EU EDF 8 – SOPAC/EU Project Report 84
Reducing Vulnerability of Pacific ACP States

PAPUA NEW GUINEA TECHNICAL NOTE – DISASTER RISK ASSESSMENT (ESPECIALLY TSUNAMI) OF THE VANIMO AREA, WEST SEPIK PROVINCE

May 2007




Compilers

H. Gedikile[1], M. David[1], P. Ila'ava[1], B. Karona[1], A. Lakamanga[2],
Dickson Dalle[3] & M. Bonte-Grapentin[2]

August 2008

For more copies of this report, apply to the SOPAC Secretariat at the address below:

PACIFIC ISLANDS APPLIED GEOSCIENCE COMMISSION
c/o SOPAC Secretariat
Private Mail Bag
GPO, Suva
FIJI ISLANDS
http://www.sopac.org
Phone: +679 338 1377
Fax: +679 337 0040
director@sopac.org

[1] UPNG Disaster Centre
[2] SOPAC Secretariat
[3]Sandaun Provincial Disaster Office

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

The team would like to thank the SOPAC for funding; Saundaun Provincial Government for all the support; and Professor Hugh Davies for project oversight.

INTRODUCTION

The study area from Ningera to Wutung villages is located in the approximate final 60 km stretch of coastline of the West Sepik Province of Papua New Guinea to the border of the Indonesian province of West Papua. The provincial capital of West Sepik Province, Vanimo, is located approximately midway between Ningera and Wutung. Vainimo which also serves as the border post station between Papua New Guinea and Indonesia.

The area lies within the North New Guinea region with the bounding major topographic feature being the inland east-trending Bewani and Torricelli Mountains (Hutchison and Norvick, 1980). The Bewani and Torricelli Mountains are a steep- fronted trans-current fault system of basement volcanic and intrusive rocks in the north and metamorphic basement in the south (Hutchison and Norvick , 1980). To the north they develop into the gentler foothills of the Oenake Mountains in the west and Serra Hills in the east.

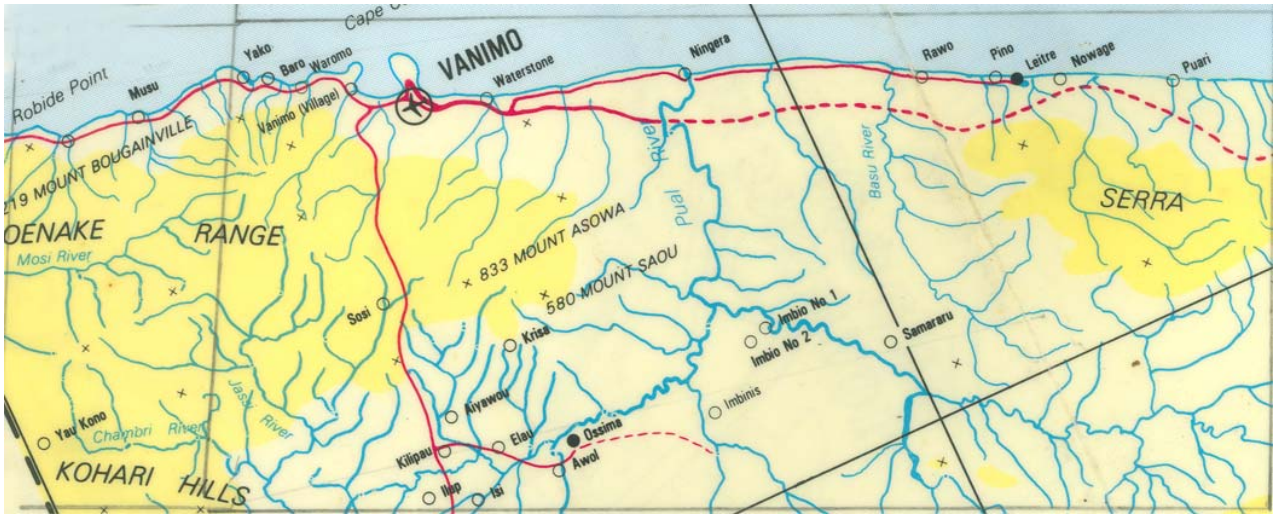

Figure 1. Map showing a section of the areas covered in this study. (Source: Wirui Press. WEST and EAST SEPIK PROVINCES. 1:500, 000. Wewak, East Sepik Province, Papua New Guinea: Wirui Press).

