Disaster-Risk Management in a Small Island Nation Through Climate-Proofed Transport Infrastructure

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Abstract: Small island nations in the Pacific regions are always faced with grave threats from natural events such as typhoons, earthquakes, tsunamis, and even volcanic activity. With the effects of global warming intensifying as evidenced in sea level rise, erratic weather conditions and more severe typhoons, the threat to the survivability of small island nations has become more critical. The small island nation of the Kingdom of Tonga sees transport infrastructure as vital to the socio-economic progress of the country through efficient provision of mobility and access which can propel tourism-related activities. Although normal vehicular traffic may not be a cause for great concern compared to those in megacities, the utility of existing transport system was put to test in February 2010 when a tsunami warning was suddenly issued due to an 8.0 magnitude earthquake that occurred near the coast of Chile. This triggered a sudden state of panic in the populace of Nuku'alofa, the Kingdom's capital and urban center, resulting in gridlock along existing roads leading to higher areas of the island. As was told it could had been a major disaster of unparalleled proportions in the history of Tonga as hundreds of motorists got stranded in that traffic jam. This prompted state officials to revisit a number of strategies that the Tongan government had been initiating against disaster mitigation and management and discovering basic inadequacies to deal such incoming disaster. This paper discusses a number transport system propositions, with climate-proofing considerations, that the Kingdom of Tonga is taking into account to protect their citizenry not only against the immediate threat of tsunamis but also from the long-term impacts of climate change. With similar situations in the coastal areas in the Philippines, the lessons learnt can also be applicable in local disaster-risk management in the country.

***Key words*:** transport infrastructure system, disaster, tsunami, earthquake, island nation, climate change, climate-proofing

1. INTRODUCTION

A salient part of living is actually surviving especially when one is faced with unusual threats from natural disasters and calamities. Such is the situation in the Pacific Islands region consisting of the Polynesian, Melanesian, and Micronesian Group of island nations and territories, where natural occurrences of typhoons or cyclones, earthquakes, tsunamis and volcanic activities are not uncommon. In the past, it was understood that people came up with their ways to survive and cope with disasters through tools and implements and migration to safer grounds. In the present setting migration is not that easy since this will entail giving up ownership of home, loss of livelihood, and severing ties with one's roots.

The socio-economic conditions in the Pacific island nations have compounded the impact of disasters, as the governments could not provide the necessary protective infrastructure and mechanisms to protect their constituents. In addition, environmental degradation, urbanization and uncontrolled settlements in constrained/protection zones such as floodplains, steep slopes and forested areas tend to magnify the imminent damage to lives and properties. With

heightened risks and vulnerability of a nation, its capacity to absorb impending impacts of natural events is compromised resulting in many downstream economic repercussions such as loss of productivity, disruption of commercial activity, reduced attractiveness to investment, etc.

Even prior to the realization of the impacts of climate change, the Pacific Island countries have been continuously experiencing these calamities at varying degrees. With the worsening effects of climate change, the impacts to these nations have been exacerbated, heightening their risks and vulnerabilities, and imperiling their existence. As has been observed, the destructive magnitude capacity of typhoons and cyclones have increased. Sea level rise can bring inundation to previously safe lands; and coupled with volcanic and tectonic activities tsunamis will become more threatening.

Being aware of these facts, governments in the region have been implementing steps with the assistance of international funding agencies in order to increase their survivability against possible disastrous eventuality. Among the programs that were set up consisted of early warning systems, capacity building, disaster preparedness, provision of necessary infrastructure, and community level preparedness. Putting these measures and mechanisms in place entails huge expenditures. Current estimates run into billions of dollars annually to enable protection to these island countries.

Still beset with limited funds to implement them, a country has to find ways and means and be creative to find solutions to improve its survivability. Like the other small island countries in the Pacific, the Kingdom of Tonga has been constantly looking for solutions to upgrade its systems and is trying to optimize assistances from funding agencies. In spite of this strategy, there still seems to be a huge inadequacy and more immediate actions are becoming necessary. As an example, the adequacy of the transport system was put to test in a Tsunami Warning issued on February 28, 2010 due to an 8.0 magnitude earthquake, which happened off the coast of Chile. This resulted in an unprecedented traffic jam along the main roads of Nuku'alofa, in Tongatapu Island, which persisted for hours. Had a big tsunami came, most of the people caught in that traffic jam would not have made it alive. This gridlock had made public officials rethink their strategies and sought other means of solving this chaotic scenario.

