MASS WASTING/MASS MOVEMENT

(“SLOPE FAILURE”/"SLOPE COLLAPSE”)

Mass wasting is the creeping, flowing sliding or falling of weathered materials down slope under the influence of gravity.

NB: Unlike erosion, mass wasting does not require a transporting agent such as ice, wind or running water. Even dry rocks can move on steep slopes freely without a transporting agent.

In East Africa, mass wasting occurs mainly in the highland areas such as the Kenya highlands, Rwenzori highlands, mountain Elgon etc.

TYPES OF MASS WASTING

There are two types of mass wasting.

(i) Slow mass movement
(ii) Rapid mass movement/landslides.

A) SLOW MASS MOVEMENT/FLOWAGE

This involves slow movement of large quantities of loosened rock materials down slope under influence of gravity. This type of mass wasting includes ;

1. **Soil creep**
   This involves down hill very slow movement of soil and fine rock materials on a very gentle slope under influence of gravity. The process of soil creep is influenced by very gentle slope, vibrations from heavy moving vehicles, scanty vegetation, alternating heating and cooling , wetting and drying conditions. Soil creep may cover a very large area and forms step – like features of 2 – 5 cm in height referred to as terracettes for example Shema, Kajara , Bushenyi in Western Uganda.

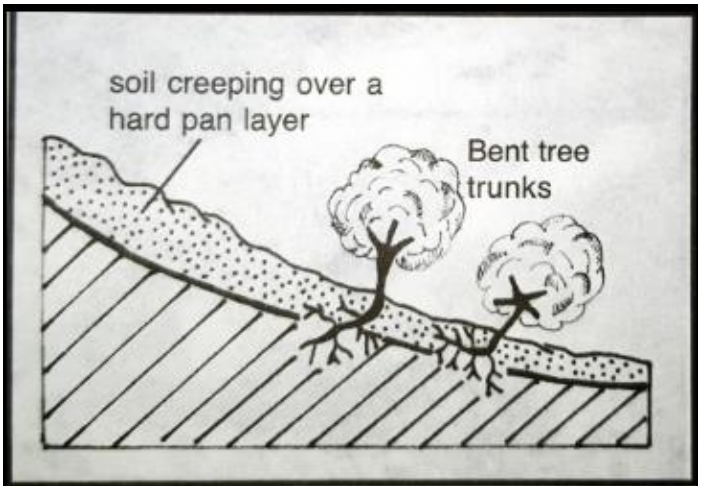


Fig. 4.1: Soil creep.

2. Solifluction

This involves slow movements of saturated soils, gravels and weathered rocks over frozen ground on a moderate slope under the influence of gravity. This type of flowage is influenced by cold conditions where ice causes a saturated rock layer to creep as a mass over the underlying frozen grounds. Common on the glaciated Mountains of Kenya, Kilimanjaro and Rwenzori.

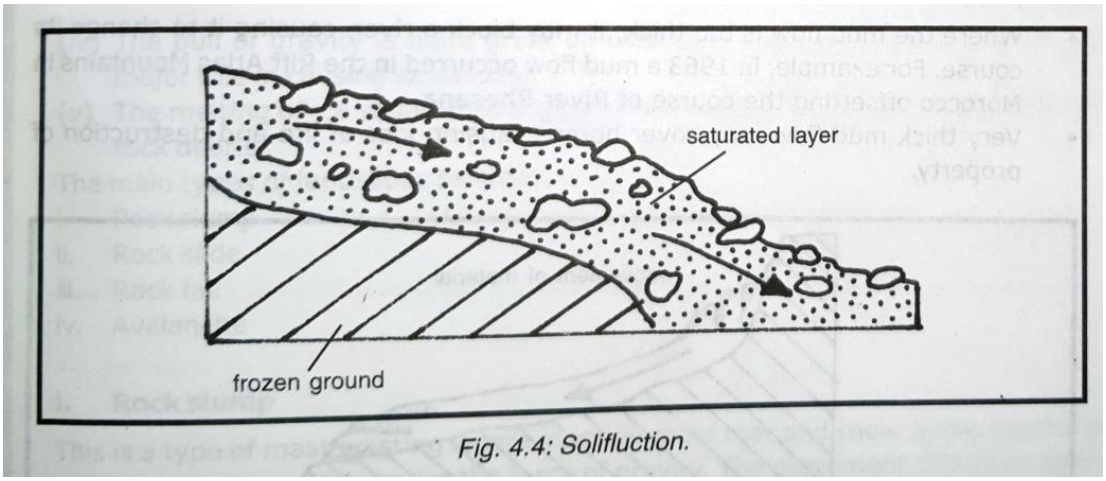


Fig. 4.4: Solifluction.

