaptation Assessment & Action
Selected Adaptation Measure	Establish water supply/catchment system for community
Action Plan	
Proposed Actions	
A. Consultation with relevant sectors with regards to sectoral assistance B. Brief provincial authorities on adaptation project C. Purchase and shipping of working tools & materials to community D. Construction and net working of water supply E. Water management workshop F. Improve agricultural practices G. Reinforcement of salt tolerant vegetation buffers H. Establishment of aid post I. Installation of Rannet Radio Information System J. Monitoring	
Resource Requirements	
• Materials as specified in project document (see annex) • Rural Water Supply Personnel • Agriculture Technical Personnel • Forestry Technical Personnel & Seedlings	
Responsibilities	
A. CBDAMPIC Coordinator, Core team & NACCC **B.** CBDAMPIC Coordinator & Core Team **C.** Coordinator & Rural Water Supply **D.** Rural Water Supply *(funding & technical personnel)* & Community **E.** Rural Water Supply & Community *(funding & technical personnel)* **F.** Agriculture Department *(funding & Personnel)* & Community **G.** Forestry Department *(funding & technical personnel)* & Community **H.** Vanuatu Health Department **I.** Meteorology Department & CIDA **J.** Core Team	
Time Line	
March 2005 Completion	
Reporting and Monitoring	
Every Six months for 1 year and 1/ year thereafter	

Fig: 30. Panita Community Relocation Project Implementation Plan

Panita Community Relocation Project Implementation Plan	
Climate Change Problem	Coastal erosion and flooding threatening settlement infrastructure and human lives
Assessment	Community Vulnerability & Adaptation Assessment & Action
Selected Adaptation Measure	Relocation of settlement and rainwater storage facilities to higher ground
Action Plan	
Proposed Actions	
A. Consultation with relevant sectors with regards to sectoral assistance B. Brief provincial authorities C. Conduct EIA of proposed relocation sites D. Selection of appropriate site from EIA recommendation E. Purchase and shipping of working tools & materials to community F. Construction of sleeping quarters & kitchens on approved site G. Construction of wells H. Monitoring	
Resource Requirements	
• Cement for foundations of existing households only & wells • Basic working tools	
Responsibilities	
A. CBDAMPIC Coordinator, Core team & NACCC **B.** CBDAMPIC Coordinator & Core Team **C.** Core Team & SPREP/CIDA **D.** Core Team & SPREP/CIDA **E.** CBDAMPIC Coordinator & Core Team **F.** Community (in-kind) **G.** Community (in-kind) **H.** Core Team	
Time Line	
March 2005 Completion	
Reporting and Monitoring	
Every Six months for 1 year and 1/ year thereafter	

In addition to CIDA assistance, the implementation of the three pilot adaptation projects will be carried out with co-funding, technical assistance and technical support from relevant sectors for some of the project components as specified in the implementation plans. Community labour, assistance and support will come as in-kind contribution to the projects. Completion of all project activities is estimated to be around June 2004 with monitoring every six months for 1 year and 1 per year thereafter by the Climate Change Core Team.

Tackling the implementation of the pilots through this multi-sectoral approach assists in broadening the understanding of everyone involved of the crosscutting issues of climate and sea level change. Most importantly, it will cement sectoral working relations and significantly improve co-ordination between sectors, which will act as a conduit for success in the implementation of future adaptation projects. Furthermore, the approach reflects strong Government commitment in the area of climate change adaptation and sustainable development.

3.0 RECOMMENDATIONS

In light of the results of the Community Vulnerability & Adaptation Assessment & Action (CV&A) of the three CBDAMPIC pilot sites and the identification analysis and selection of adaptation measures, the following are recommended for implementation in the three pilot communities;

Pilot Site	**Adaptation Option**
Lateu, Tegua	• Relocation of settlement (including aid post, church and rainwater catchment and tank) and increase number of rainwater tanks and catchment facilities
Luli, Paama	• Establishment of water supply system for the community
Panita, Tongoa	• Relocation of settlement to higher ground

Given the multi-sectoral nature of the impacts of climate and sea level change, the pilot projects must be implemented in close collaboration and with the technical and financial assistance of relevant government sectors and institutions as per the implementation plans. The involvement and assistance of provincial governments are also vital in the ground implementation of the pilots.

Where necessary, sectors or institutions concerned should also address other problems identified during the CV&A process.

At the national level it is necessary for government to mainstream climate change adaptation into sectoral development planning and budgeting processes. Furthermore, it is necessary for the government to institutionalise a Multi-Sectoral CV&A Assessment Team that will work at community level to carry out vulnerability and adaptation assessments and develop adaptation recommendations that would be mainstreamed into the planning and budgeting machinery of government

Continuous capacity building in climate change vulnerability and adaptation are among activities necessary at the national and provincial levels to strengthen human and institutional capacities to assess, plan and respond to climate related risks.

