

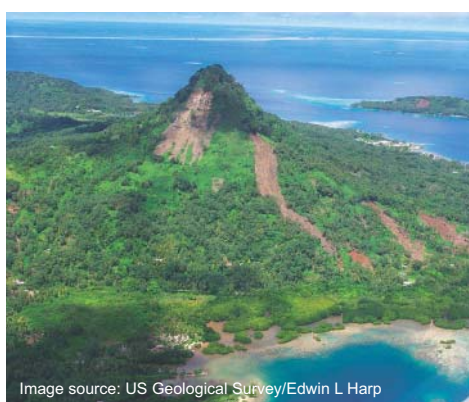
Landslides

NATURAL HAZARDS IN THE PACIFIC - FACT SHEET 4



Reducing Vulnerability of Pacific ACP States

Landslides are a serious geological hazard affecting the mountainous, volcanic islands of the Pacific region - namely Fiji, Papua New Guinea, Samoa, Solomon Islands, Vanuatu and the Federated States of Micronesia. Globally, landslides are more widespread than any other geological event and cause thousands of deaths and injuries each year and can cost billions in damages.



Over 250 landslides initiated by the heavy rains of Typhoon Chata'an in 2002 (some 500 mm in less than a day), killed 43 people and destroyed 230 houses in the islands of Chuuk State, FSM

Image source: US Geological Survey/Edwin L Harp

What is a Landslide?

Landslides occur when rock, soil or waste becomes unstable and moves downward under the influence of gravity. Many factors contribute to the instability of slopes, but the main factors that pre-dispose a slope's stability are its geology, its geometry and its (pore)-water conditions.

Three distinct physical events occur during a landslide:

- Initial slope failure
- Subsequent transport
- Final deposition of the slide materials

The term landslide refers to a number of different processes:

- **Falls & Topples:** Often the result of weathering, a fall is the collapse of steep (usually rocky) slopes, while a topple occurs when material detaches from an exposed vertical face with a rotational outward movement.
- **Slides:** A slide occurs when material detaches from the slope and slides downwards along the slope in either a translational or rotational movement.
- **Flows:** During a flow, material moves like a liquid at speeds of about 10 m/s and travels long distances. These can be highly destructive due to their speed and ability to accumulate large chunks of debris, such as trees, vegetation, cars etc.

Landslides travel at a variety of speeds from a few millimeters a year to over 100 metres per second and are frequently associated with other natural hazards. Natural events and human activity can also cause slope failures.

Natural causes include:

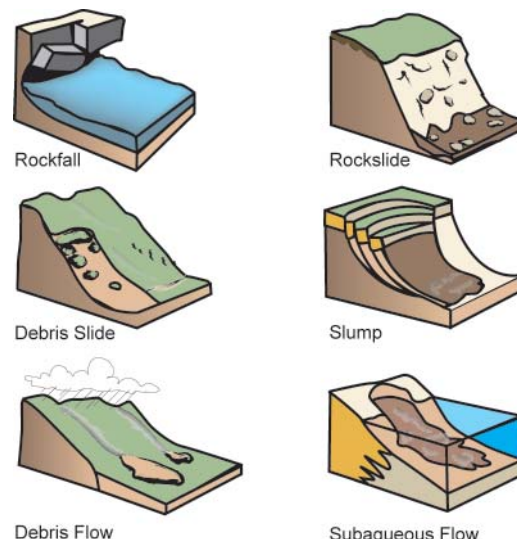
- Saturation of slope material from intense/prolonged rainfall or seepage due to storms and tropical cyclones.
- Earthquake vibrations.
- Volcanic eruptions.
- Undercutting of cliffs and banks by waves or rivers etc.

Human activities that cause landslides may include:

- Removal of vegetation or interference with or changes to natural drainage.
- Leaking pipes (water, sewer) or modification of slopes by construction of roads, railways or buildings.
- Mining activities and vibrations from heavy traffic or blasting and excavation or displacement of rocks.

The steep, volcanic Pacific islands are particularly susceptible to landslides due to large amounts of rainfall, continual urban development and high earthquake potential and volcanic activity in the region.

Types of Landslide



EXAMPLE: Three of the world's largest landslides within the last 120 years occurred in the Pacific. A debris avalanche in 1985 along the Bairamen River (PNG), which released 0.18 km³ of material, formed a 210 m high dam that impounded a 0.05 km³ lake. Villagers were evacuated just in time before the dam failed causing a debris flow-flood downstream. A major rockfall in 1988 killed 74 people at Kaiapit (PNG) by discharging 1.8 km³ of material, which ran out into the main valley over a distance greater than 10 km. The collapse of Ritter Island volcano (PNG) in 1888 is maybe the largest landslide in recent times. The displacement of 5 km³ of material caused a local tsunami with 12-15 m high waves destroying several coastal villages.

