

## NEWS

### TO THE PEOPLE

## LANDSLIDES



Terrain landslide.



Rock slide with damage on the road during a storm

***"What is a landslide, what are the hazards of landslides, why must they happen in certain locations and what are the devastations which occur as a result?"***

As the tectonic tantrum of the earthquake , catastrophic as pure weather-borne calamities (floods, hurricanes, tornados), the mudslide lies which waits like a heart attack are the various ways in which nature can kill an individual, but the most cruel one is through a landslide. It springs its localized force quite slowly. If no initiative is taken then it becomes filthy, bone-crushing, and suffocating. Any trust you have in dry land will promptly be upended!

Landslides produce extremely more fear as compared to other disasters whose death counts go much higher for example: fires, earth quakes, plane crashes and freak weather conditions because they are very rare. More often do social media expose us to the damages done by hurricanes and tornados but rarely on landslides hence it introduces an unfamiliar damages to us. *"It feels like you are in not a junkyard, but in a landfill,"* said the sister of one of the Oso victims as she surveyed the site. *"You've got sewer pipes. You've got dirty diapers."* She added.

## **What is a landslide?**

A landslide is the movement of a mass of rock, debris, or earth down a slope. Landslides are a type of mass wasting which denotes any down-slope movement of soil and rock under the direct influence of gravity.

## **Causes of landslide**

*Water, friction and force of gravity play a great role in the movement down a slope during land sliding. this is because the force of gravity; which acts to move material downhill is usually counteracted by two things: which are; the internal strength of material and the friction of the material of the slope. A landslide occurs because the force of gravity becomes greater than either friction or the internal strength of the rock and soil sediments.*

### **THE ROLE OR WATER IN CAUSING LANDSLIDE**

The addition of water to material on the slope can make landslides more common as water adds significant weight to the slope when it seeps into the ground thereby becoming ground water and adding to the gravitational force. Water also lowers the strength of the material which can make it less able to withstand the force of gravity. It also reduces friction thereby making it easier to move material downhill. Hence landslides are much more common during or right after large storms.

### **ROLE OF FRICTION IN CAUSING LANDSLIDE**

The amount of friction between a deposit of rock or soil and the slope that it rests on plays an important role the occurrence of landslides. Steeper slopes have less friction making landslides more common ;any change to the earth's surface that increases the slope for example river incision or the removal of material at the base of a slope or that reduces the friction of a slope such as the addition water can increase the likelihood of a landslide.

### **ROLE OF GRAVITY IN CAUSING LANDSLIDE**

When the force acting to move materials down a slope becomes greater than either friction or the internal strength of sediments of soil and rock a landslide occurs

## ***Types of landslides***

They can occur as flows slides or rock falls and topples. A major difference between the three types is the amount of water; as flows have the most and rock falls have the least.

### **FLOWS**

It is a mixture of water, soil, rock and debris that moves rapidly downslope. They usually occur in fine grained material or water saturated slope. They may or may not be confined in a channel. Earthflows have a characteristic hourglass shape. The slope material forms a liquid and runs out forming a bowl or depression at the head .Debris flows usually occur in steep gullies and contain coarse materials. They move very rapidly and can travel a distance of many miles. Slopes whose vegetation have been removed by fire and human activities are at great risk of debris flow.Laharas are debris that originate on volcanoes. A volcanic eruption can rapidly melt snow and ice causing a deluge of rock or soil ash and water that accelerates down the slopes of a volcano devastating anything in its path. They can travel great distances and damage structures in flat areas away from their source.

The diagram below shows a Volcanic eruption which has caused a landslide.



**Diagram showing volcanic eruption which has resulted to landslide**

### SLIDES

They are downslopes movements of soil and rock along a surface and can be deep seated or shallow. They are initiated by steep slope. Translation slides usually fail along geological discontinues such as bending surfaces. They move out or down along a planar surface with little tilting and can move a great distance. They often contain loose sediments or large slabs of bedrocks. Rotational slides occur along a curved surface or spoon shaped surface. They often occur because the internal strength of the material overcome by its own weight. They are composed of unconsolidated material.

### ROCKFALLS AND TOPPLES

They are usually rapid downward movement of large pieces of rock. Sometimes this is enough rock to cover a road or burry a stream or river. Lateral spreads occur on very low angle slopes toward a free face such as cliff or embankment movement is accompanied by cracking of ground. The failure is cause by liquefaction of soil usually because of an earthquake.

