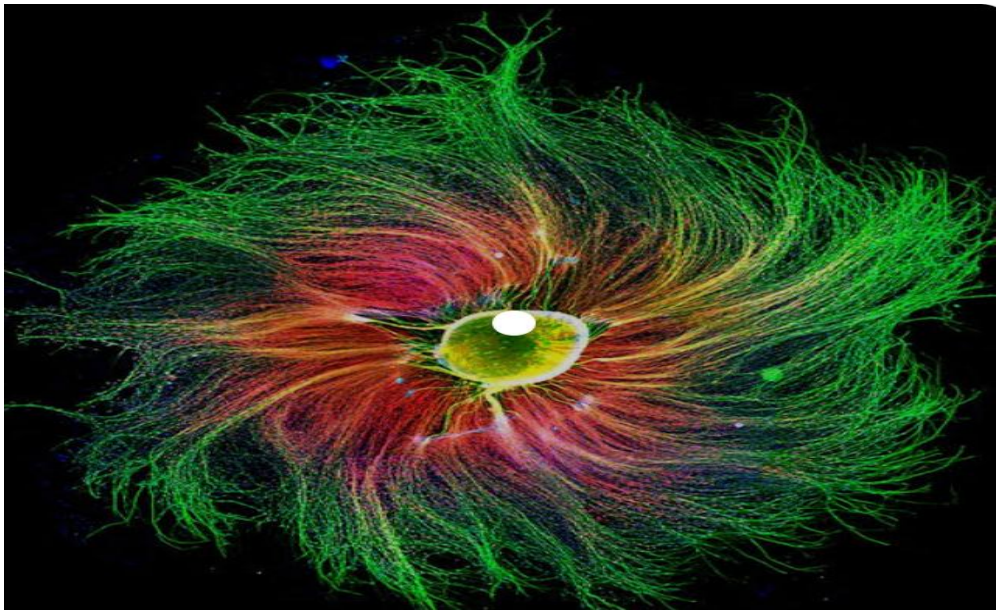


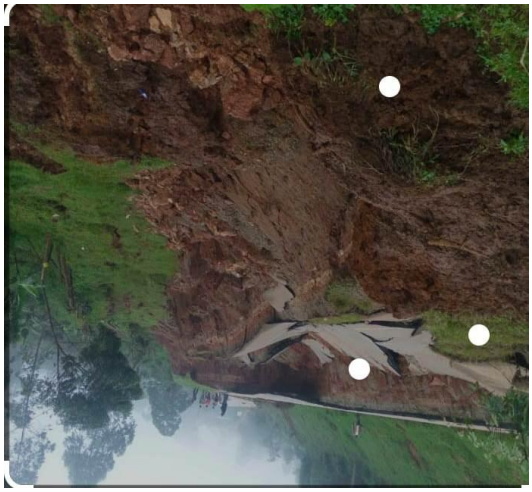
SCIENCE

Considering the sensitive interpreters of phenomena's ideas, the ultimate intelligibility of nature has seemed to demand some rational guiding spirit. This is evident from an expression by Einstein that the wonder is not that humankind comprehends the world but that the world is comprehensible.

Science refers to any system of knowledge that is concerned with the physical world and its phenomena which entails unbiased observations and systematic experimentation. Generally, science involves a pursuit of knowledge covering general truths or the operations of fundamental laws. Amongst these natural phenomena is a landslide.

LANDSLIDE.

Photographs on landslide retrieved from Umuhama Gatuna-Kigale Today of 19/05/2018



These photographs show Kabale Road landslide of 2018.

Abstract

Landslides are powerful geological events that happen suddenly, causing fear in people who live in areas with unstable hills, slopes, and cliff sides. Landslides damage the surrounding habitat and can destroy homes in their path. According to Antonello G, Casagli N, Farina P, Leva D, Nico G, Sieber A. and Tarchi D (2004) landslides cause great disasters and their impact to society is very great hence there is a need to study them in many scientific and engineering fields. Despite the fact that the study should be comprehensive, studies on landslides from various fields have not been conducted in an integrated manner. There has neither been an international society nor an international journal which has clearly stated the meaning of landslide hence it remains undefined both internationally and interdisciplinary. "What causes landslides? Can slides happen on any slope, or do slopes have to have certain characteristics, such as a steep angle and a specific material mass? "These questions often go unanswered.