B) LANDSLIDES

This is a type of mass wasting that involves fast, rapid or sudden downhill movement of loosened, rock materials on a moderate/steepslopes under the influence of gravity. This process may be aided by rain water.

TYPES OF LANDSLIDES

1. Talus creep

This is the movement of angular rock debris of various shapes and sizes down a moderate slope at moderate to fast speed under the force of gravity. It is common on mountains experiencing freeze-thaw action that provides melt water which lubricates the broken rocks making them move down. For example along Mt. Rwenzori , Mt. Kenya and Mt. Kilimanjaro.

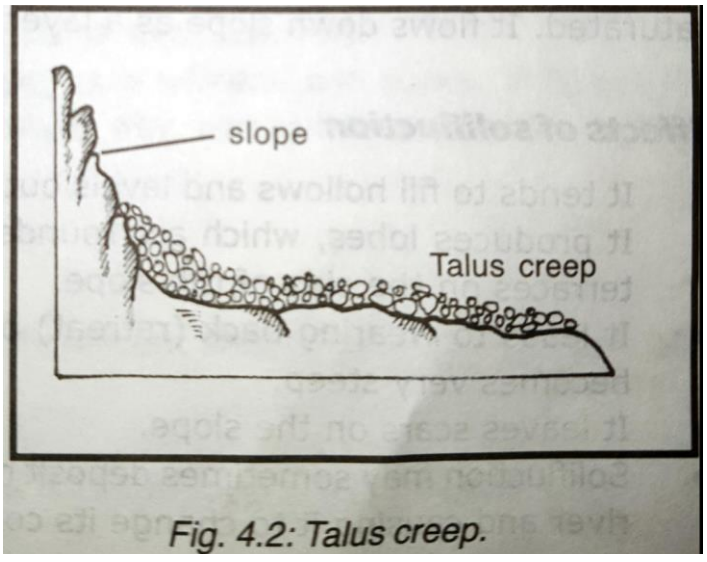


Fig. 4.2: Talus creep.

2. Rock fall

This is the rapid free fall of individual boulders and rocks down a very steep slope/ vertical slope under the influence of gravity. It is common on cliffs, escarpments, mountain steep slopes. Rock fall is accelerated by vibrations from rock explosions, heavy moving vehicles, earthquakes. It occurs in areas of Bugishu highlands, Kigezi highlands, Bundibugyo.

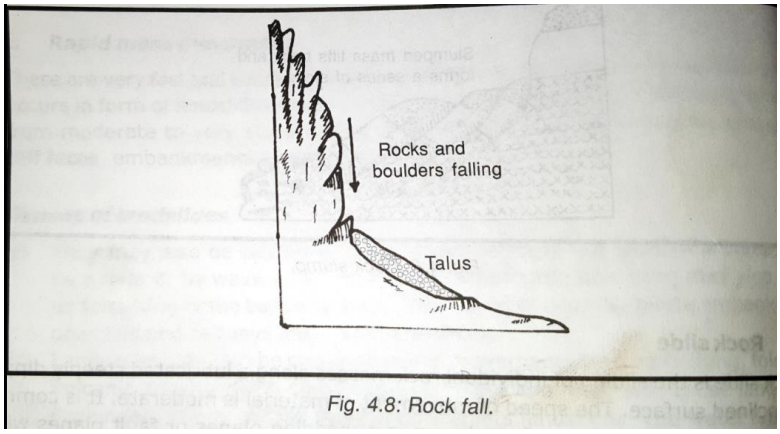


Fig. 4.8: Rock fall.

3. Rock slides

This is the sliding/rolling of large masses of detached rocks and debris at a fast speed along a slippery over steepened slope. It is common on slopes with bedding planes. It is accelerated by earth quakes, heavy moving vehicles, absence of vegetation cover. It occurs in areas of Kigezi highlands, Bugishu highlands, Bundibugyo.