### **Hazards of landslide**

Landslides can be initiated in slopes by:

- a) *Saturation of slopes by precipitation* (rain or snow melt) which weakens soil and rock by reducing cohesion and friction between particles and increasing the pressure in pore spaces, pushing grains away from each other. Cohesion, which is the tendency of soil particles to stick to each other, and friction affects the strength of the material in the slope and contribute to a slope's ability to resist down slope movement. In addition to this, saturation increases the weight of the slope materials and, like the addition of material on the upper portion of a slope, increases the gravitational force on the slope which reduces the slope's resistance to the force of gravity by removing the much needed support at the base of the slope. Alternating cycles of freeze and thaw can result in a slow, virtually imperceptible loosening of rock, thereby weakening the rock and making it susceptible to slope failure as in the case of the small landslide in the 2017 Thomas fire burn area that initiated during atmospheric river events in December 2022 and January 2023 and Mud Creek landslide of 2017.
- b) *Erosion and under cutting of slopes by streams, rivers, glaciers, or waves* which increase slope angles and decrease slope stability. If the bottom of a slope is continually eroded, for

example by the sea or a river, the slope will eventually become too steep to hold itself up. This in steepness of the slope as observed coastal erosion increases the likelihood of a landslide as in the case of Laguna Beach Landslide of 2005 which destroyed at least 11 homes many people were evacuated in California.

- c) *Earthquakes* which create stresses that weaken slopes and physically cause slope movement by inducing shaking in water bodies causing landslides under water. These landslides are called submarine landslides. Submarine landslides sometimes cause tsunamis that damage coastal areas. It should also be taken in considering that when an earthquake occurs, the transmission of seismic waves can cause shaking and vibration of ground surface. This often triggers the collapse of potential landslide areas, which is known as earthquake-induced landslide. This was observed in January 1994 when the magnitude 6.7 Northridge earthquake triggered over 11,000 landslides, contributing to the quake's total \$20 billion in property damage centered around the San Fernando Valley region.
- d) *The overweighting and under cutting of slopes for facilities; roads, trails, mines, and other man-made structures* which change the natural slope equilibrium and cause slopes to fail. These activities undertaken without adequate grading of slopes, poorly planned alteration of drainage patterns, cause disturbance of the soil structure and may lead to landslide. In the Himalayan mountain region, particularly in Nepal and India, many of the fatal landslides (Between 2004 to 2016) occurred on road construction sites in rural areas, while in China many took place in urban construction sites.
- e) *Volcanic activities*; Volcanic lava may melt snow at a rapid rate, causing a deluge of rock, soil, ash, and water that accelerates rapidly on the steep slopes of volcanoes, devastating anything in its path. These volcanic debris flows reach great distances, once they leave the flanks of the volcano, and can damage structures in flat areas surrounding the volcanoes. An example is 1980 eruption of Mount St. Helens in Washington which triggered a massive landslide on the north flank of the volcano, the largest landslide in recorded times.

### **Why do landslides occur in certain locations?**



**Landslides in Brazil – France (to the left) and Malaysia (to the right) as a result of**

### **deforestation**

Areas which are likely to receive landslides include:

a) ***Areas where wildfires or human modification of the land have destroyed vegetation;***

Vegetation and soil changes after a fire increase the runoff and erosion in a water shed, and significantly increase the likelihood of debris flows and flash flooding. Flash flooding and debris flows can initiate during even moderate rainstorms over burn areas and often occur with very little warning. Post-fire flow can alternate between flood and debris flow. Again, the loss of forest vegetation leads to a reduction in soil cohesion and a decrease in the shear strength of the soil profile. As a result, the slope becomes more susceptible to land sliding and deforestation destabilizes the soil as tree roots decay, further increasing landslide hazard. Landslide disaster risk in the Kivu Rift was linked to deforestation.

b) ***Areas where landslides have occurred before;***

Landslides can be initiated in slopes already on the verge of movement by rainfall, snowmelt, changes in water level, stream erosion, and changes in ground water, earthquakes, volcanic activity, disturbance by human activities, or any combination of these factors. After landslides' occurrence the slope remains unstable hence can be affected by landslide as in the case of: The Himalayas mountain belt which comprise of tectonically unstable younger geological formations subjected to severe seismic activity and the Western Ghats and Nilgiris which are geologically stable but have uplifted plateau margins influenced by neo- tectonic activity.

c) ***Steep slopes and areas at the bottom of slopes or canyons;***

Landslides are more common on steep slopes due to erosion. Erosion happens on slopes, like mountains, when heavy rains move water down the slope. The movement of water down the slope means that the side of the slope is not absorbing very much water. This leads to reduced vegetation and a higher erosion rate. Therefore, there is less ability for the slope to hold on to trees and plants, which makes it easier for large objects and debris to slide down. Examples of landslides as a result of steep slope are calcareous and silicate schist's of the south-facing slope of the Urseren Valley in Switzerland.

d) *Slopes that have been altered for construction of buildings and roads;*

Without tree roots to absorb heavy rainfall, the soil on steep slopes becomes oversaturated and loses friction. The resulting flow of water down the hills dislodges soil and boulders, putting residents and buildings located below at risk. The Caribbean Islands is a good example a, the area is characterized by intense heavy rainfall and steep slopes which give to frequent landslide occurrence bringing down constructions.

e) *Channels along a stream or river;*

Slope saturation by water is a primary cause of land- slides. This effect can occur in the form of intense rainfall, changes in ground- water levels, and water-level changes along coastlines, earth dams, and the banks of lakes, reservoirs, canals, and rivers. The landslides along King County River are a perfect example to show that channels along rivers are likely to be affected by landslides.

f) *Areas where surface runoff is directed*

High content of water increases the weight of the slope materials and, like the addition of material on the upper portion of a slope, increases the gravitational force on the slope which reduces the slope's resistance to the force of gravity by removing the much needed support at the base of the slope. Alternating cycles of freeze and thaw can result in a slow, virtually imperceptible loosening of rock, thereby weakening the rock and making it susceptible to slope failure.

