Pacific Catastrophe Risk Financing Initiative

COUNTRY RISK PROFILE

PAPUA NEW GUINEA

Tropical Cyclone and Earthquake Hazards in Papua New Guinea

The South Pacific is a region prone to frequent natural catastrophe. Its location south of the equator results in the frequent occurrence of tropical cyclones with damaging winds, rains and storm surge. Papua New Guinea, however, is relatively closer than other countries in the region to the equator, where strong tropical storms occur less frequently. The Bougainville Island and the New Britain region of Papua New Guinea are among the most seismically active areas in the world. These are active seismic zones capable of generating large earthquakes and major tsunami traveling great distances. The region around the Port Moresby, is, however, comparatively less prone to earthquake hazard.

Figure 1 shows the path of the eye, or center, of major tropical cyclones having affected Papua New Guinea since 1945. These storms can be very wide, with damaging winds and rain extending throughout Papua New Guinea. The color of the path reflects the intensity of the storm, as measured using the Saffir-Simpson tropical cyclone scale shown in Table 1. A more intense storm such as a category 4 or 5 has more damaging winds, higher precipitation rates and storm surge levels.

Figure 1: Selected historical Tropical Cyclone Activity in Papua New Guinea since 1945

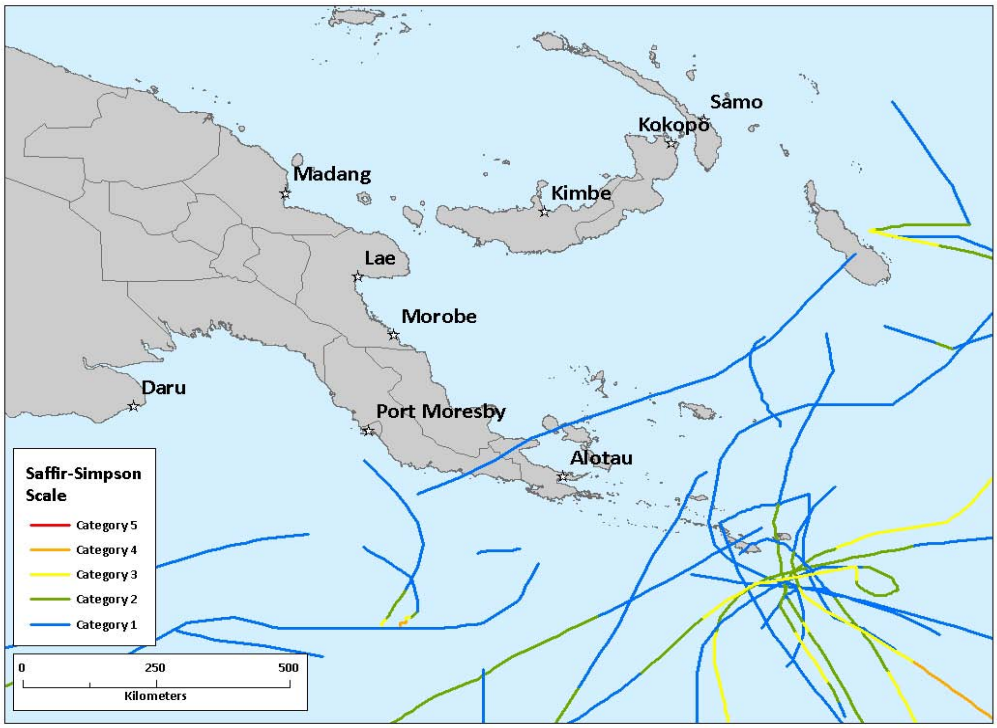
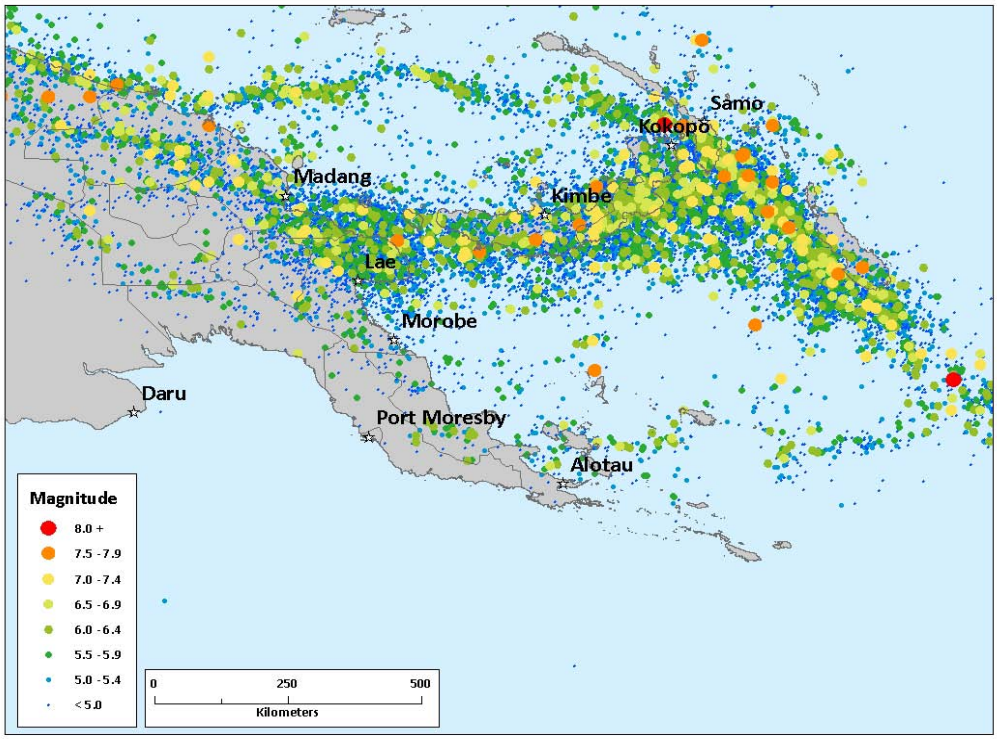