4.0 CONCLUSION

By the analysis, assessment and projections published in the IPCC reports concerning climate and sea level change, coupled with increasingly emerging evidences of diverse sectoral impacts identified in previous Vanuatu V&A assessments, it is evident that it will have far reaching effects on the environmental and socio-economic livelihood of Vanuatu.

According to the analysis developed by the experts who have taken part in the preparation of this Community Vulnerability Assessment and Action Report, climate and sea level change will have significant effects in the three communities of Lateu, Luli and Panita if current problems go unattended. Hence, the necessity and urgency for the immediate implementation of the selected adaptation measures in the pilot sites so as to enable the communities to cope with future climate and sea level change.

Being the first and leading adaptation projects of this kind, the experience, knowledge or lessons learnt from their implementation will be invaluable to Vanuatu in shaping the success of future community climate change adaptation projects.

5.0 REFERENCES

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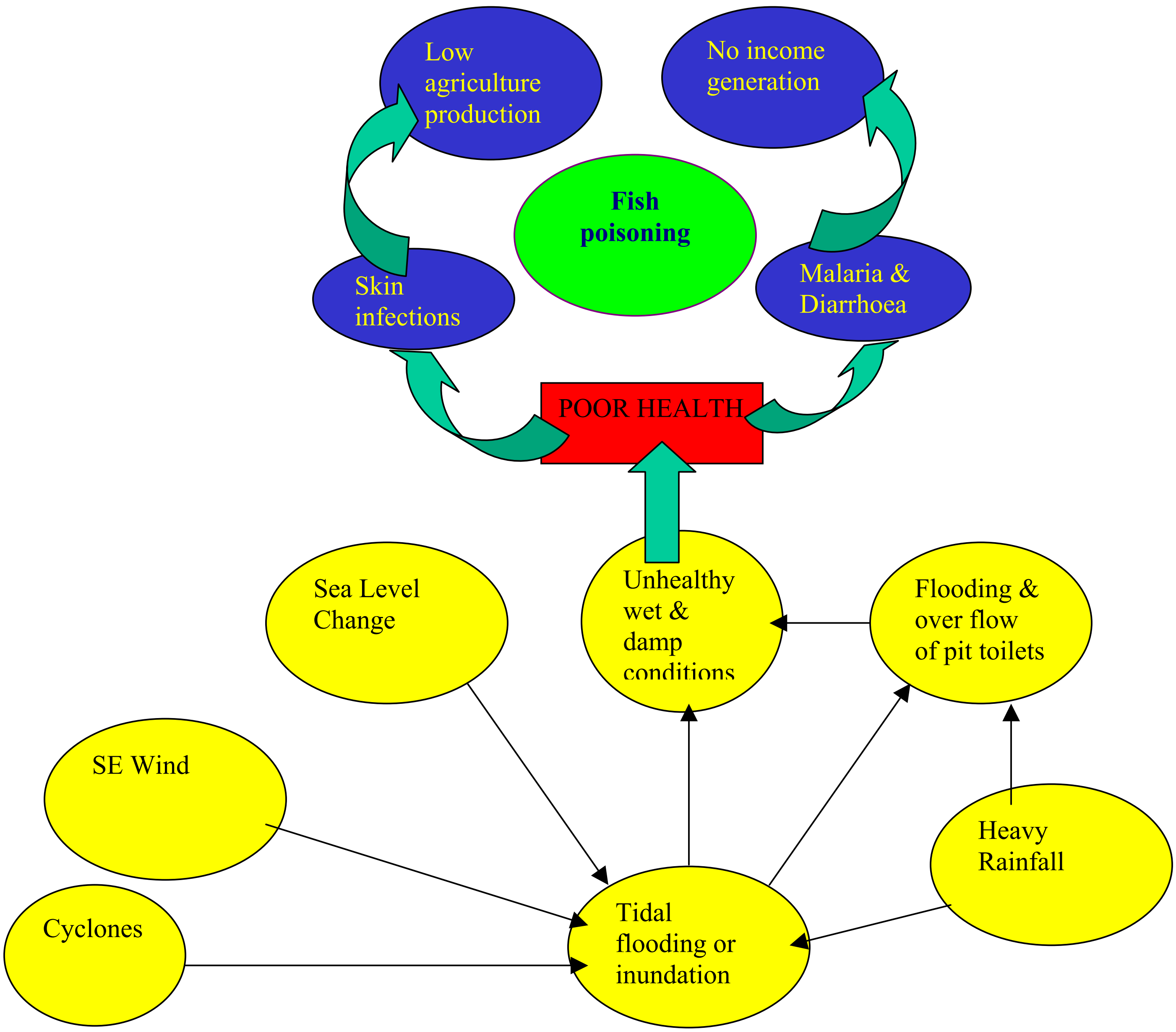
Chief Richmond Selwyn (52yrs) Pers.Com, May 2003, Lateu, Tegua Island