## **DEVASTATIONS CAUSED BY LANDSLIDES.**





**A landslide which resulted into destruction of infrastructure and loss of lives.**

The impact of a landslide can be extensive, including loss of life, destruction of infrastructure, damage to land and loss of natural resources. As explained below:

**a) Lead to economic decline**

Landslides cause destruction of property. If the land slide is significant, it could drain the economy of the region or country. After a landslide, the area affected normally undergoes rehabilitation. This rehabilitation involves massive capital outlay. For example, the 1983 landslide at Utah in the United States resulted in rehabilitation cost of about 500 million U.S dollars. The annual loss as a result of landslides in United States stands at an estimated 1.5 billion dollars



**b) Decimation of infrastructure**

The force flow of mud, debris, and rocks as a result of a landslide can cause serious damage to property. Infrastructure such as roads, railways, leisure destinations, buildings and communication systems are decimated by a single landslide. In Manipur, a landslide on NH2 which is a road between Senapati and Lairouching led to decimation of the road.

**c) Loss of life**

Communities living at the foot of hills and mountains are at a greater risk of death by landslides. A substantial landslide carries along huge rocks, heavy debris and heavy soil with it. This kind of landslide has the capacity to kill slots of people on impact. For example, Landslides in the United Kingdom that happened a few years ago caused rotation of debris that destroyed a school and killed over 144 people including 116 school children aged between 7 and 10 years. In a separate event, NBC News reported a death toll of 21 people in the March 22, 2014, landslide in Oso, Washington.

**d) Affects beauty of landscapes**

The erosion left behind by all forms of landslides leaves behind rugged landscapes that are unsightly. The pile of soil, rock and debris downhill can cover land utilized by the community for agricultural or social purposes.

**e) Impacts river ecosystems**

The soil, debris, and rock sliding downhill can find way into rivers and block their natural flow. Many river habitats like fish can die due to interference of natural flow of water. Communities depending on the river water for household activities and irrigation will suffer if flow of water is blocked. Landslide material can also block rivers and increase the risk of floods. They also have a devastating effect on farmers' livelihoods as they can prevent access to land for years, destroy seed and food stocks and will commonly result in the loss of livestock and standing crops. For example, The landslide at Ramche village in Myagdi district, about 140km north-west of Kathmandu, Nepal, struck late on Saturday 23 May 2015 blocked the Kali Gandaki river, creating a dam about 200 metres deep and a 100 metres wide.

**CONCLUSION**

Landslides are a dangerous hazard which include a wide range of phenomena involving down slope ground movement, such as rock falls, deep slope failure, shallow debris flows, and

avalanches. Gravity acting on a slope is the primary cause of land slide but there are other important and dynamic factors that serve as triggers. It can cause: serious damages to infrastructure, death, injuries and affect a variety of resources.

Saturation of slopes by precipitation weakens soil and rock by reducing cohesion and increasing the pressure in pore spaces, pushing grains away from each other. Erosion and undercutting of slopes by streams rivers, glaciers, or waves increase slope angles and decrease slope stability .Earthquakes create stresses that weaken slopes and physically cause slope movement and the overweighting, and undercutting of slopes for facilities, roads, trails, mines, and other man-made structures change the natural slope equilibrium and cause slopes to fail which in turn expose land to land sliding.

Landslides affect the following elements of the environment: the topography of the earth's surface, the character and quality of rivers and streams and ground water flow, the forests that cover much of the earth's surface, and the habitats of natural wild life that exist on the earth's surface, including its rivers,lakes,and oceans. Large amounts of earth and organic materials enter streams as sediment as a result of this landslide and erosion activity, thus reducing the portability of the water and quality of habitat for fish and wildlife .Biotic destruction by landslides is also common; widespread stripping of forest cover by mass movements has been noted in many parts of the world. Removal of forest cover impacts wildlife habitat.

The ecological role that landslides play is often overlooked as they contribute to aquatic and terrestrial biodiversity. Debris flows and other mass movement play an important role in supplying sediment and coarse woody debris to maintain pool habitat in streams. As disturbance agents landslides engender a mosaic of serial stages, soils, and sites to forested landscapes.

By understanding the different types and causes of landslides it can help us predict future occurrences and reduce the potential effects. In addition to this, a high resolution data is required for landslide investigation through application of satellite and advanced technologies such as robust methods,models,and high resolutions partial data, which includes in-situ and remotely sensed measurements for landslide studies. These will help understand landslide mapping, prediction, monitoring, and risk assessment to reduce the impact of landslides globally and address the impact of future human activity, climate change, land use or land cover change on landslide hazards from local to the global scale.

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