Landslide Hazards

Landslides can be fast, sudden and can cover large areas, engulfing people, crops, animals and buildings. Areas prone to landslide hazards include old landslides, slopes dried out and cleared by fire, the bases of steep slopes, drainage channels and developed hillsides.



Cyclone Bola 1988 caused this large landslide in Gisborne, New Zealand, creating a lake.

Image source: Noel Trustrum, GNS NZ.

Fatalities and Damage

Landslides cause tremendous damage to property and infrastructure, as well as numerous fatalities and injuries. One of the major problems is that landslides can cut off roads and communication lines, leaving people stranded. Landslides also affect the viability of food gardens and cash cropping areas on which rural Pacific economies are heavily dependent.

Secondary Effects

Alteration of the landscape. Very large landslides can have an enormous effect on the surrounding geography. They create huge gaps in the vista and dam rivers, flooding surrounding areas and creating lakes.

EXAMPLE: A prehistoric landslide that occurred in the Namosi Gap (Fiji) sent 50 million m³ of debris downhill building a dam 120 m thick. This led to flooding of the areas surrounding the river as a lake of 150 sq km formed. After 1000s of years the lake emptied to the South cutting the narrow Navua Gorge and creating a new river system.

Landslide dam outburst floods. Failure of a landslide dam, which has trapped large volumes of water behind it, can cause catastrophic flooding downstream.

Tsunamis. Large landslides underwater or into the sea may create tsunamis.

Reef damage. Landslides cause severe soil erosion and deposit this sediment in rivers, which then carry it into the sea causing considerable damage to the surrounding coral reefs.



Blockage of road by landslides during the Vanuatu earthquake in 2002.

Image source: Esline Garaebiti, Vanuatu MLGM

Landslide Warning Signs

- Doors or windows stick or jam for the first time.
- New cracks appear in plaster, tile, brick, or foundations.
- Outside walls, walks, or stairs begin pulling away from the building.
- Slowly developing, widening cracks appear on the ground or on paved areas and underground utility lines break.
- Bulging ground appears at the base of a slope and water breaks through the ground surface in new locations.
- Fences, retaining walls, utility poles, or trees crack, tilt or move and boulders knock together.
- You hear a faint rumbling sound that increases in volume as the landslide nears.
- The ground slopes downward in one specific direction and may begin shifting in that direction under your feet.
- If you are near a stream or channel, be alert for any sudden increase or decrease in water flow and for a change from clear to muddy water.

For further information on landslides see the following websites:

<http://landslides.usgs.gov>

<http://www.redcross.org/services/disaster/keepsafe/landslide.html>

<http://www.fema.gov/hazards/landslides/>

Or contact your government natural resources department.

What you can do before, during and after a landslide

PREPARE FOR A LANDSLIDE

- Learn to recognise the landslide warning signs.
- Look for drainage patterns on slopes near your home noting where flow increases over soil-covered slopes. Check these slopes for signs of land movement, such as small slides or flows or even increasingly tilting trees — changes could alert you to a greater landslide threat.
- Minimize home hazards — plant ground cover on slopes and build retaining walls.
- Make evacuation plans — plan at least two evacuation routes since roads may become blocked or closed.
- Safe areas include slopes that have no movement history, flat-lying areas away from sudden changes in slope, and areas along ridges away from tops of slopes.
- **BE ESPECIALLY ALERT WHEN DRIVING.** Embankments along roads are particularly susceptible to landslides.

DURING A LANDSLIDE

- Quickly get out of the path of the landslide or mud flow, **RUN UPHILL** to the nearest high ground in a direction away from the path. If rocks and other debris are approaching, run for the nearest shelter such as a group of trees or a building.
- If escape is not possible, curl into a tight ball and protect your head.

AFTER A LANDSLIDE

- Stay away from the slide area, there may be danger of additional slides. Remember that flooding may occur after a landslide.
- Check for injured and trapped persons near the slide, without entering the direct slide area. Direct rescuers to their locations.
- Listen to a battery-operated radio or television for the latest emergency information.
- Check building foundations, chimney, and surrounding land for damage. Check for damaged utility lines and report any damage to the utility company.
- Replant damaged ground as soon as possible since erosion caused by loss of ground cover can lead to flash flooding.