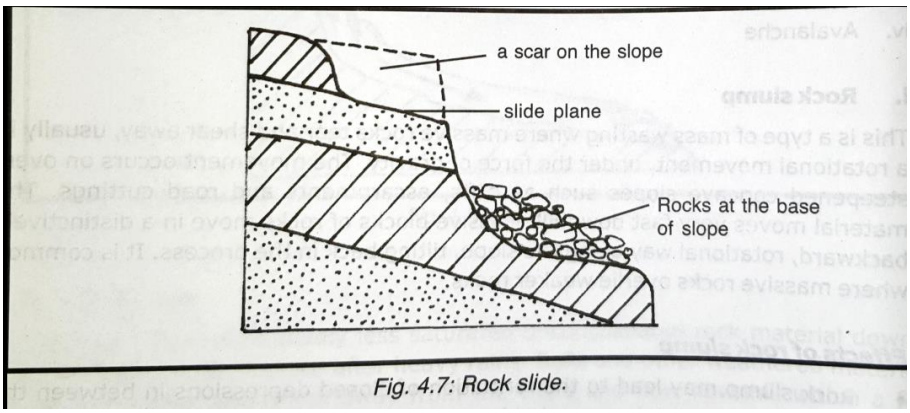


Fig. 4.7: Rock slide.

4. Rock slump

This involves tearing away of large masses of rocks and debris from over steepened slopes such as cliff, escarpments, road cuttings and move down slope at a fast speed under the force of gravity. It is common where massive rocks over lie weaker rocks saturated by heavy rain. For example along the slopes of Kilimanjaro highlands, mountain Elgon, Bundibugyo, Kigezi highlands.

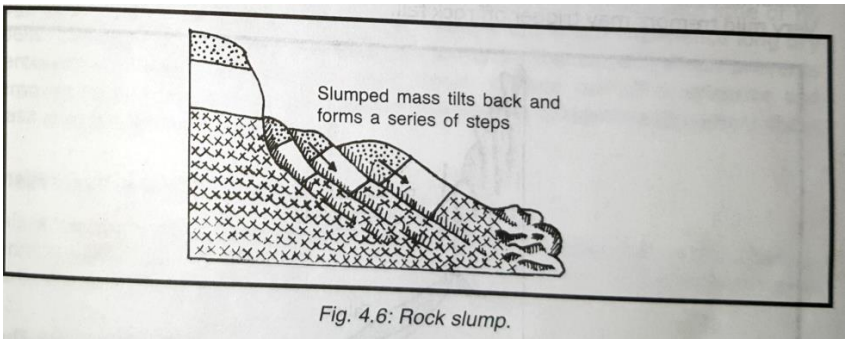


Fig. 4.6: Rock slump.

5. **Mudflow**
   It is the movement of semi- liquid mud with gravels and boulders down on moderate to steep slopes at a fast speed under the influence of gravity. It is facilitated by heavy rainfall and accelerated by absence of vegetation cover. It is common in Buwalasi, Bududa , Bulucheke along the mountain Elgon slopes, Bundibugyo, Kigezi highlands.

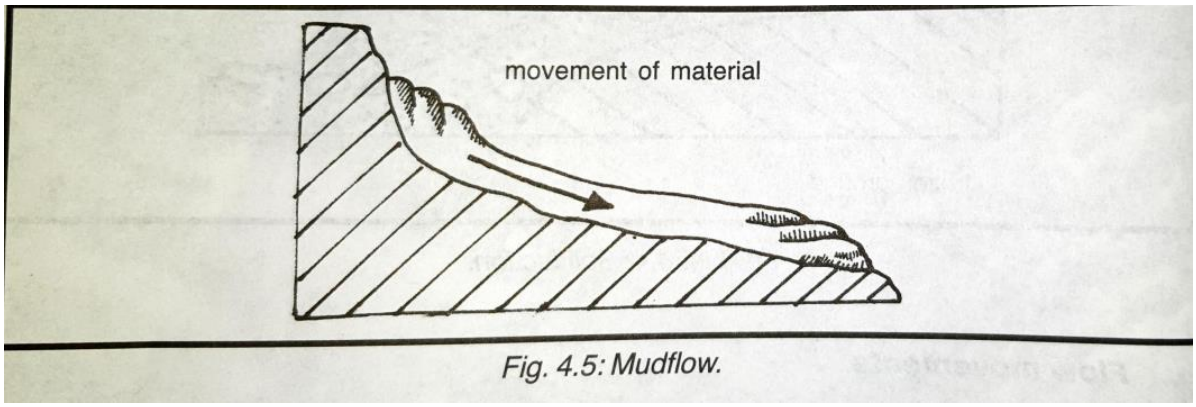


Fig. 4.5: Mudflow.