Access

Air access to Vanimo is on a daily basis through flights operated by Air Niugini, Airlink and other third- level airlines via Madang and Wewak. Road access from Vanimo to Wutung is on the International Highway to Jayapura which is currently being upgraded and sealed. From Vanimo to Ningera there is a main unsealed dry weather road going inland to Aitape and a coastal bush track to hamlets of Ningera Village.

Previous Work

On a regional scale, the North New Guinea basin was first most extensively explored for petroleum in the 1920's, particularly in the Aitape area where shallow bores were drilled near oil seeps. This was followed by a programme of widespread geological mapping by Oil Search Ltd, Australasian Petroleum Co. Pty Ltd (APC) and Island Exploration Co. Pty Ltd (IEC), which were later summarised in a series of unpublished reports by Stanley (1932), Osborne (1942) and Montgomery (1943) (Hutchison and Norvick, 1980). Later surveys to the Yagroner Hills and Border Mountains and one over the area between the coast, mountain axis and international border were undertaken by Stanley (1938) and Osborne (1942). Following other

extensive petroleum exploration work, the Australian Bureau of Mineral Resources in 1972 and 1973 mapped the Vanimo and Aitape Sheet areas to produce the 1:250 000 Aitape – Vanimo Geological Maps and Explanatory Notes by the Geological Survey of Papua New Guinea (Hutchison and Norvick, 1980).

Regional Geology

The region in which the Ningera – Wutung area lies forms part of what was termed the 'North New Guinea Basin' by Osborne (1956) and Thompson (1967), which is now known to comprise several troughs. This area is part of a large Neogene to Quaternary sedimentary province which stretches from West Papua to the Huon Peninsula (Hutchison and Norvick 1980).

Structurally, the dominating feature in the area is the east-trending Bewani – Torricelli Axis, a metamorphic and volcanic basement outcrop which continues into West Papua. It separates the two coeval troughs of the North New Guinea Basin – Aitape and Lumi – which comprise mainly Miocene to Recent clastic sediments (Hutchison and Norvick 1980). The major fault system in the Bewani – Torricelli Axis is a complex of anastomosing, closely spaced faults. Individual faults are vertical or steeply dipping and are exposed as brecciated or mylonitized shear zones which vary in width from less than a metre to more than a kilometre (Hutchison and Norvick 1980).

The coastal topographic highs in the area are the Oenake and Serra Hills Uplift, where uplift and tension caused normal block faulting of reef carbonates which are Middle Miocene to Late Pliocene in age.

The metamorphic and volcanic basement rocks of the area outcrop in the Bewani – Torricelli axis and Border Mountains. The oldest known rocks are un metamorphosed Permian diorite and granodiorite which occurs as stream boulders in the southwest Border Mountains, near the international border, and are derived from a source in West Papua (Hutchison and Norvick). The Bewani and Torricelli Mountains are comprised mainly of Upper Cretaceous to Lower Miocene intrusive rocks (Torricelli Intrusive Complex) and the Bliri Volcanics which are of Palaeocene to Late Miocene age with basaltic and andesitic lavas and pyroclastics. The intrusive rocks are mainly dolerite, gabbro and diorite with rare ultramafics.

An angular unconformity separates the basement rocks from the Neogene and Quaternary cover sediments, which are over 3000 m thick and made up of primarily clastic rocks which are chemically and texturally immature. There is a progressive trend of older sediments in the west and younger sediments in the east. Turbidity currents were responsible for the deposition of the Miocene greywacke while the Pliocene sandstones and subgreywackes were deposited by a combination of turbidity currents, shallow and marginal marine and fluvial conditions.

Quaternary cover sediments were deposited after tectonic activity had ceased so do not exhibit the folding and faulting of earlier formations. There is however evidence for recent uplift of young coral reefs over 100 m above sea level around Vanimo and the Serra Hills. At the present day, coral reefs are developing along the coast, alluvium is accumulating in the modern river flood plain and landslide debris (colluvium) is accumulating in the intramontane valleys (Hutchison and Norvick 1980).

OBJECTIVE

The objective of the study is to assess the risk of disasters, especially tsunami, at this coast. This coast is selected because of its vulnerability to tsunami because of its geologic setting being next to the New Guinea trench that runs sub-parallel to the coast some 20 to 35 km from the shoreline. Two tsunami are known to have originated from this trench, Biak tsunami that killed 281 people in 1996; and the 1998 Aitape tsunami that cost Papua New Guinea 3210 lives.