Figure 2: Historical Earthquake Activity in Papua New Guinea since 1900



Storm Category	Wind Speed (km/h)	Central Pressure (mbar)
1	119-153	980
2	154-177	965-979
3	178-209	945-964
4	210-249	920-944
5	>250	<920

Table 1: Saffir-Simpson Tropical Cyclone Intensity Scale

Table 2 shows the Mean Return Period of tropical cyclone of different Saffir-Simpson categories passing within 100km of Port Moresby. For example a tropical cyclone of category 1 or higher is expected to pass within 100km from Port Moresby, on average once approximately every 100 years.

Stronger events, or events occurring closer to the most populated areas, tend to cause more damage.

Saffir-Simpson Category	Mean Return Period (years)
≥ 1	103
≥ 2	200
≥ 3	500
≥ 4	2,500
5	3,333

Table 2: Mean Return Period for different Tropical Cyclone Categories

Figure 2 shows the mean return period of earthquakes of different magnitude occurring within 200km from Port Moresby. As mentioned earlier, the relatively seismically quiet area around the capital captured in Table 3 does not fully convey the high level of earthquake hazard in the entirety of Papua New Guinea and especially in the north

eastern region where seismic hazard is higher than in California or Japan.

Magnitude	Mean Return Period (years)
M ≥ 5	42
M ≥ 6	55
M ≥ 7	100
M ≥ 8	-

Table 3: Mean Return Period of Different Magnitude Earthquakes occurring in the vicinity of Port Moresby.

Exposure

Table 4 summarizes population and building stock or "exposure" as well as key economic values for Papua New Guinea. The exposure includes residential, commercial, industrial, and public assets. Figure 3 illustrates the exposure distribution around Papua New Guinea color coded by concentration of replacement value. The color of any dot in the map represents the replacement cost of all the assets assigned to that location in the model and not the replacement cost of a single structure. Although not explicitly indicated on the map, the number of assets assigned to each location is not the same. Note also that often many dots, each one with relatively low number of assets and, therefore, relatively low total replacement cost, overlap in areas with higher concentration of assets. The high concentration areas have a higher total replacement value of assets than other areas where the locations are more dispersed.