Fortunately, an opportunity presented itself, when a project, funded by ADB went underway, which included components in infrastructure, transport, urban planning, capacity building, etc. This project was Tonga Integrated Urban Development Project (TIUDP). Most of its project components primarily respond to infrastructure and facility upgrades; however, there are other components worth considering, which were carried over in the next ADB project entitled Urban Planning and Management Systems (TA 7082-TON). These project components, especially the transport systems portions, were then restated in an attempt to respond to emergency situations to save more lives as much as possible. This paper presents the restatement of these projects for future implementation. The lessons in Tonga hope to serve as examples for coastal communities in the Philippines in coping with future potentially disastrous calamities.

2. GENERAL PROFILE OF THE KINGDOM OF TONGA

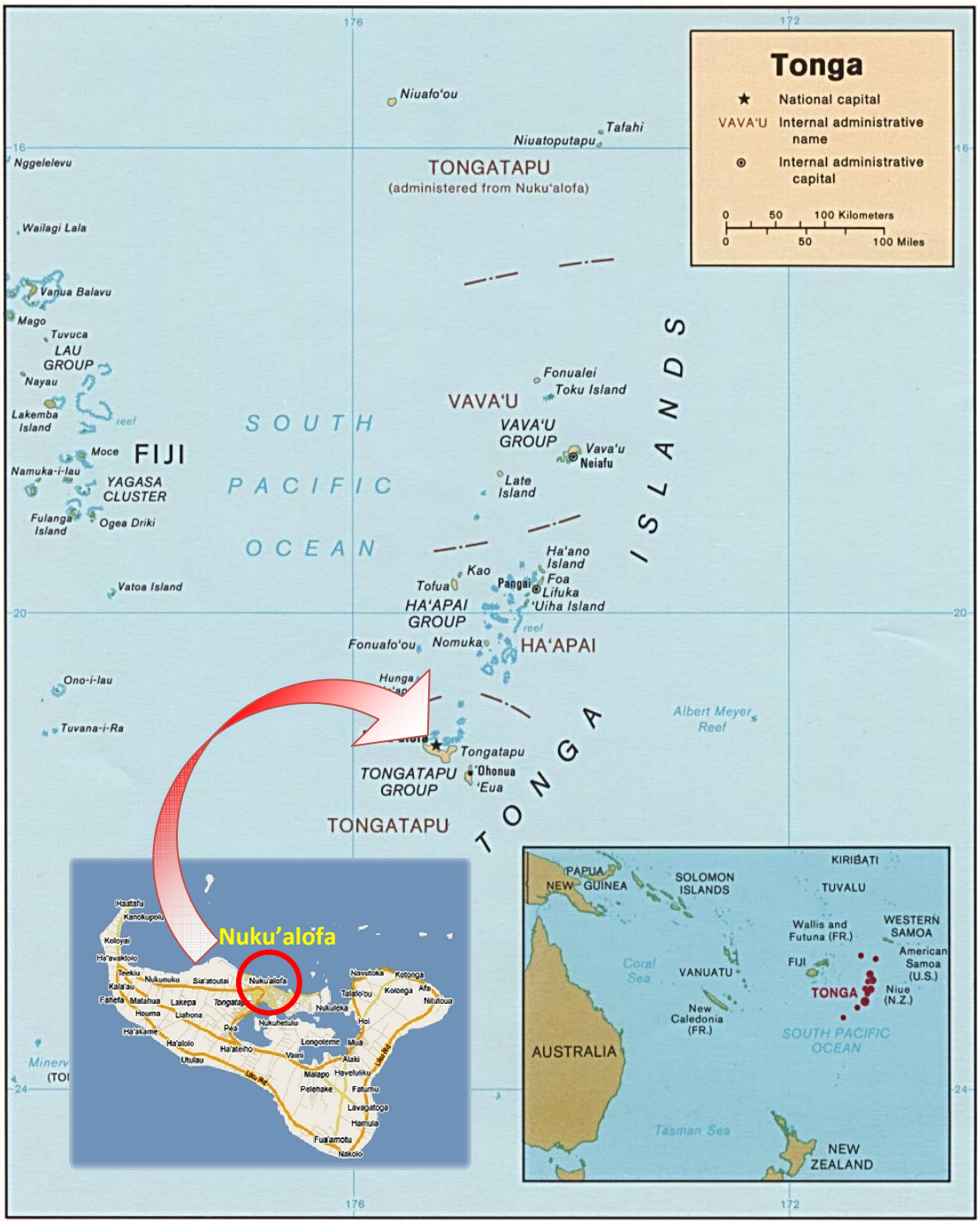
The Pacific region consists of the three major groups of countries and territories – the Micronesia, Melanesia and Polynesia. Micronesia lies between the Philippines and Hawaii and consisting of the Marshall, Caroline, Mariana and Gilbert groups of islands. Melanesia starts from Papua New Guinea curving downwards to Solomon Islands, Vanuatu, New Caledonia and Fiji. The Polynesian triangle, which spans from New Zealand to Easter Island and going upwards to North of Hawaii, is made up of French Polynesia, Pitcairn, Eastern Island, the Cook Islands, Niue, Tonga, American Samoa, Samoa, Tokau, Wallis and Futuna, and Tuvalu.