In 1990-2000, during the United Nations International Decade for Natural Disaster Reduction (IDNDR), landslide researchers worldwide agreed on the definition of landslides as the movement of a mass of rock, debris or earth down a slope. This formed a basis for the development of the study of landslides as a scientific field. This paper will inform the public on:

i) Hazards of landslides.

ii) Why landslides happen in certain locations

iii) The devastations which occur as a result of landslides.

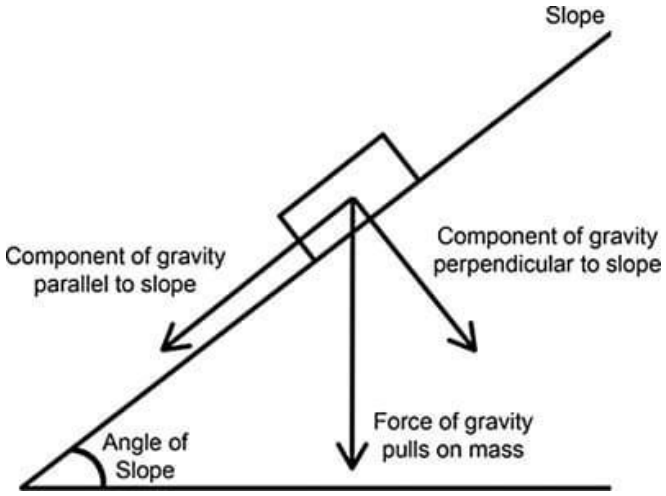
INTRODUCTION

National Geographic,(2013)describes landslide as a catch-all phrase that describes any geological process resulting in a downward movement from a slope of rock, soil, artificial fill, or a combination of the three under the influence of gravity. Landslides can result from several causes, including mechanical weathering which is the gradual disintegration of rock due to physical activity, chemical weathering ;the gradual disintegration of rock due to chemical

activity, erosion ;the removal of rock or soil by wind, water, or other natural processes, earthquakes, and volcanic activities.

Bapyou (2007) in his study explained vividly that there are five main different types of landslides: slides, flows, falls, topples, and lateral spreads. Depending on the type of landslide, solid parts of the slope such as rocks, debris, or soil might slide down a slope, or fall off a cliff, as a unit or in several units (this in happens in slides, falls, and topples). Also, material might move down the slope like a river, as a collection of loose soil, rock, air, and water as observed in flows. We should also put it in mind that soil can even liquefy, due to an earthquake or other rapid motion nearby, and this may cause any material above the liquefied soil to become unstable, creating a spreading type of landslide known as lateral spread.

Reader's Physics4kids.com (2014) has it that although different kinds of landslides or mass movements of earth behave differently, they have a major force in common that helps initiate them. This force is known as gravity. We are aware that the force of gravity pulls an object vertically down; but when that object is on a slope, it gets just a bit more complicated because gravity has both magnitude and direction. On a slope, the effect of gravity can be separated into a component that is parallel to the slope and a component that is perpendicular to the slope. This means that part of the force of gravity pulls an object down the slope and part pulls it against the surface of the slope, resisting movement down the slope as shown below:



Force diagram of an object resting on a sloped surface

The resistance caused is called friction. According to Reader's Physics4kids.com (2014), the friction that occurs depends upon the gravity perpendicular to the slope, as well as the surface of the slope and objects sliding down the slope. This is because friction happens when rough parts of a slope catch rough parts on an object sliding down the slope, as the two surfaces rub together. Just how much two types of surfaces interact with each other when rubbed together is measured by a value called the coefficient of friction, and this depends on the surface materials of the two objects.

When the component of gravity parallel to the slope becomes greater than the resistance, or friction, holding the objects on the slope in place, the objects become unstable and then slide or flow down the slope. The critical angle at which this happens is called the angle of repose.