FIELDWORK AND INVESTIGATION

A team from UPNG Disaster Centre (H. Gedikile, M. David, P. Ila'ava and B. Karona), PNG EDF-SOPAC Intern (Arnold Lakamanga) and Sandaun Disaster Coordinator (Dickson Dalle) spent two weeks (19 October to 2 November 2005) studying the coast from Wutung (Papua New Guinea /Indonesian border) on the West to Paul Paol) river on the East.

Border/Wutung

The border area is predominantly raised dead coral boulders. Next to the border mark is a preserved old wave cut platform, notch and cliff. The local people use it as a burial site. There are human skulls at one end of the old wave-cut platform. The old wave-cut platform is about 5 m wide before it drops about 20 m to the current wave-cut platform.

Figure 2. L: Raised wave-cut cliff uplifted about 20 m above sea level. R: Raised dead corals at the coast.

The raised dead corals at the coast are *in situ* (in place). They had not been moved, rotated or turned upside down as occurs when big tsunamis hit reefs like what happened during the Rita tsunami in 1888 that carried so many large coral boulders inland. A small tsunami (2-3 m waves) in Hograno District in Solomon Islands had 3 m coral boulders moved, rotated and some turned upside down.

Wutung Village is located at the coast just before the PNG/Indonesian border (see Figure 1) and has a population of more than 500 people. The area where the village is doesn't have very large coral boulders like the border area. The area is made up of sand and coral fragments. The village is no more than 3 m above the high water mark. There is a small hill about 150 m inland from the coastline that can be used as a safe haven for people to run for safety if small (< 2 m) tsunamis hit the coast.

During the Aitape tsunami the stream that runs into the bay rose to about 2.7 m. This is an estimate based on the people's account of the water level at Wutung bridge (Bougainville Bay). Wutung Village itself didn't experience extreme high tides like what happened at Wutung bridge. This is reflective of the sea floor topography. Wutung Bay is deep right to the coastline where the stream meets the ocean. Whereas at Wutung Village, there is a reef at the coastline.

Figure 3. L: Wutung Village. R: Looking west towards Bougainville Bay near Wutung.

Much of the coastline between Wutung bridge and Vanimo Town is made up of uplifted massive corals and coral boulders (see Figure 2 right picture).

New Musu Village is also located at the coast with a beautiful bay. A number of villages/settlements are located in a similar setting. It was an attractive choice for people to settle in such areas, because of the beautiful harbour that gave them easy access to the sea for fishing or travelling to other places. Another factor is the availability of fresh water nearby.

Figure 4. Looking west towards new Musu Village.

The site of New Musu Village is an attractive and convenient place to settle but there are risks that people need to be informed about. The two risks at New Musu are: 1. Incoming tsunami. 2. Flooding due to normal big floods from the stream and backwash from a tsunami. The stream meanders to the west at the back of the village before it comes out into the ocean (see Figure 4).

Vanimo Town to the east has a distinctive geology compared to western side of Vanimo town toward the PNG-Indonesian border. There are beautiful sandy beaches in the east compared to the raised dead corals in the west.

The beachfront had a stretch of very coarse sandstone from Warastone and all the way towards Ningra. There are no indications of tsunami sedimentation at the Eastern part of Vanimo Town to Ningra.

Plate 1. L: Looking east at Warastone towards Usipi Creek. Very coarse sandstone.

Plate 2. L: Looking west towards Warastone and Vanimo from NFA beach. The beachfront is made up of very coarse sandstone to pebble sandstone dipping seaward (NE). R: Closer view of the sandstone.

Plate 3. L: Paul (Paol) river. R: river cut. No tsunami sediments recognized.

Tsunami deposit?

No tsunami deposits were found to the west and east of Vanimo Town. River cuts, shoreline, cliff faces etc. were studied but tsunami deposits were not found.

The western side of Vanimo Town to the border is all made up of corals but there is no ripped up corals or some other deposits indicative of tsunami deposits found. It would have been easy to find tsunami deposit if there were any as there is only a thin layer of soil cover on top of the corals on the eastern side of the Vanimo Town (see picture on the next page).

Plate 4. L: Looking seaward at the western part of Waramo village. R: Coral reef exposures at a creek about 100 m from high water mark at west Waramo.

There is only one site at the Western end of the runway (Vanimo airstrip) where two layers of altered pumice (20 cm and 15 cm thick layers) at 1.9 m depth and 97.9 m from the high water mark were found. These deposits appear to represent a major volcanic eruption and possibly two tsunami.

