Landslides Fact Sheet

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Some basic facts

Landslides are part of the natural process that shape mountains and new land forms by distributing materials down slope. Where expanding human activity has not assessed possible risks or an increase thereof due the changes in practice, resulting disaster may appear unexpectedly and unpredictably. Landslides can be a major contributor to floodwaters dramatically increasing the power and devastation of flood events.

Though only 14 events in 100 years with over a thousand deaths were recorded as primarily initiated by heavy rains and earthquakes, this is but the 'tip of the iceberg.' Many medium scale events around the world are reported annually and these are more significant in their national impact due to lack of risk assessment, local government capacity to respond and community awareness and preparedness.

➢ Major Landslide Disasters Worldwide

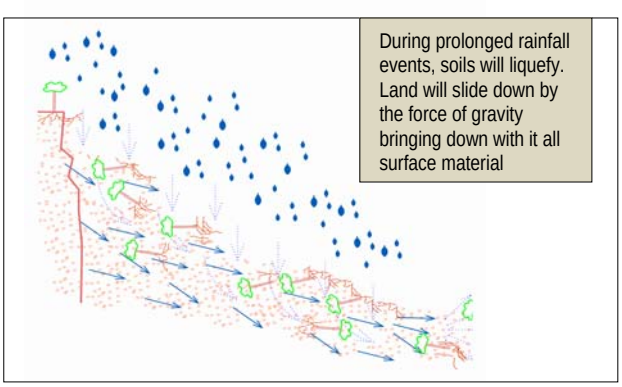
Country	Year	Description	Cause	Vol.	Deaths
Indonesia	*1919*	*Lahars*	*Crater draining*	*n.r*	*5,160*
China	*1920*	*Dry loess*	*Earthquake*	*n.r.*	*180,000*
China	*1933*	*Landslides & dam*	*Earthquake*	*n.r.*	*6,800*
Tajikistan	*1949*	*Rockslide*	*Earthquake*	*n.r.*	*18,000*
Japan	*1958*	*Landslide, debris flow*	*Typhoon*	*n.r.*	*1,094*
Peru	*1962*	*Debris & rock*	*Ice & rock*	*13*	*4,500*
Italy	*1963*	*Rockslide*	*Heavy rains, reservoir*	*300*	*1,899*
Brazil	*1966*	*Debris slides/flows*	*Heavy rains*	*n.r.*	*1,000*
Brazil	*1967*	*Debris slides/flows*	*Heavy rains*	*>10*	*1,200*
Peru	*1970*	*Debris slides/flows*	*Earthquake*	*30-50*	*18,000*
Colombia	*1985*	*Earthflow*	*Rainfall*	*3.5*	*23,000*
Ecuador	*1987*	*Rock slides, wet soils*	*2 earthquakes*	*7-10*	*1,000*
Venezuela	*1999*	*Debris slides/flows*	*Heavy rains*	*n.r.*	*30,000*
Philippines	*2006*	*Landslide debris flow*	*Heavy rains*	*n.r.*	*18,000*

vol. - volume of material in millions of metric tons. n.r. - not recorded
Adapted from Sidle & Ochiai

Rainfall is the dominant trigger for landslides along with seismic activity that can also set soil and rock materials in motion. Landslides, debris slides and debris avalanches mean technically the same. The term landslide is used to describe a variety of processes that result in the downward and outward movement of slope materials (rocks, soil, landfill, vegetation) that may fall, topple, slide, spread or flow. Landslides are due to gravity and characterized by the inability of the slope to hold earth materials during heavy and sustained rainfall or concentrated rainfall over a short period of time in a susceptible area.

Smaller scale slides due to unstable lands and different degrees of liquefaction make landslides a continuing concern in terms of the volume of material and their impact on populations. Land cover change, notably deforestation, played a major role in many landslide events in New Zealand, India, Nepal, and Western Australia. Deforestation also exposes the land to erosion. During rainfall events, runoff on exposed mountain slopes erodes off soil and carried away debris if rainfall is prolonged. This debris along with other suspended sediments is then transported by rivers to the valleys and river beds downstream. Increased sediment loading in creeks and rivers is often triggered by engineering works especially in cities or road construction as cities expand to accommodate new settlements. The transformation of these landscapes have contributed to multiple disasters and increase the risk of disasters impacting humans, property and the environment in the long and short term.

Areas with a history of landslides and seismic activity, located near steep mountain slopes with high rainfall occurrence, are susceptible to landslides. Soil type, depth and land cover are other factors that may predispose to several hazards that include landslides. There are landslides where the soil structure is weakened by the rains and ultimately collapses under the sheer gravity of the material (mass wasting). This happens where there is expansion and contraction of the soil from the wetting and drying over time.