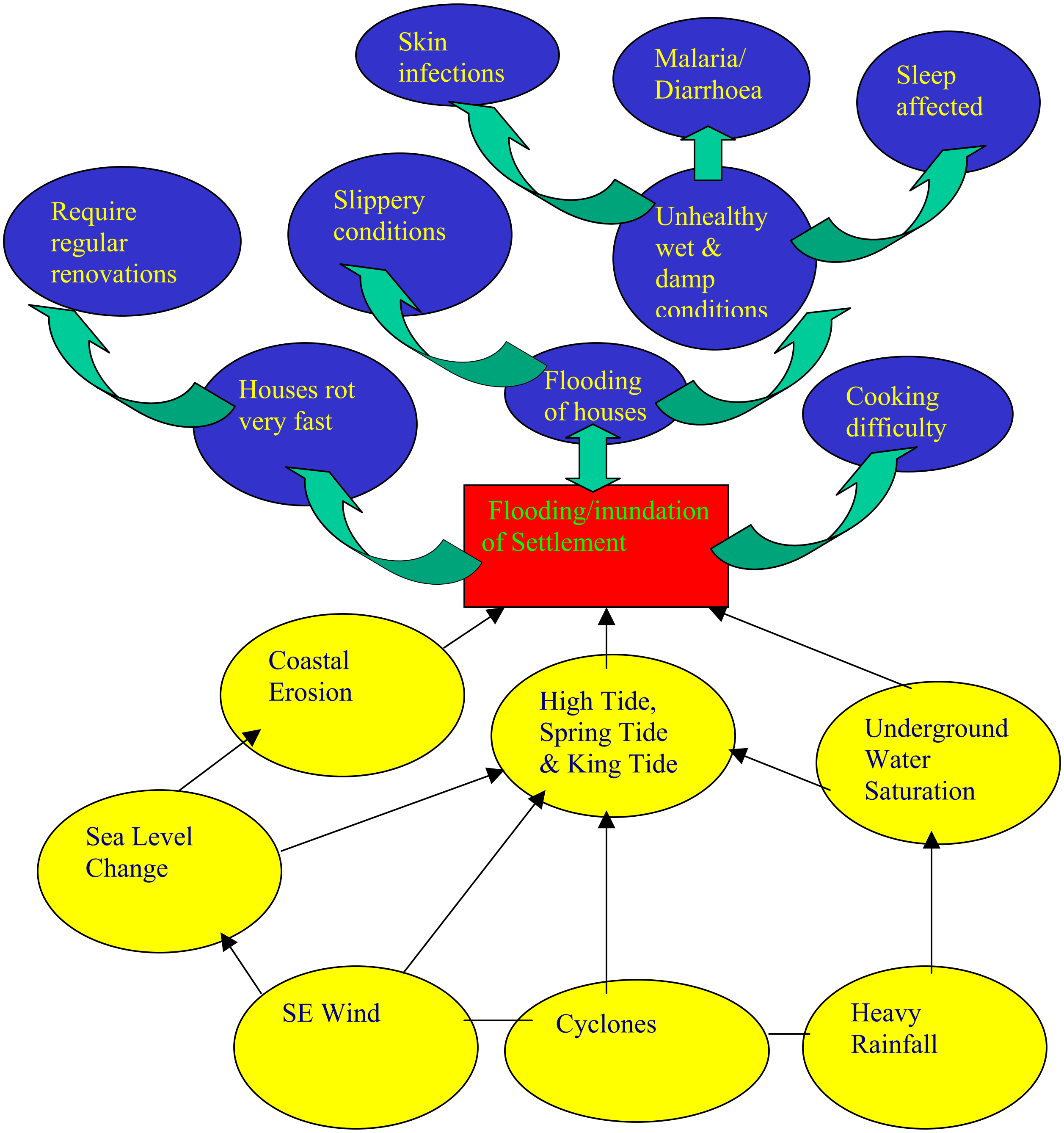
Chief Morten Rarua (50yrs)Pers.Com, June 2003, Panita, Tongoa Island