The numbers of residential units as well as their geographical distribution were derived from the Papua New Guinea 2000 Census. The 2007 population was used to estimate the housing information into the present.

The working population was obtained from the Annual Business Census and was then used to derive the number of commercial units.

Table 4:
Summary of Exposure in Papua New Guinea (USD)

GENERAL INFORMATION (2007):

Total Population:	5.8 million
GDP Per Capita:	$1,080
Total GDP:	$6,260 million

BUILDING UNITS COUNT:

Number of Detached Homes:	1.1 million
Number of Flats:	5,731
Number of Commercial, Industrial, and Public Units:	45,636

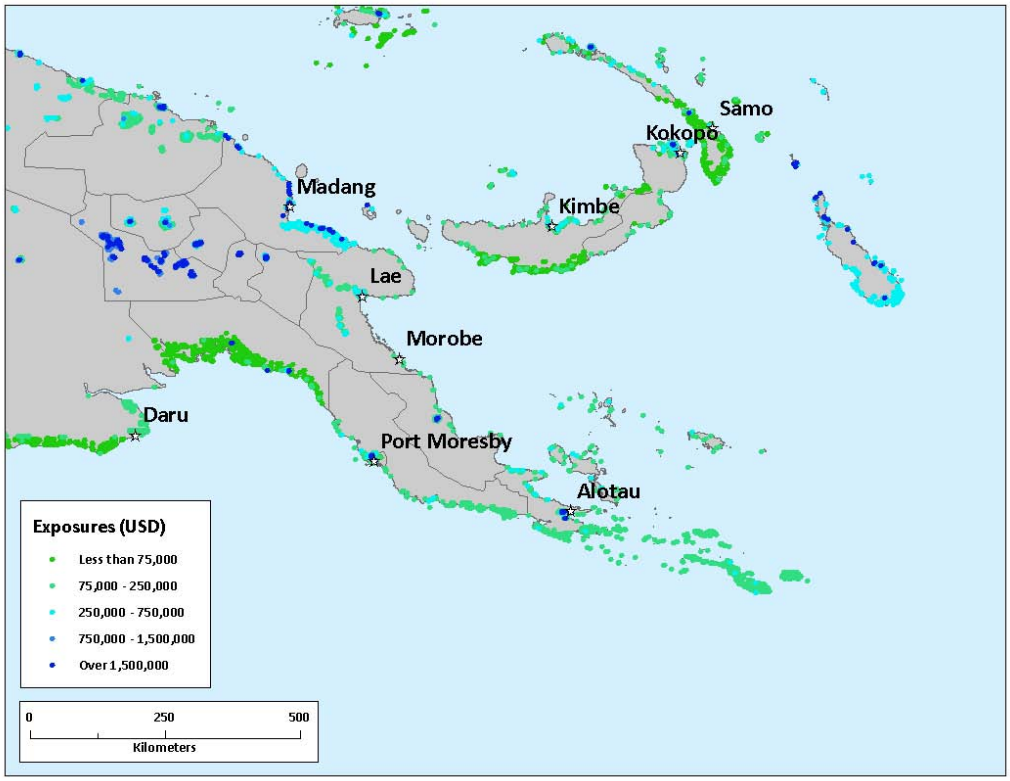
COST OF REPLACING THE BUILDING STOCK:

Residential Buildings:	$11.20 billion
Commercial, Industrial, and Public Assets:	$6.96 billion

GOVERNMENT RESOURCES AND EXPENDITURES

Total Government Revenue	
(In USD):	$2,122 million
(% GDP):	33.9%
Total Government Expenditures	
(In USD):	$2,209 million
(% GDP):	35.3%

Figure 3: Exposure Distribution in Papua New Guinea by Individual Exposure Location



NOTE: The color of any dot in the map represents the replacement cost of all the assets assigned to that location

Risk Analysis Results

To estimate the risk profile for Papua New Guinea posed by future tropical cyclones and earthquakes a mathematical model of potential storms and earthquakes that may affect the country in the future was constructed. This model, based on historical data, simulates about 150,000 tropical cyclones and 2.2 million earthquakes, grouped in 10,000 annual realizations of the potential next year activity. As occurred in the past, the simulations show that some years will see no damaging storms or earthquakes affecting Papua New Guinea, while other years may see one or more events affecting the country.