6. **Avalanches**
   It refers to a sudden downfall of rock materials embedded in ice and snow on steep slopes under the force of gravity. It is common on the glaciated highlands of Rwenzori, Kenya and Kilimanjaro.

CAUSES OF MASS WASTING

Mass wasting is influenced by various factors/conditions and these include;

1. **Climate**
   Prolonged heavy rainfall provides water that saturates rocks and weathered materials making them heavy, slippery and also lubricates the slopes resulting into rock slump , mud flow, rock slides for example in Bududa, Bulucheke, Buwalasi along the slopes of Mt. Elgon in Eastern Uganda.

   Pounding effect of heavy rainfall destabilises surface layers of rocks triggering movement of rocks and weathered material under the influence of gravity.

   Temperature changes that lead to alternate freezing and thawing make the ground slippery and release water that increases weight of rocks and weathered materials leading to solifluction, mud flow, talus – creep, rock fall and avalanches. For example along the slopes of mountains Rwenzori, Kilimanjaro and Kenya.

   Alternate heating and cooling effect on the soil weakens it accelerating the occurrence of soil creep.

   Alternate wetting and drying of the soil particles where the rain water causes the soil to expand and also adding weight to it causing it to move. On drying the particles loosen and easily move down slope in form of soil creep.

2. **Nature of slope/relief /topography**
   The steeper the slope the greater the force of gravity that accelerates mass wasting. Very steep or vertical slopes encourage very fast movement of weathered materials in form of rock falls for example on the slopes of Mt. Elgon, Ruwenzori, Kilimanjaro, Kenya.

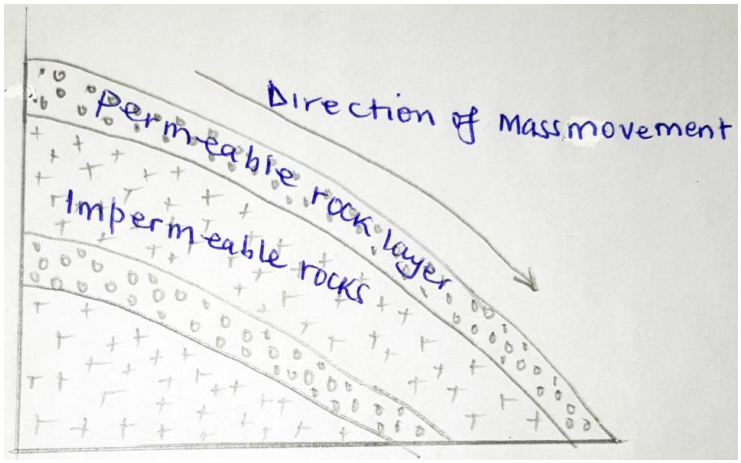
Over steepened slopes such as cliffs, scarps, road cuttings accelerate the movement of loosened rock masses down slope in form of slumping, rock slide and avalanches for example on the slopes of Mt. Elgon, Kigezi highlands, Rwenzori.

Steep slopes encourage the occurrence of rock slides, mud flow , avalanches .

Moderate to steep slopes encourage the occurrence of solifluction, talus creep and mud flow.
Very gentle slopes influence the occurrence of soil creep.

3. Nature of the rock

Permeable weathered rocks overlying impermeable rocks absorb rain water and become saturated, heavy and lubricated and easily move downhill in form of mudflow, rock slide. For example in Bududa , Bulucheke, Bulambuli on Mt. Elgon slopes.



Well jointed rocks allow rain water to percolate through joints leading to increased rock weight and lubrication accelerating their down hill movement in form of rock fall, rockslide, avalanches, slumping for example on Mt. Rwenzori.

Alternate layers of hard and soft rocks also cause mass wasting in form of rock slump, rock fall, rock side, mudflow for example on the slopes of Mt. Elgon, Kilimanjaro.

Angular rocks encourage the occurrence of Talus creep for example on Mt. Rwenzori.

4. Nature of soils

Heavy wet massive clay soils when they absorb rain water, the weight increases, become lubricated and more slippery leading to down hill movement in form of mudflow, rock slump.

Loose sandy soils when affected by high temperatures and strong winds are triggered into motion leading to soil creep. For example in the semi-arid areas of Karamoja, Turkanaland.

5. Tectonic movement/forces

These endogenic disturbances like earthquakes and earth tremors have strong vibrations capable of breaking off sections of mountains/steep slopes and also loosening rocks, causing them to move down slope in form of rock slide, rock fall, rock slump for example in Bundibugyo.