The Kingdom of Tonga is the only surviving constitutional monarchy among the South Pacific Island nations. Known as "The Friendly Islands", it was united into a Polynesian kingdom in 1845, became a constitutional monarchy in 1875 and a British protectorate in 1900. In 1970, Tonga acquired its independence and became a member of the Commonwealth of Nations. It comprises of three major island groups – Tongatapu and neighboring islands in the south, the Ha'apai group located centrally, and the Vava'u group to the north (see Map below).

Tonga is composed of 170 islands (36 of which are inhabited) with areas amounting to 688km2, scattered over an ocean area of 360,000 km2. The Tongan population is roughly 101,100 with about 34% residing in the capital, Nukul'alofa located in the biggest island, Tongatapu. It has a small, open economy with limited export base, which are primarily agricultural products contributing 30% to the nation's GDP. The main crops consisting of squash, coconuts, banana, vanilla beans, and other crops make up two-thirds of total exports. Tonga imports a high proportion of its food, especially the manufactured goods mainly from New Zealand. The industrial sector contributes about 10% of GDP, while tourism and fishing are the primary sources of foreign currency earnings. To counteract the big deficit Tonga relies much on external aids from donor countries and agencies as well as remittances from Tongan nationals living abroad.

Tongatapu is a raised coral atoll island, which stands about 65 meters above mean sea level (msl) at its highest point. Nuku'alofa, the capital and administrative centre and the largest urban area of Tonga, is situated on the northern coast of Tongatapu. Nuku'alofa's location is quite low, only 1 to 2 meters above msl and experiences periodic flooding during regular heavy rains. Since the substrate is limestone, most of the rainwater infiltrates downward. However, there are also quite large outlying areas of Nuku'alofa that are low-lying wetlands, which are perennially underwater.

The climate of Tonga is largely determined by its location. Since it is situated in the vast expanse of the southern region of the Pacific Ocean climatic variations are rather mild. Because of this, the climate is generally tropical the whole year round. A mild and dry climate prevails between the months of May and October, which can be referred to as winter. While the Tongan summer, which is warm and humid, is generally experienced from the month of November until April.



(Source:http://www.reliefweb.int/rw/rwb.nsf/db900LargeMaps/SKAR-64GCBF?OpenDocument)

Figure 1: Map of the Kingdom of Tonga and Nuku'alofa

3. TRANSPORT SYSTEMS IN TONGATAPU ISLAND

The Kingdom of Tonga has its own problem with respect to infrastructure provision. Generally, since its many islands are spread apart, it is difficult to completely provide efficiency in infrastructure services, especially in transport system. The main island, Tongatapu, carries two-thirds of the population of Tonga, with more than 30% living in the capital town of Nuku'alofa. Hence, the provision of efficient and risk-secured transport system has become a priority in this area.

The major gateway in Tongatapu is the Fua'amotu International Airport with a number of direct flights to New Zealand, Australia, and Fiji. It is located around 21 kms south of the capital Nuku'alofa. A passenger seaport, Faua Harbour, is located around 2 kms southeast from the center of Nuku'alofa and serves as the main entry point by sea. The road system in Tongatapu provides the connectivity and access to the other towns, villages and tourism destinations within.