The country risk profile is derived from an estimation of the direct losses that the simulated potential future events generate to the assets in the exposure. Direct losses to infrastructure, agriculture, and forestry are not included. After adding up the cost of repairing or rebuilding the damaged structures, it becomes possible to estimate the severity of direct losses for future catastrophes. The direct losses for tropical cyclones are caused by wind and flooding due to both rain and storm surge while for earthquakes they are caused by ground shaking and tsunami.

Table 5 summarizes the risk profile for Papua New Guinea due to future tropical cyclones and earthquakes. In addition to the direct losses, which reflect the cost needed to repair

or replace the damaged assets, the table lists the emergency losses, which are the expenditures that the Papua New Guinea's government may need to sustain in the aftermath of a natural catastrophe to provide necessary relief and conduct repair activities such as debris removal, setting up shelters for homeless or supplying medicine and food. The emergency losses are estimated as a percentage of the direct losses.

Mean Return Period (years)	50	100	250
Risk Profile: Tropical Cyclones			
Direct Losses			
(USD million)	46	58	76
(% GDP)	1%	1%	1%
Emergency Losses			
(USD million)	11	13	18
(% of total government expenditures)	0.5%	0.6%	0.8%
Risk Profile: Earthquake and Tsunami			
Direct Losses			
(USD million)	294	473	720
(% GDP)	5%	8%	11%
Emergency Losses			
(USD million)	55	90	125
(% of total government expenditures)	2%	4%	6%

Table 5: Papua New Guinea's Potential Risks

The table includes the values that are expected to be exceeded, on average, once every 50, 100, and 250 years. For example, an earthquake loss in exceedance of USD 473 million, which is equivalent to about 4% of Papua New Guinea's GDP, is to be expected on average, every 100 years.

In Papua New Guinea tropical cyclone losses are expected to be substantially less frequent and severe than losses due to earthquake ground shaking and tsunami. The former, however, remain potentially catastrophic events. As illustrative examples, Figure 4 shows the mean return period of direct losses in million USD generated by earthquake, tsunami and tropical cyclones combined. Figure 5 shows the same direct losses expressed as a percent of the national GDP. The national GDP is listed in Table 4.

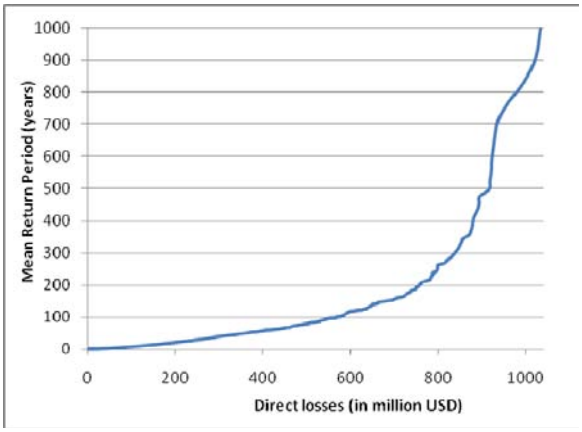


Figure 4: Mean Return Period of Direct Losses in million USD

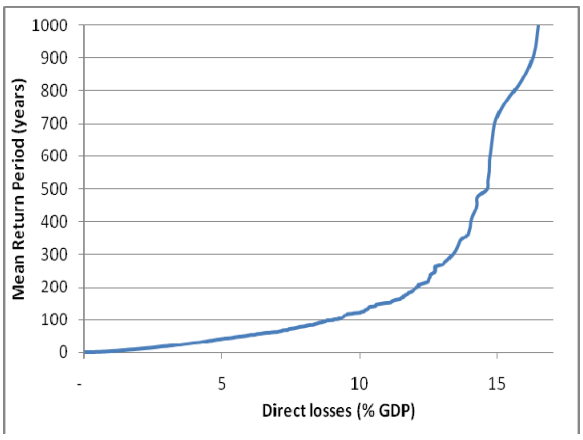


Figure 5: Mean Return Period of Direct Losses as a percentage of GDP

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