Annexes

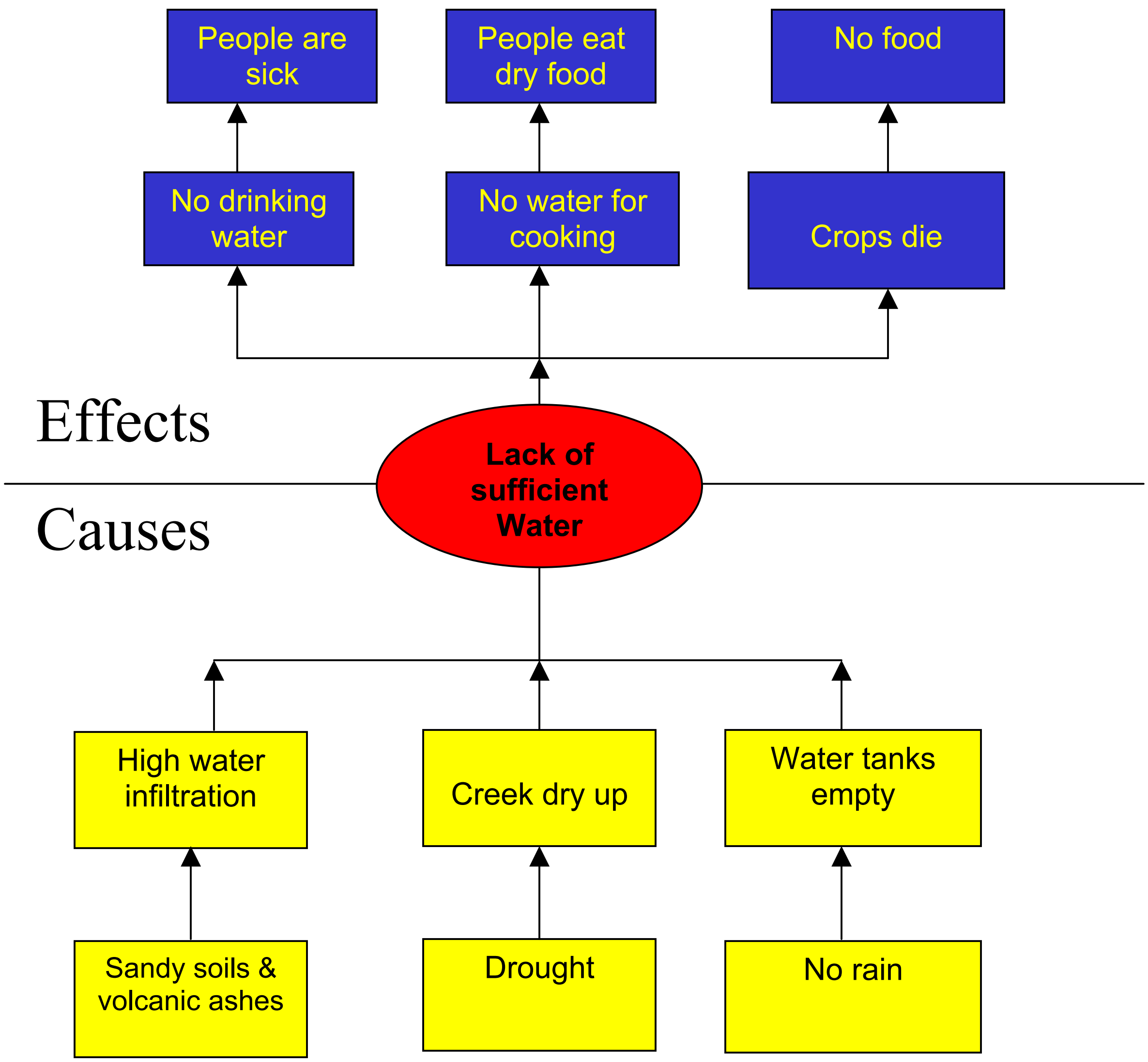
Assessment of cause & effect of problems (Lateu)



Assessment of cause & effect of problems (Lateu).



Assessment of cause & effect of problems (Luli)