In Nuku'alofa, the existing road network was generally designed following Australian standards and provides sufficient mobility and circulation within the central business district (CBD). The main arterials consist of Taufa'ahau Road, Vaha'akolo Road, By-pass Road (Alaivahamama Road), Vuna Road and Taufa'ahau Road-Vaha'akolo Road, of which Taufa'ahau Road serving as the primary link from the international airport to the CBD area.

Over the years, with increasing urbanization in Nuku'alofa, the existing road network has become inefficient. Traffic has increased along the two main approaches, Taufa'ahau and Vaha'akolo roads, to the CBD as manifested by long lines at key intersections. At peak hours congestion becomes severe in the urban center particularly around the public market, offices and schools. Recent analysis showed the following additional deficiencies:

(1) There are minimal traffic management measures within the CBD.
(2) There are also very few off-street parking areas and with minimal parking regulation enforcement resulting in double parking along streets, consequently reducing road capacity.
(3) Along some of the roads, there are either no foot paths or sidewalks or these are in bad conditions quite often forcing pedestrians to use the side of the road.
(4) Shoulders are mostly in bad shape, posing hazards to pedestrians and discourage bicycle riders.
(5) Absence of or insufficient traffic signs and markings:

In the event of rain, the bad drainage lines affect mobility as the entire system is in need of upgrade and maintenance. The drainage lines along the foreshore are already silted and requiring much-needed declogging. In addition, drainage lines are non-existent in some parts of the CBD resulting to ponding and momentary flooding on the streets. Water ponding in certain areas has become prevalent, thus posing environmental and health hazards to residents.

These deficiencies and issues cast serious doubts on the transport system's effectivity especially in times of emergency. The CBD and its surrounding areas have higher population density, more so since it is located in lower elevations, making it more vulnerable to coastal threats.

4. THREATS, RISKS AND CLIMATE CHANGE CHALLENGES IN TONGA

Tonga's geographical location and natural features present distinct set of threats, risks and challenges to the small island nation of Tonga. The country is highly vulnerable to natural disasters and impacts of climate change as it is prone to earthquakes, volcanic eruptions, tsunamis, cyclones, and coastal flooding. Climate change was said to have exacerbated the impacts of naturally occurring phenomenon. The rise in sea levels has also aggravated tidal and storm surge flooding in low-lying and coastal areas.

One of the disastrous tropical cyclones that hit Tonga was the one on 3 March 1982. Tropical Cyclone Isaac, which had a the maximum gust speed recorded at 92 knots or 170 km/hr, claimed lives and caused enormous devastation to structures and farm crops especially in Nuku'alofa.

The town was entirely under water. The northern coastal areas also experienced extensive flooding. The total cost of the damage was estimated at T$18.7M Tongan Pa'anga ($9.7M USD).

Damages by other previous cyclones were also considerable. Tropical Cyclone Ofa, which severely hit the Niua Toputapu group in 1990, caused an estimated damage of T$3.2 million. Tropical Cyclone Cora, which raged over the Tongatapu, Haapai and Eua groups in 1998, caused T$19.6 million damage. In 2002, Tropical cyclone Waka severely ravaged the islands of Niuafoou, Niua Toputapu and Vava'u and caused a total estimated cost of T$104.2 million destruction.

Tonga is located on a subduction zone, known as the Tongan Trench, at the junction of the Pacific and Australian tectonic plates and at the northern end underlain by a seismic zone located at a depth of approximately 100 kms beneath the active Tongan volcanoes. The Tongan Trench is part of the Pacific Ring of Fire, which causes much of the seismic disturbances in the Pacific Ocean. Due to this, the threat to volcanic eruption and earthquake are rather high. The most recent volcanic eruption occurred on March 16, 2009, when a submarine eruption occurred near Hunga Tonga-Hunga Ha'apai, 39 miles north-west of the Tongan capital.