Plate 5. L: Vanimo dumpsite. R: closer view of the cleaned pit face showing two altered pumice layers.

ORAL HISTORY OF ANCIENT TSUNAMI

The people living along this coast reported no ancient tsunami. They only reported the recent tsunami of the 1960s probably related to the Chilean tsunami. They reported they saw the sea retreating before the tsunami came.

A number of villages also experienced the 1998 Aitape tsunami. At Bougainville Bay near Wutung, the stream rose up to about 2 m. New and Old Musu (Fitchin), Lido and Ningera villages also experienced the Aitape tsunami. There were no breaking waves; the villages only experienced abnormal high tides that rose beyond the high water mark after the sea receded.

It's interesting to note that Vanimo Town didn't experience any effect of the Aitape tsunami; and this may be due to the sea-floor topography.

TSUMANI AWARENESS TALKS

Tsunami awareness were conducted at the following villages and schools: New and Old Musu, Baro Primary School, Musu Community School, Yako, Waramo, Lido, Black wara (Ningra settlement), Nigra (Paol river).

The material used for the talks included; a video show titled “Save your lives from Tsunami”; a Powerpoint presentation using Papua New Guinea tsunami examples; giving live accounts of the 1998 Aitape tsumani by Dickson Dale. Finally the group gave an assessment of tsumani risk of the local area (village or school) and identifying possible escape route(s) for each place (see the new Musu hazard map in Figure 5). Tsunami awareness pamphlets and posters were also distributed to the village elders and head teachers at schools.

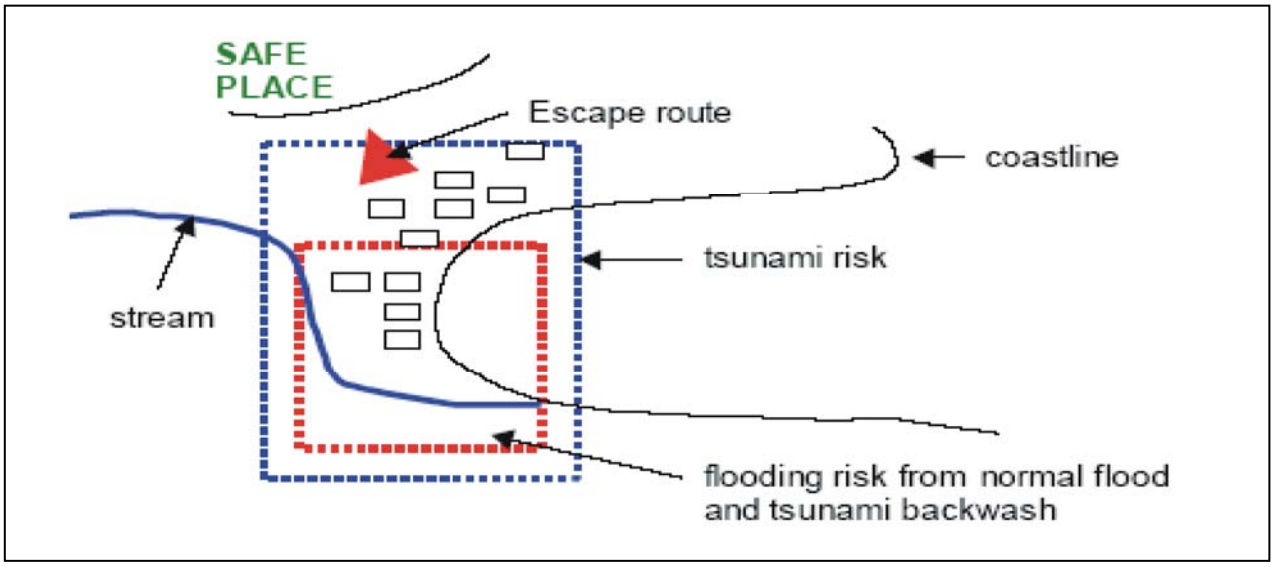

Figure 5. Hazard map of New Musu Village.

Plate 6. L-R: Tsunami awareness at new Musu Village.

Plate 7. L: Tsunami awareness at Fitchin (Old Musu). R: Looking west at the beachfront of Fitchin.

Plate 8. L: Fitchin Village. R: Tsunami awareness at Fitchin.