Two force diagrams of gravity acting on an object resting on a low angled slope and a high angled slope is as below:

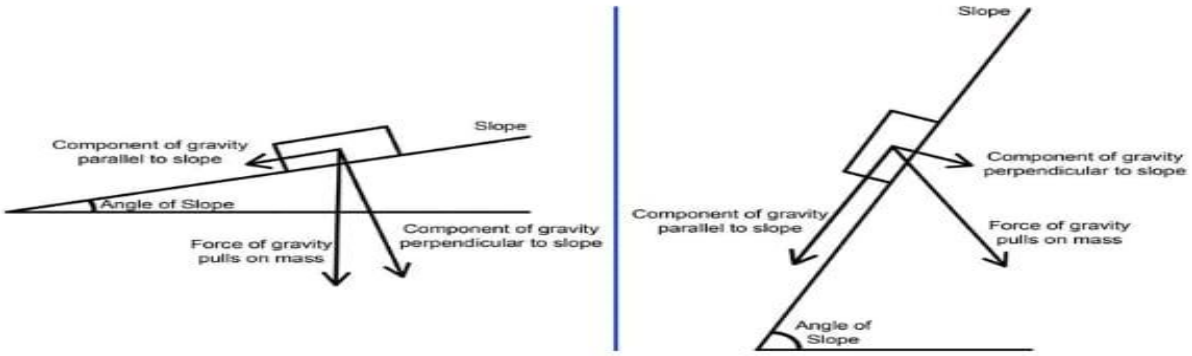


Diagram showing that; the magnitude of slope parallel and slope perpendicular components depends upon the angle of slope.

The angle of slope is less on the left side of this figure than it is on the right side. On the left side, the component of gravity that is parallel to the slope is smaller, whereas the component that is perpendicular is greater, when compared to the right side. On the left side, the object will stay in place. However, on the right side, the angle of the slope is so great that the object is much more likely to slide down the slope.

DISCUSSION

Hazards of landslides.

While it is fascinating to watch geological forces form and restructure the surface of Earth, the flip side is that they can be very hazardous. Landslides include a wide range of phenomena involving downslope ground movement, such as rock falls, deep slope failure, shallow debris flows, and avalanches. Gravity acting on a slope is the primary cause of landslides, but there are other important and dynamic factors that serve as triggers.

a) Saturation of slopes by precipitation (rain or snowmelt) weakens soil and rock by reducing cohesion and increasing the pressure in pore spaces, pushing grains away from each other.

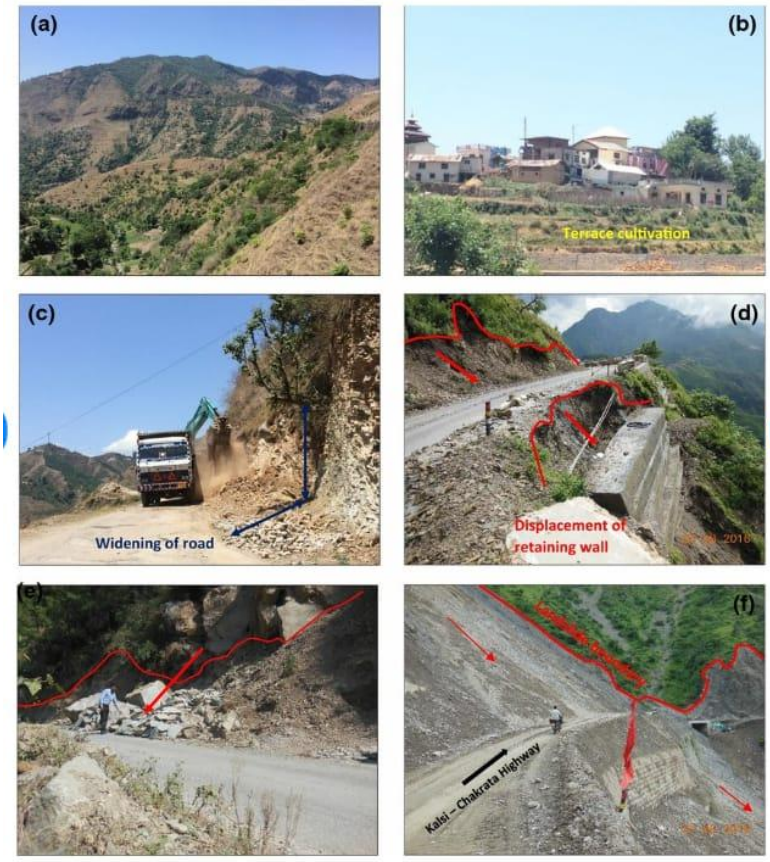
b) Erosion and undercutting of slopes by streams, rivers, glaciers, or waves increase slope angles and decrease slope stability.

c) Earthquakes create stresses that weaken slopes and physically cause slope movement.

d) Perhaps most significant from a management perspective, the over weighting, and under cutting of slopes for facilities, roads, trails, mines, and other man-made structures change the natural slope equilibrium and cause slopes to fail.