Based on records, the strongest earthquake which took place in Tonga was on 23 June 1977, with a surface wave magnitude (Ms) of 7.2 and with epicenter located approximately 200 kilometers to the southwest of Tongatapu. This earthquake caused damaged to houses, churches, the Vuna Wharf and other public utilities. Recently, on March 20, 2009, at 6:17 AM local time a major 7.6-magnitude earthquake, centered at 210 kilometers (130 miles) south-southeast of Nuku'alofa struck at a depth of 10 kilometers (six miles) as monitored by the United States Geological Survey (USGS). This was followed by a 5.3-magnitude aftershock, which was also recorded in the same region just over two hours after the initial quake. Fortunately, there were no signs of significant damage or of a tsunami after the shallow quake struck. According to reports around 200 earthquakes happen annually but these are mostly mild; however, a destructive earthquake does occur every decade.

Remembering the massive devastation and loss of lives caused by the earthquake-triggered tsunami in the Indian Ocean on December 26, 2004, tsunami became a dreaded word in coastal areas and small island countries. On May 3, 2006 a major earthquake with magnitude 7.9 occurred at about 4:26 AM local time located about 160km NE of Nuku'alofa and lasted for 90 seconds. Fortunately, there were no fatalities reported and the damage was minor in all of the islands since only a small tsunami, with amplitude of 60 cm (less than 2 feet), was generated. A power failure, which lasted for about two hours, prevented the receipt of the tsunami warning from the Pacific Tsunami Warning Center.

On February 28, 2010, an 8.8 magnitude earthquake was registered off the coast of Chile and had generated a wave, triggering tsunami warnings in the Pacific Islands. With the distance between the coast of Chile and Tonga, it was estimated that the tsunami would reach Tongatapu between 7:30 AM and 8:30 AM local time. There were no clear indications on the actual height of the possible tsunami wave, which might hit the eastern and southeastern part of Tongatapu Island so precautions had to be taken. The southern edge of the island is of higher elevation than the northern edge, hence would be safer than the capital town of Nuku'alofa (see Figure 2).

This prompted the public officials to initiate informing the people through the local radio of the impending disaster. As the warning centers were still assessing the possible destructive magnitude of the tsunami, all persons in coastal and low-lying areas all over Tongatapu were advised to stay tuned-in for directions and instructions. Nevertheless, this caused panic on the people to escape to higher grounds. Those living in the low-lying areas of Nuku'alofa got into their vehicles to drive out of the area as quickly as they could.

As everyone wanted to escape fast, the main thoroughfares Taufa'Ahau and Vaha'akolo Roads became congested with vehicles, causing unprecedented traffic jams which persisted for hours. Worse was experienced at the junction of Taufa'Ahau and Vaha'akolo Roads, where the traffic merged (see Figure 3). There was also a big confusion and mixed-up in the traffic as some were trying to get into the town to get their families out, like kids in schools and kins in offices.

Another factor that contributed to the build-up of traffic was that the state officials were not able to advise the people properly where to go. The evacuation grounds were not designated. Hence, while the people were driving on the road toward any safe grounds, debates were looming on where to go. So some people ended up just driving around and staying on the road longer than necessary. Finally, the King of Tonga, upon realizing the situation, decided to open his mansion grounds to let the people in as his estate is quite spacious and located on the elevated portions of the island. However, this also caused some problems, as the area did not have adequate parking, toilet facilities and places for people to stay temporarily. Hence, the place was far from being equipped to handle many people, except that it had space.

With that situation, had a big tsunami arrived, a lot of people would have been caught up by the wave in the traffic jam and the effect would have been severely devastating to the people of Nuku'alofa. Fortunately, the tsunami arrived with low wave and made no impact on the island. This episode clearly showed the lack of preparedness in the systems of Tonga to deal with impending disaster. The traffic jam and congestion that resulted due to people evacuating en masse showed the inadequacy of transport system - roads and traffic management, in times of emergency. This prompted state officials to revisit their strategies and to come up with possible future solutions to such situations.