Plate 9. L: Beachfront of the western part of Yako village. R: Beachfront at eastern part of Yako.

Plate 10. L-R: Tsunami awareness at Yako Village.

Plate 11. L: Transect at Waramo Village. R: Tsunami awareness at Baro Primary School to students and staff.

Plate 12. L: Awareness at Musu Community School. R: Tsunami awareness at night at Waramo.

Plate 13. L-R: Tsunami awareness at Lido Village at night.

Plate 14. L-R: Tsunami awareness at Ningra near Paul (Paol) river.

Plate 15. L: Tsunami awareness at Black wara. R: Looking west from Black wara.

Plate 16. L: Looking southwest to Jon Bini Seminary at about 120 m from the shoreline. R: Looking northwest to Vanimo point (Lido village) from Daundo Creek.

VANIMO TOWN DISASTER RISK ASSESSMENT

Vanimo is the provincial capital of Sandaun Province. All the important public infrastructure such as airport, telekom, bank and main business houses are all located in a flat area no more than 2.5 m above the high water mark.

Plate 17. L-R: Vanimo Town from the east.

All the public infrastructure and business houses shown above are all at risk if tsunami struck the area. Emergency response will be a difficult one since the airports/telecom-munication will be inaccessible to outside help.

Sandaun Provincial government should seriously think about building some kind of barrier to protect these important infrastructure. For example, building a sea wall. It doesn't have to be expensive high tech walls. It can be built by dumping rocks along the coast to at least 3 metres high. Later trees can be planted. This should be done at both the east and west side of the town.

Plate 18. L: Vanimo Town looking west. R: Looking east to the proposed fish loin plant site.

SUMMARY OF JAYAPURA TRIP

The team went across with Moses Poigena (Vanimo Foreign Affairs/Border Liaison Officer) and PNG Consul Officer (Mr Nasa) to Jayapura. The team had a meeting with the Director of Social Services (Mr Albert Pogolomun) and two of his officers, one is the Disaster coordinator and the other one is the Aid Coordinator in Papua Province of Indonesia.

The Sandaun Province delegation comprise; Vanimo Provincial Officer and Disaster Coordinator (Mr Dickson Dale), Mr Moses Poigena, Mr Nasa and the UPNG Centre of Disaster Reduction party (Harrison Gedikile, Manuel David, Patricia Ila'ava and Ben Karona). PNG SOPAC representative Arnold Lakamanga also attended the meeting.

The purpose of the meeting was to:

1) Establish a dialogue between the two provinces, Sandaun and Papua in disaster studies (risk assessment, awareness) and disaster management.

2) Set up joint a Disaster Border Committee. The committee will be made up of the two provincial representatives and representatives of the three universities (UPNG, Cenderawasih and Manokwari) and a representative from SOPAC.

The studies will involve UPNG, Cenderawasih University and Manokwari University. It was proposed that there would be a meeting between the Universities after the 5th November 2005.

The Director (of Social Services), with his two Officers expressed that they are happy with the suggestions put forward and would like to see them move forward sooner the better. The Director will put forward the ideas with the two Universities in Papua after the 5th of November and there will be a meeting organized for the three universities (UPNG, Senderawasih and Manokwari) in Papua soon after. Dickson Dale will update us of any progress from Vanimo.

Plate 19. L: Meeting at the Director of Social services' Conference room. L-R: Dickson Dale, Alberto Pogolomun, Patricia Ila'ava, Harrison Gedikile, Benjamin Karona, PNG Consul translator, Moses Poigeno, Nasa and Arnold Lakamanga. R: L-R: Disaster Coordinator, Aid Coordinator, Dickson Dale, Alberto Pogolomun.

Plate 20. L-R: Jayapura Town taken from Hombald Bay Hotel towards the bay.

CONCLUSION

The study did not find any tsunami deposit apart from the layers of pumice at Vanimo rubbish dump. This is in agreement with the interviews with the locals that they had no ancient tsunami.

Even though the study could not find tsunami deposits, it was an important wake up call for rural dwellers to be aware of signs and learn what to do to save their lives before tsunami strikes.

RECOMENDATION

Detailed Hazard maps for Vanimo Town, villages and schools need to be drawn up with the help of the local people.

REFERENCE

Norvick, M., Hutchison, D. S. 1980. Aitape-Vanimo Papua New Guinea: 1:250 000 Geological Series Explanatory Notes. Geological Survey of Papua New Guinea, Dept of Minerals and Energy. 44 p.+ map.