Faulting , warping volcanicity and folding create steep slopes, mountains, escarpments that accelerate mass movement in form of rockslide, rock fall, rock slump for example Kigezi highlands, Mt. Elgon, Mt Rwenzori.

Volcanicity also involving basic lava flowing downslope mixed with ashes promote mudflows, rock slump for example along Kigezi highlands.

6. Under cutting on the base of a steep slope by a river/lake /sea through erosion creates over steepened slopes/over hanging slopes leading to mass wasting in form of rock fall , rock slump for example along the cliffs of L.Victoria, banks of river Manafwa, river Mubuku, river Nyamwambwa.

7.Over loading of slopes

Additional weight or load on a slope due to large masses of rock debris and rain water accelerates slope failure hence triggering off down hill movement in form of mud flow, rock slump, rock fall for example on Mt. Elgon slopes.

8. Human activities

Man through various activities encourages the occurrence of mass wasting and these include;

Mining and quarrying involves use of explosives that cause vibrations which loosen the rocks and eventually trigger off rock fall, rock slide, rock slump. It also creates over steepened slopes which promote slumping, rock fall, rock slides at Wanale ridge on Mt. Elgon.

Up and down ploughing along steep slopes makes unconsolidated soils and weathered rock materials to move down slope in form of mud flow, slumping , rock slide, rock fall, at Bulucheke, Bududa, Buwalasi on Mt. Elgon , Kigezi highlands.

Deforestation on steep slopes leads to loose and unconsolidated rock particles as their binding power of tree roots is reduced and easily move down hill. Deforestation also leaves the slopes bare, exposing them to rain-water which encourages mudflow, rockslide, rock slump at Bududa, Bulucheke, Wanale on Mt. Elgon, Kigezi highlands.

Over stocking and over grazing along steep slopes loosen the rock structure due to trampling of animals and exposure of the rock materials leading to mudflow, rock slump, rock fall along Kigezi highlands.

Heavy moving vehicles and trains cause vibrations that loosen rock materials along the road cuttings and steep slopes, eventually triggering of down hill movement in form of rock fall, rockslides, rock slump for example along Kabale – Kisoro road, Simu – Kapchorwa road, Fortportal – Bundibugyo road.

Building and construction of transport routes/roads, settlements in highland areas create over steepened slopes such as cliffs, scarps that encourage rock slump, rock fall, rock slide for example in the Kigezi highlands, Mt Elgon , Bundibugyo.

9. Living organisms

Burrowing animals like rodents loosen the rocks allowing water to penetrate resulting into over loading and lubrication that encourages rock slump, rockslide, mudflow. Movement of heavy

animals such as elephants, cattle cause vibrations that trigger off downhill movements of rockslides, rock fall, rock slump.

EFFECTS OF MASS WASTING

Mass wasting has resulted into both dangerous effects and positive contribution and these include;

- Landslides such as rockslides, rock falls, avalanches cause loss of lives and destruction of property, if they occur in settled areas of highlands or valleys for example at Bulucheke, Bududa, Bulamburi along Mt. Elgon, Kigezi highlands.
- It usually results into displacement and resettlement of people from the affected highland areas to safer areas. For example from Bubulo , Bulucheke, Bududa along Mt. Elgon to Kiryandongo.
- Rocks and boulders deposited on roads and railways by mass wasting in form of rock fall, avalanches, slumping block them, making the areas temporarily inaccessible for example along the Kabale – Kisoro road, Fort portal – Bundibugyo road, Kapchorwa – Bukwa road.
- Mass wasting has resulted into massive destruction of agricultural land as fertile soils along the steep slopes are moved down hill, creating wasteland or barren land uphill for example at Bubulo, Bulucheke, Bududa on Mt. Elgon, Kigezi highlands.
  Rocks and boulders moved downhill in form of rock fall, rockslides, rock slump cause damage to crops, farmland and animals along their routes of movement and in the lowlands leading to food shortage for example in Bududa, Bulucheke, Bubulo on Mt. Elgon.
- Mass wasting in form of rock fall, rock slump, rockslide, avalanches uproot trees resulting into forest destruction for example along Mt. Elgon in Bududa, Bubulo, Bulucheke, Kigezi highlands.
- Mass wasting deposits soil and rock materials into water bodies displacing water causing floods for example along river Manafwa on Mt. Elgon , river Nyamwamba on Mt. Rwenzori in Kasese.
- Soil , rocks and boulders deposited in low lying areas by mass wasting pollute water sources accelerating the spread of diseases such as cholera , bilharzia in the communities of Bubulo, Bududa, Bulucheke on Mt. Elgon, Kasese, Bundibugyo.
- It leads to a reduction in the water table due to destruction of the forests which act as the catchment areas and the silting up of water points by rock deposits in the low-lying areas.
- Features produced by mass wasting such as lobes, which are tongue – like features, scars, terracettes at sheema in western Uganda, are of great tourist attraction promoting the tourism industry that earns foreign exchange to the region.
- Mounds of rock debris from mass wasting may block rivers causing temporary lakes for example L. Mbaka in Tukuyu valley, Southern Tanzania and L. Bujuku on the floor of Mt. Rwenzori in western Uganda.
- Materials deposited in lowlands by mass wasting may constitute fertile soils suitable for crop cultivation for example along the Kano plains in the low lands of Kenya highlands.
- Mass wasting exposes fresh rocks to weathering processes leading to soil formation that is suitable for crop cultivation and forestry for example along Mt. Elgon.
- Landslides expose minerals to the surface, easening the process of mining or quarrying for example at Wanale on the slopes of Mt. Elgon.