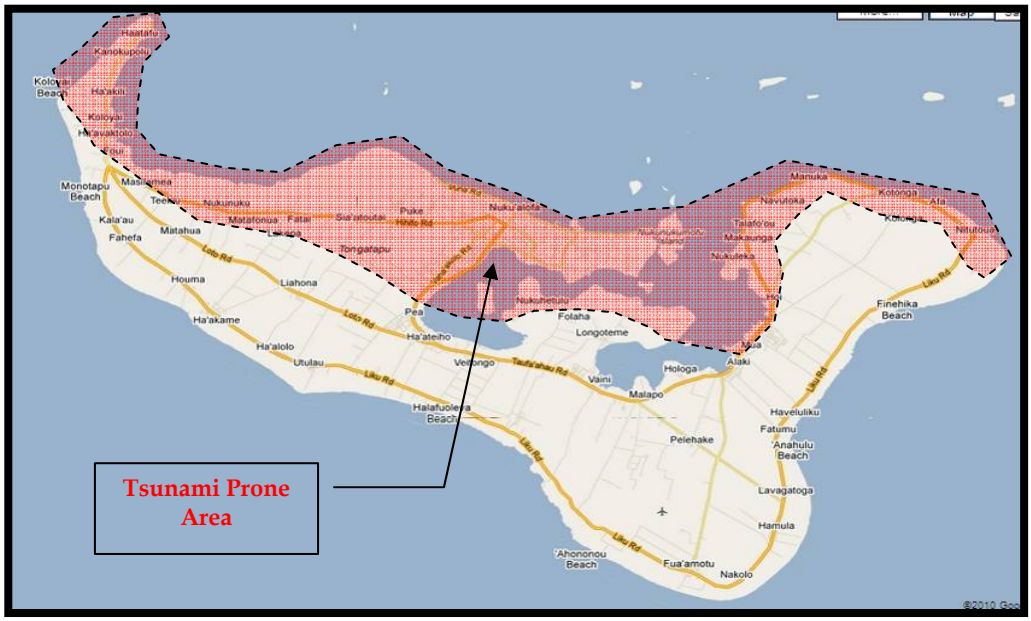


Figure 2: Indicative Tsunami Prone Area in Nuku'alofa

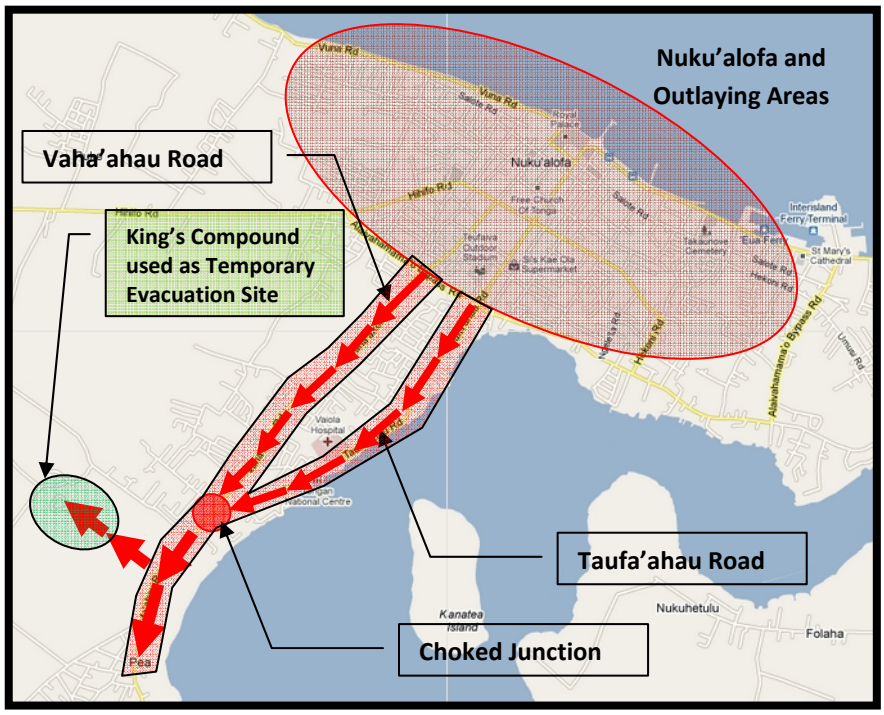


Figure 3: Nuku'alofa and Congested Thoroughfares during Tsunami Alert

5. STRATEGY OF DISASTER-RISK MANAGEMENT

Because of the ensued public confusion and anxieties following the issuance of Tsunami Warning on February 28, 2010, a number of state officials were alarmed and started evaluating current and programmed disaster-risk management program of the Government of Tonga. The purpose was to find out what systems were in-placed and what future initiatives were needed to be undertaken to minimize hazard vulnerability and improve the people's survivability, especially those in the main island of Tongatapu.