Why landslides happen in some locations.

Some of the areas which are more likely to experience landslides include:



Photographs on landslide probability mapping by considering fuzzy numerical risk factor (FNRF) and landscape change for road corridor of Uttarakhand, India.

According to Ujjwal S,Prof P, Praveen K and Jay K(2021) these photographs demonstrate an overview of the landscape and spatial location of landslides as follows'.)The landscape along the Kalsi-Chakrata road corridor near Chakrata; b) view of typical village in near Sahiya; c)cutting of slope for road widening near Sahiya; d)lateral displacement of retaining wall near Amraha; e rock fall and fragmentation near Dhaira village; f)debris slide in Amraha area, the prevalent landslide in the road corridor

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

According to Christiane W. (2014), it is well documented that deforestation results in an increase in landslide frequency due to the control that forest roots have on slope stability. Hence, 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 the return time of landslides decreases. When a landslide removes the soil profile, there may not be adequate time for seedlings to grow and enhance soil stability.

B) Areas where landslides have occurred before;

Landslides are caused by disturbances in the natural stability of a slope. Since it has occurred in such areas, it is clear that such areas' terrains are naturally unstable therefore such areas are at a risk of being affected.

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

The bedrock in tectonically active mountains is so extensively fractured that in some ways it behaves like a sand pile. Removal of sand at the base of the pile will cause miniature landslides, just as erosion of material at the base of hill slopes in real mountain ranges will lead to landslides.

D) Slopes that have been altered for construction of buildings and roads

In fragile mountain environments road construction almost inevitably increase landslide hazard and risk .Roads destabilize mountain slopes and increase the probability of landslides along their corridor.

E) Channels along a stream or river;

Slope material that becomes saturated with water may develop a debris flow or mud flow. The resulting slurry of rock and mud may pick up trees, houses, and cars, thus blocking bridges and tributaries causing flooding along its path.

F) Areas where surface runoff is directed.

Devastations which occur as a result of landslides

The impact of a landslide can be extensive, including loss of life, destruction of infrastructure, damage to land and loss of natural resources (Sassa K, 2006).As explained below:

a) Lead to economic decline

Landslides cause destruction of property. If the landslide 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.

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 kills lots 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 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.

CONCLUSION

While concluding, landslides include a wide range of phenomena involving downslope ground movement, such as rock falls, deep slope failure, shallow debris flows, and avalanches. Gravity acting on a slope is the primary cause of landslide but there are other important and dynamic factors that serve as triggers.

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. Perhaps most significant from a management perspective, the over weighting, and under cutting of slopes for facilities, roads, trails, mines, and other man-made structures change the natural slope equilibrium and cause slopes to fail.

Landslides affect the following elements of the environment: the topography of the earth's surface; the character and quality of rivers and streams and groundwater flow; the forests that cover much of the earth's surface; and the habitats of natural wildlife 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. Landslides 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

There are comprehensive and effective national strategy for reducing losses from landslides nationwide and provides an assessment of the status, needs, and associated costs of this strategy. The strategy was developed in response to the rising costs resulting from landslide hazards in the United States and includes activities at the National, State, and local levels, in both the public and private sectors. The strategy gives the Federal Government a prominent role in efforts to reduce losses due to landslide hazards, in partnership with State and local governments. In addition to that, the United States Geological Survey (USGS) has taken the lead in developing the strategy on behalf of the large multisector, multiagency stakeholder group involved in landslide hazards mitigation. The USGS derives its leadership role in landslide hazard-related work from the Disaster Relief Act of 1974 (Stafford Act). For example, the Director of the USGS has been delegated the responsibility to issue disaster warnings for an earthquake, volcanic eruption, landslide, or other geologic catastrophes.

The National Landslide Hazards Mitigation Strategy includes developing new partnerships among government at all levels, academia, and the private sector and expanding landslide research, mapping, assessment, real-time monitoring, forecasting, information management and dissemination, mitigation tools, and emergency preparedness and response. Such a strategy uses new technological advances, enlists the expertise associated with other related hazards such as floods, earthquakes and volcanic activity, and utilizes incentives for the adoption of loss reduction measures nationwide.

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