➢ Debris flows and floods

Landslides or debris slides when liquefied become debris flow. This is most dangerous as debris flow is the most rapid and fluid type of mass wasting and contains solid material that rams into objects in its path. With more water, debris flow becomes a debris flood that overflows river banks and deposited material such as major rock material on the riverbed and floodplains. On entering the lowland, debris floods may contribute to a much larger flood event or settle to form a debris fan.

A debris flow may occur even under full forest cover during major rainfall events. This occurrence is more frequent in degraded

forests and on exposed slopes, though the depth of soil loss may not be as great due to longer history of continuous erosion. Debris flows may begin as debris avalanches that move into streams and then flow rapidly downstream. It cannot be assumed that the spate of major landslides contributing to disastrous flooding in tropical Asia is caused by deforestation, rather triggered by intense and/or prolonged rainfall that liquefied the soil even under primary forest.

Urban landslides are common due to intense infrastructure development and poor waste management and drainage. Engineering efforts to contain or prevent flooding and landslides in areas with high economic activity and investments often compound the problem. Even in rural areas with large populations in towns established on known floodplains, mud or debris flows combined with floodwaters continue to take lives and devastate livelihoods and properties as has happened in the Philippines. (Ormoc 1990, Infanta 2004, Albay 2006)

Impacts and risks

Landslides and floods are connected due to their capacity to transport and deposit sediment over large areas and cause changes in the landscape. Gradual but continuous siltation has a cumulative effect that builds up over time, while a major event such as a flash flood or landslide will result in significant changes in the landscape. The coupling of negative natural processes and human-induced change in an area can dramatically increase the instability and disaster risk.

➢ Alluvial fans and braided rivers

Active or new alluvial fans are porous and can be eroded easily by strong currents. A river running through the fan can easily fork into several channels downstream that converge and then diverge again creating a braided appearance of the river. Settlements along river banks or in close proximity to braided rivers are subject to flash floods and debris flows as the river forms new routes.

➢ Shallowing and widening of rivers

Gradual but continuous erosion slowly silt up river channels with sediments and debris. Large and multiple landslides triggered by major storm events can deliver tons of material and debris in creeks and rivers compromising the capacity of the river to hold and drain floodwaters into the sea. With increased land use pressure, not only is erosion and sedimentation exacerbated but the degree of devastation and impact to people and livelihoods is greater.

While landslides are limited to a much smaller and determinable area, widespread soil degradation (soil loss and nutrient leaching) from inappropriate land use, deforestation, overgrazing, salination of the water table from over-extraction of ground water for household and irrigation use has resulted in large economic losses and famine over time.

➢ Formation of a delta from sediments spewed out by mountains and rivers

Inland floodplains, marshlands and coastal deltas, areas of great river systems, are the natural "overflow" areas of floods that slow floodwaters, allowing the nutrients and sediments to settle. These rich and fertile areas are increasingly reclaimed for agriculture, housing and industry. As settlements are established, large and multiple landslides triggered by major storm events will deliver tons of material and debris downstream onto these settlements. Engineered flood control structures and dams that channel water compromise the capacity of the river to hold and drain flood water to the sea, and destroys the natural movement of sediments and nutrients.

What can be done

Landslide-prone areas are definable and easily mapped in all countries. Vulnerable areas need attention both in terms of community preparedness and management and greatly improved governance in identifying and allocating land for appropriate relocation and livelihood. The misidentification of the real causes as to how landslides and floods are triggered has delayed and misdirected the proper response and reinforced the problems.

People need to know the risks of the location where their homes and livelihoods are situated. Developing an understanding of the risks and what levels of response are needed before, during and after disaster events permits better governance and strategic use of scarce resources. Traditional knowledge of an area or historical memory is often too limited and communities who are in the first line of actors in a disaster are generally not oriented or prepared to act. This results in further marginalisation of people, especially of the poor who are exposed to the highest risk, bear the greatest impact and are the slowest to recover in disaster events.

Building competencies in community-based disaster management includes:
Developing local self-reliance in disaster preparedness by increasing community awareness of disaster risks in the area through education and training, and developing early warning systems and evacuation strategies
Capacitating local governments to shift from post-facto to pre-disaster responses in identified vulnerable areas – pre-disaster mitigation and prevention, disaster response and management, as well as post-disaster rehabilitation and reconstruction
Multi-hazard identification and disaster risk assessment
Area zoning and land allocation especially in resettlement and housing development projects
Establishing sustainable livelihoods or expanding livelihood options for the resettled or affected population

Sources:
Sidle, Roy C. and Hirotaka Ochiai. 2006. *Landslides: Processes, Prediction and Land Use.* Washington: American Geophysical Union.
Walpole SJ, Peter. 2007. *Rainfall, Landslides, Debris Flows and Flooding: Understanding the Real Causes the Put Lives at Risk*. Quezon City (in press)

Photos: Peter Walpole SJ