Tonga has undertaken and participated in quite a good number of programs on risk-disaster management. One of these programs was the Cyclone Emergency Recovery and Management Project, 2002-2007, funded by the World Bank. This involved strengthening and upgrading of the emergency and risk management capacity of the country through the improvement of its nationwide resilience to natural hazards, including the effects of climate change through GIS support in hazard-risk planning and study.

In terms of urban infrastructure upgrading and improvement in Nuku'alofa, the Government of Tonga requested for ADB's assistance. In response, in 2006, the Tonga Integrated Urban Development Project was formed (TIUDP); with its primary objective was to develop an Urban Planning and Management System (UPMS), and to undertake Project Design and Feasibility Studies (PDFS) for improvements to infrastructure and other services in the country's capital of Nuku'alofa. The Project, which would be implemented by the Ministry of Works (MoW), would also enhance capacities in urban planning, project management and maintenance. The Project would provide transport related civil works consisting of road rehabilitation, drainage improvement, and resurfacing of existing road.

Still on-going, the road rehabilitation will improve traffic flow and will become more responsive to unprecedented traffic during an impending disaster. The project will also entail intersection improvement to reduce bottlenecks and congestions at major intersection which can be chocked during an emergency, when people will be too anxious to escape and disregard traffic rules. The drainage improvement will improve getting rid of water and reduce flooding which can buy time to some people in a disaster, as well as provide additional safety measures. Nevertheless, drainage may become inoperable during a tsunami. The wider shoulder can be extra driving space for vehicles to enable more people to escape to higher grounds at shorter time.

The TIUDP also came up with long-term project propositions, which can be explored to improve the disaster-risk management measures and improve the survivability of the residents in Nuku'alofa. For these propositions, among the requirements now being considered by the Planning and Urban Management Division (PUMD) of the Ministry of Lands, Survey, Natural Resources and Environment (MLSNRE) is to incorporate climate change proofing requirements to better respond to disaster scenarios in the future. These long-term project propositions are as follows:

- Causeway and Reclamation works for a Lagoon-side Town – As mentioned in the TIUDP, a Lagoon-side Town Development was proposed as urban planning initiative for new site development. The reclamation works would entail land filling a concave area of the Fanga'uta Lagoon from a north point close to Alaivahamama'o Road (or Bypass Road) to the western edge connecting to Taufa'ahau Road. The lagoon side would be bordered by a causeway, which shall also serve as dyke protection to the reclaimed area. The dyke could be designed to include flood-proofing parameters to minimize the effects of sea level rise. This Fanga'uta Lagoon Causeway could serve as alternate route of vehicles destined to the Queen Salote Wharf via the Bypass Road. The new site can be well fortified from climate change impacts by properly elevating it well beyond coastal flooding possible scenarios

- Bridge and/or Causeway Crossing from Mataika Village to Nukuhetelu – Another possible project mentioned in the TIUDP, was connectivity at the shortest distance of the lagoon from north at Mataika to south at Nukuhetelu. The connectivity can be in terms of bridge or causeway and can primarily serve to provide shorter access from the airport to Nuku'alofa CBD and to the Queen Salote Wharf, via the Bypass Road. This connectivity project can relieve traffic in the CBD by providing additional access to the eastern part of Tangatapu. This causeway or bridge should now consider climate-proofing parameters for effective functionality against impacts of climate change.

During consultations of the author with key informants it was determined that the Lagoon-side Town Causeway could also be extended further southward to the villages of Pea and Ha'ateiho as supplemental access route to and from the CBD. As experienced in the previous tsunami warning (February 28, 2010), vehicular congestion occurred along the main thoroughfares of Taufa'ahau Road and Vaha'akolo Road resulting in a standstill of traffic for several hours.

This necessitated an exploration of other alternative routes, which could serve as evacuation routes for the CBD residents to expediently evacuate to higher grounds in the southern part of Tongatapu. One possibility is to extend the conceptualized Lagoon-side Town Causeway up to the villages of Pea and Ha'ateiho. At certain spots at these villages, certain roads can be improved to connect to designated evacuation areas. Connection can also be enabled at the junction of Taufa'ahau Road and Tokomolo Road for connection to Loto Road and further to Liku Road. With such project, the potentially devastating incident could be prevented.