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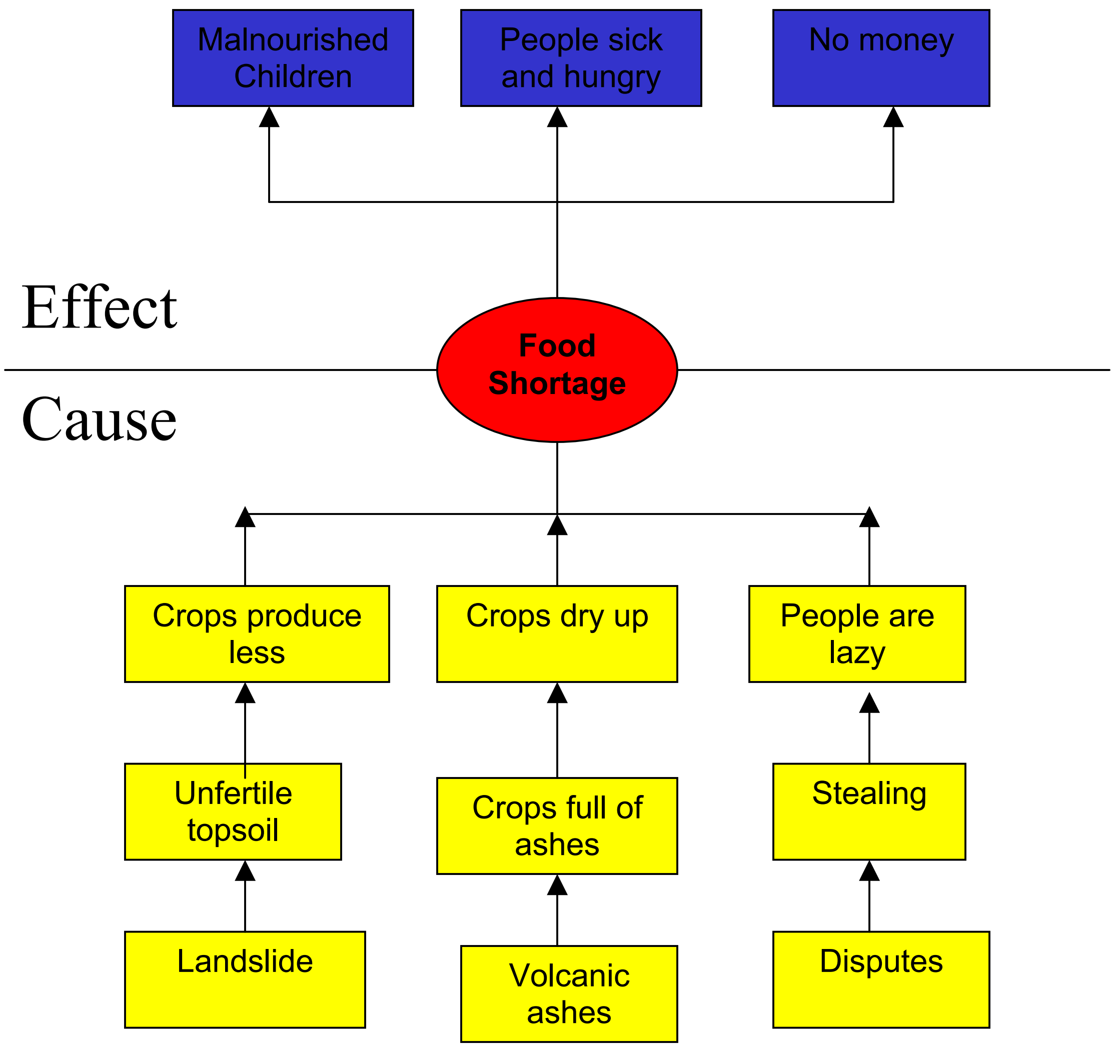