MEASURES TO CONTROL MASS WASTING

- Afforestation and re-afforestation on steeslopes provide forest cover that checks the rate of downslope movement of soil and rock materials. Also, the forest cover through its strong root system binds the soil particles together making them firm against mass movement. For example Mafuga forest in Kigezi highlands, Mt. Elgon conservation forest in Mbale.
- Infilling of depressions created by mining or quarrying with waste rock materials to provide basements to hanging steep slopes which makes them firm against mass movements for example at Wanale quarrying site in Mbale.
- Application of soil erosion control measures such as terracing, contour ploughing , strip cultivation to retard movement of loose rock materials on steep slopes hence checking on the occurrence of landslide for example on Kigezi, Kenya, Elgon highlands.
- Controlled grazing and stocking of animals to allow regeneration of vegetation that retards downhill movement of loose rock materials. Also, the generated vegetation cover through its root system binds the soils particles together making them firm against mass movement. Controlled stocking also reduces on the number of animals causing vibrations on steep slopes hence checking on the rate of mass wasting occurrence. For example on the slopes of Kigezi highlands in South western Uganda.
- Reducing on the number of people living in landslide prone areas by resettling them reduces the effect of man's activities such as quarrying, mining, cultivation, deforestation on the steep slopes hence leaving the land stable against mass movement. For example Mubuku resettlement scheme in western Uganda reduced land pressure in Kigezi highlands.
- Restricting settlement along steep slopes by government as this reduces on man's activities that loosen the rock masses hence limiting the occurrence of mass wasting. For example settlements in the highlands of Kenya, Kigezi are restricted to the lower slopes and valleys.
- Creating environmental awareness to masses through seminars, Newspapers, extension workers by encouraging environmental conservation strategies such as agro-forestry, afforestation, re-afforestation that stablise the steep slopes hence limiting the occurrence of landslides. For example at Buwalasi, Bududa, Bulucheke in Mbale district.
- Strict enforcement and implementation of environmental laws to protect the 'fragile' steep slopes against man's destructive activities such as deforestation, over grazing, quarrying, which makes the slopes stable against mass movement.
- Draining excess rain water by installing drainage pipes and trenches along the slopes to reduce lubrication of rock particles and the weight of the slope hence retarding downhill movement of materials. For example in the highlands of Kenya, Kigezi.

REVISION QUESTIONS

1. To what extent are physical factors responsible for the occurrence of landslides in East Africa?
2. Examine the causes and effects of slope failure in East Africa.
3. (a) Distinguish between solifluction and mudflows.

(a) Explain the factors that lead to occurrence of mud flows in East Africa.

4. Account for the occurrence of large scale mass wasting in the highland areas of East Africa.
5. (a)Distinguish between mudflow and rock fall.
   (b)Examine the measures taken to control landslides in East Africa.
6. Explain the causes and effects of mud flows in East Africa.
7. To what extent have human activities been responsible for the occurrence of landslides in East Africa?

8. Examine the extent to which relief has contributed to the occurrence of landslides in the highland areas of East Africa.
9. With reference to any one mountainous region in East Africa, account for the occurrence of slope failure.