A diagram showing these proposed Risk Disaster Management Propositions for Nuku'alofa are shown in a diagram layout in the next figure (Figure 4).

Figure 4: Nuku'alofa's Tsunami Disaster-Risk Management Measures

6. CONCLUSIONS AND RECOMMENDATIONS

6.1 Lessons Learned from Tonga

With the effects of climate change already being felt and recognized worldwide, thus worsening the vulnerability of small island nations and coastal areas, disaster-risk management is becoming critical. Although no one knows when the next natural disaster will strike in a certain place, the experiences in the South Pacific Islands indicate that these natural phenomena are becoming more frequent and their impacts more severe. The small island Kingdom of Tonga, particularly Tongatapu, which is the nation's capital, urban center and residence of majority of the population, is taking necessary steps to mitigate the impact of disasters and improve the survivability of their people.

In line with the TIUDP's objectives, immediate and short term projects consisting of road upgrading and drainage projects can serve as infrastructure mitigation measures in the event of the disaster, since an improved system can facilitate traffic flow and consequently save more lives during emergency and evacuation periods. The TIUDP's long-term proposition consisting of the (i) Lagoon-side causeway and (ii) Langoon Crossing Causeway/Bridge with climate

change proofing requirements, will be able to respond to future disaster scenarios which may occur in Nuku'alofa.

In addition, aside from the infrastructure measures mentioned, Tonga should establish the following:

1. Evacuation Plan for Nuku'lofa – a more comprehensive and clearer evacuation plan for the people to understand and follow is necessary to avoid undue confusion in times of emergency.
2. Establish a Number of Evacuation Sites – evacuation sites should be identified and the people should be properly informed of their locations, directional routes, and basic instructions on usage.
3. Come up with effective Rescue and Relief Measures – For those who may be needing assistance a rescue center should be designated and protocols established for rescue procedure along with relief measures for survivors.
4. Community Preparedness and Well-defined Communication Protocols – the entire populace should have the necessary and correct information, and drills should be conducted to assess their effectiveness.
5. Preparation of Community Action Plan – Concerted efforts of the community are necessary for coordinated action and greater chances of surviving the calamities.
6. Incorporate Climate Proofing in the planning, design and implementation of Infrastructure Projects – Forecasting future climate change scenarios and using them as basis for design in lieu of current and prevailing conditions improves the adaptability of these infrastructures and enhances the survivability of the population against disasters.

The experience in Tonga and the steps initial steps taken in the planning stage demonstrated proactive approach of the public officials in protecting their people. The preparation for even worse eventuality ensures greater adaptability of infrastructure and consequently higher survivability of the impacted constituents.

6.2 Applicability in the Philippines

In comparison, the Philippines is likewise exposed to threats similar to the ones being experienced in Tonga. As such, the Philippine authorities can learn from the experiences and proactive approaches of South Pacific nations like Tonga in times of disasters. The following items can be considered as applicable to coastal areas in the country:

1. Efficient transport system is important – For people to escape and evacuate to higher grounds, an efficient transport and road system is necessary where traffic should not occur in times of emergency. The LGUs should ensure that the people will not be stuck in traffic by having reliable roads and sound traffic management measures.
2. A well-defined communication protocol is necessary for a quick and effective response – The LGUs should be able to reach to their constituencies in times of emergency to issue instructions and directions for everyone's safety.
3. Climate proofing of systems or components of infrastructure is necessary – traditional planning should be supplemented by future risks that can be attributed due to global warming such as increase rainfall intensity and duration, etc.
4. Establishment of evacuation plan and sites – The people should be informed where exactly to go in times of emergency and what needs to be done as part of a community action plan to be coordinated and directed by branches of government and the LGU.
5. Upgrading and maintenance of systems incorporating climate-proofing requirements is necessary – Planning for disaster ensures better survivability rather than reacting to emergent situation in a chaotic manner.
6. Community involvement is a must – The community should be involved in the planning, implementation and operationalizing emergency plans

With the changing climate, people's mindset and ways should also change. Climate proofing is one of the necessary approaches that LGU executives should consider as part of their responsibilities and duties to their constituencies.

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