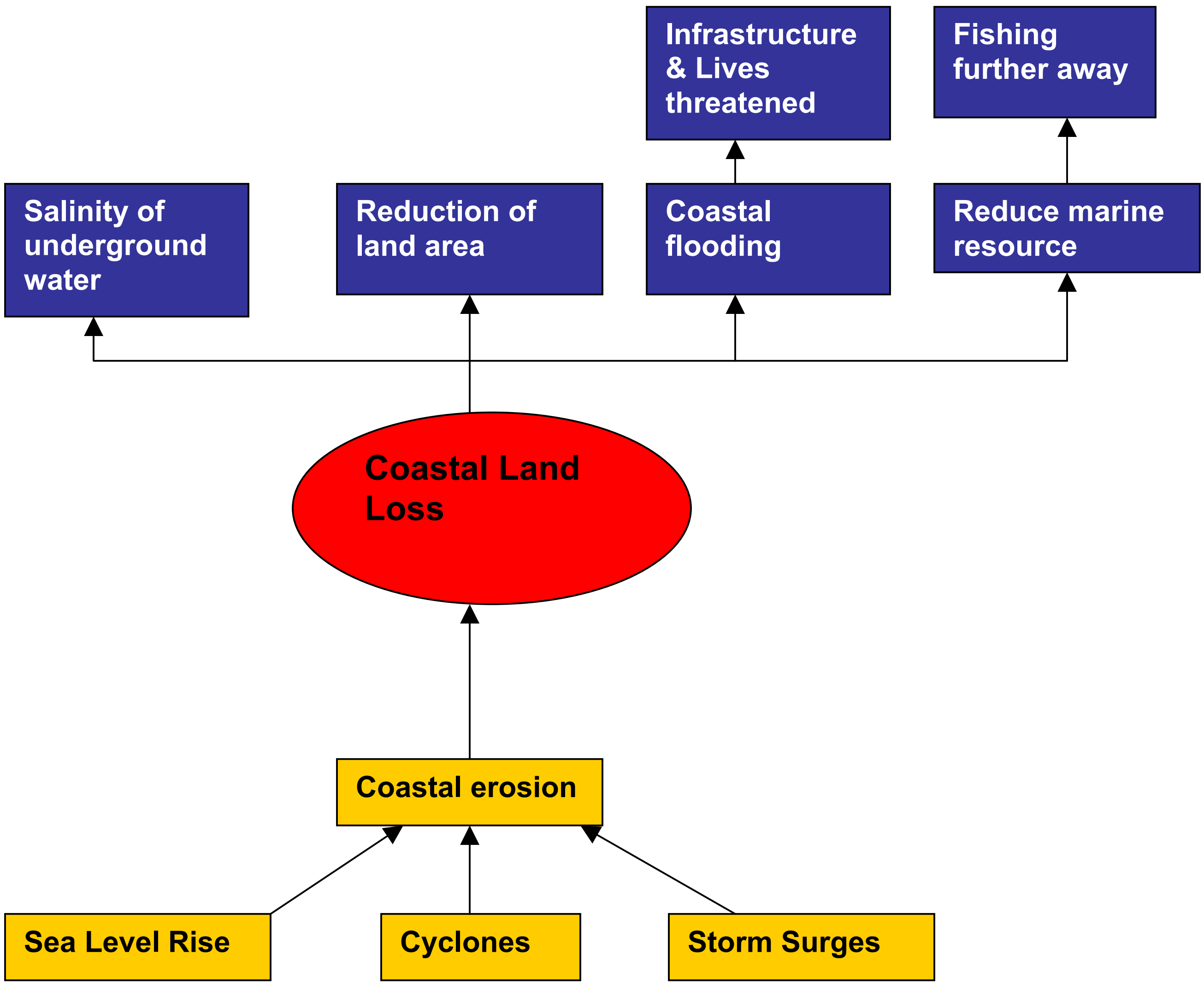
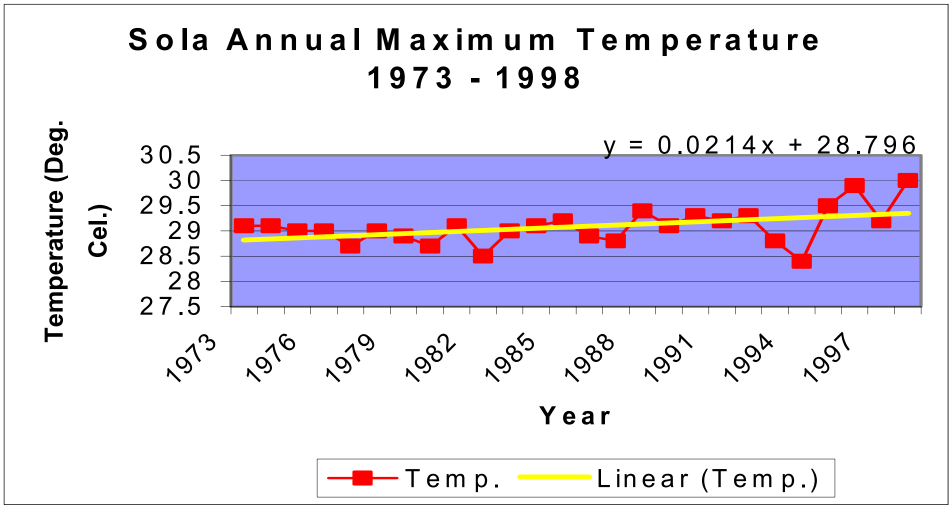
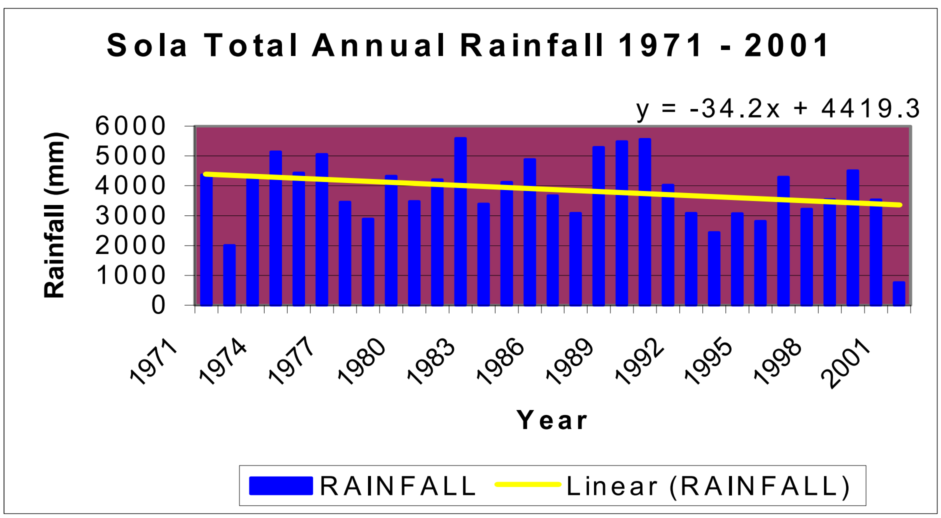


Assessment of cause & effect of problems (Panita)

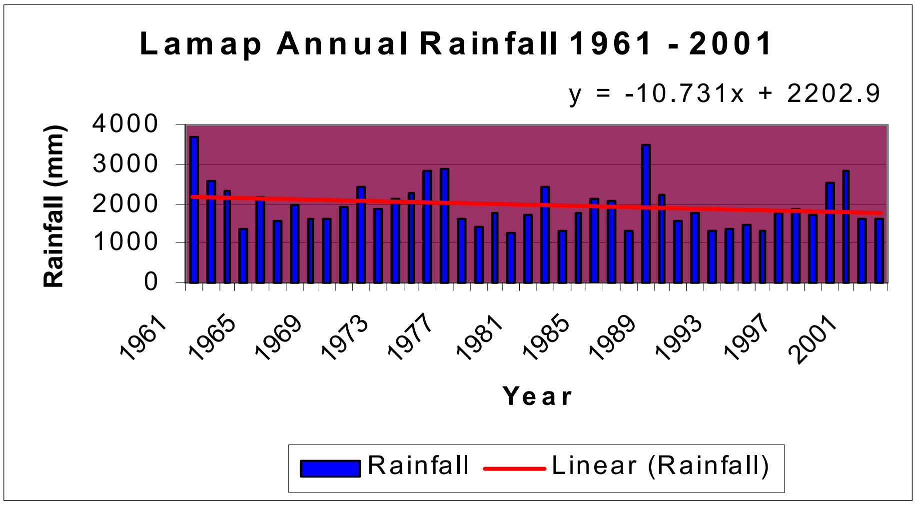


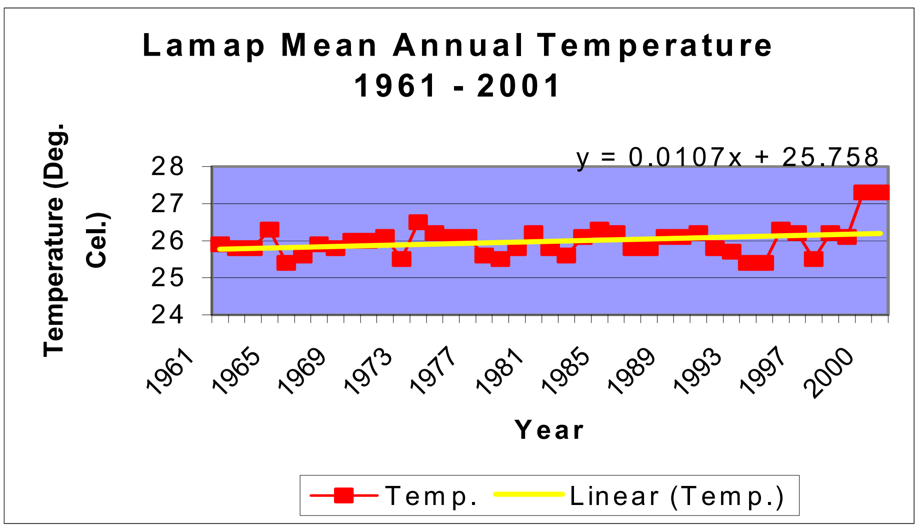


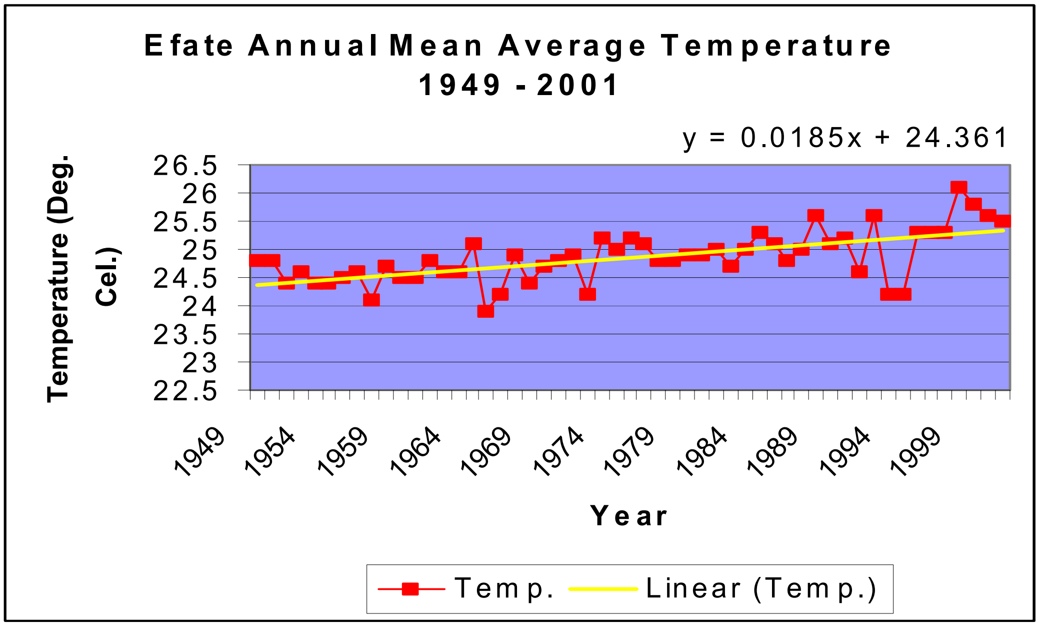
Sola Annual Maximum Temperature
1973 - 1998
y = 0.0214x + 28.796
Temperature (Deg. Cel.)
30.5
30
29.5
29
28.5
28
27.5
1973
1976
1979
1982
1985
1988
1991
1994
1997
Year
Temp.
Linear (Temp.)

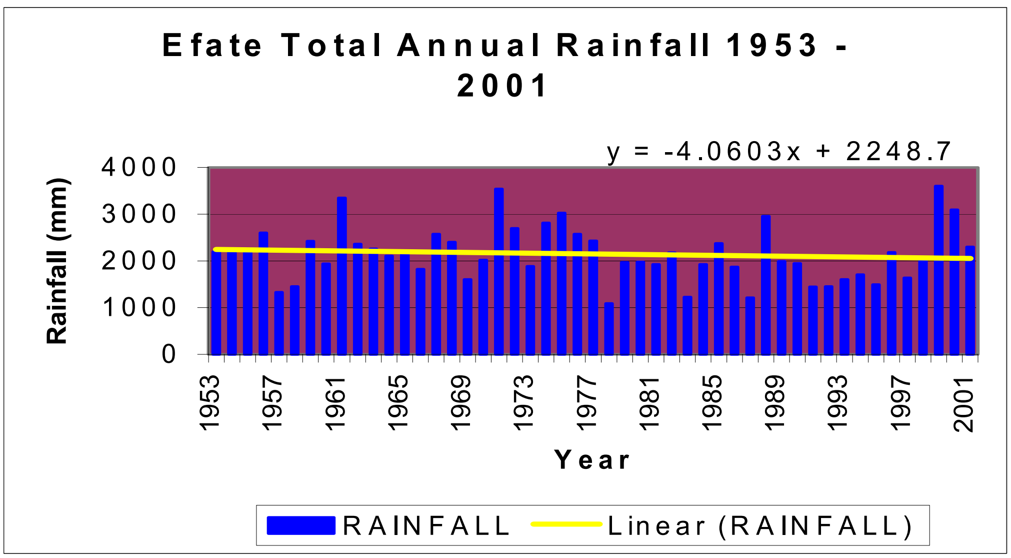


Sola Total Annual Rainfall 1971 - 2001
y = -34.2x + 4419.3
Rainfall (mm)
6000
5000
4000
3000
2000
1000
0
1971
1974
1977
1980
1983
1986
1989
1992
1995
1998
2001
Year
RAINFALL
Linear (RAINFALL)


Lamap Annual Rainfall 1961 - 2001
y = -10.731x + 2202.9
Rainfall (mm)
4000
3000
2000
1000
0
1961
1965
1969
1973
1977
1981
1985
1989
1993
1997
2001
Year
Rainfall
Linear (Rainfall)


Lamap Mean Annual Temperature 1961 - 2001
y = 0.0107x + 25.758
Temperature (Deg. Cel.)
28
27
26
25
24
1961
1965
1969
1973
1977
1981
1985
1989
1993
1997
2000
Year
Temp.
Linear (Temp.)





Reported Environmental Health Diseases 1999 - 2001

Year	***Gastroentritis***	***Scabies***	***Conjunctivitis***	***Malaria***	***Intestinal (defect sanitation)***	***Pneumonia***	***Tinea***
1999	4	20	5	22	11	45	
2000	2		4		4	20	
2001	1	2	1			3	24