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Landslides on the escarpments of Western-highlands and flash floods in the Mbos plain (West-Cameroon)

Glissements de terrain le long de l'escarpement des Haute-terres et les crues subites dans la plaine des Mbos (Ouest-Cameroun)

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Abstract:

Landslides, a component of natural disasters, have always been major events in human history. The objective of this paper is to study landslides and their impacts on flash floods in the Mbos plain. The methodology is based on the analysis of satellite images, the location of landmarks by GPS and photos from field observation, the construction of maps using ARCGIS software, the analysis of climate and geomorphological data integrated into GIS. The results show that between 25 and 26 August 2017, it fell 89.1 mm and 73.2 mm in total 162.3 mm, or 40.09% of precipitation; combined with deforestation and steeply sloping cultivation (25°-40°), they caused mass movements and flash floods that ended their course in the Mbos plain after destroying everything in their path. Direct observations indicate that the study of landslides in the highlands and the development of the Mbos plain are intimately linked.

Résumé:

Les glissements de terrain, composante des catastrophes naturelles, ont toujours été des événements majeurs dans l'histoire de l'humanité. L'objectif de ce travail est d'étudier les glissements de terrain et leurs impacts sur les crues subites dans la plaine des Mbos. La méthodologie est basée sur l'analyse des images satellitaires, la localisation des points repère par GPS et les photos à partir des observations de terrain, la construction de cartes à l'aide du logiciel ARCGIS, l'analyse des données climatiques et géomorphologiques intégrées au SIG. Les résultats montrent qu'entre le 25 et le 26 août 2017, il est tombé 89,1 mm et 73,2 mm en tout 162,3 mm, soit 40,09% de précipitations; combinées au déboisement et à la culture en forte pente (25°-40°), elles ont provoqué des mouvements de masse et des crues subites qui ont terminé leur course dans la plaine des Mbos après avoir tout détruit sur leur passage. Les observations directes indiquent que l'étude des glissements de terre sur les hautes terres et l'aménagement de la plaine des Mbos sont intimement liés.

Keywords / Mots clés

Landslides, escarpments, exceptional floods, Mbos plain
Glissements de terrain, escarpements, crues exceptionnelles, plaine des Mbos

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Introduction

Natural disasters represent risks for humankind and constitute recurrent events which have always marked the history of humanity. Landslides are disasters that are not yet mastered in areas with high population density. Landslides can seriously injure or even kill people and damage property. The International Disaster Database (EM-DAT) revealed that landslides account for 4.9% of all-natural disaster events and 1.3% of all-natural hazards fatalities between 1990 and 2015; 54% of these landslide events occurred mostly in Asia (Guha-Sapir et al., 2018). Although Africa does not appear as a landslide hotspot at a global scale, nevertheless, this is due to the limited number of scientific publications (e.g., Igwe et al.., 2014; Che et al.., 2011; Claessens et al.., 2007; Kitutu et al.., 2009; Knapen et al.., 2006). From 2010 to 2012, over 500 people were killed by dramatic deep-seated landslide in the Mt Elgon in Uganda. The largest events occurred on March 1st, 2010 (> 300 fatalities), on 25th June 2012 (>100 fatalities) (Jenkins et al.., 2013; Mugagga et al.., 2012a). Also, in Sierra Leon a study on landslide revealed that natural and human factors made its capital vulnerable to a landslide that killed more than 400 people in 2016. Still in 2016, another landslide in a fishing village in eastern Democratic Republic of Congo killed at least 40 people (Edward McAllister 2017).

The reports of the Directorate of Civil Protection /PNUD (MINADT/DPC, 2004, 2005, 2006 and 2007) and other scientific works (Zogning et al. 2001, 2003, 2007, 2008; Zangmo et al. 2009 and 2011, Che, 2011) have underlined the growing and harmful importance of landslide in Cameroon. The rapid increase in population and level of economic activities in the highlands has resulted in deforestation, reduction of land available for food crops and slope instability as well as bare surfaces. Degradation derived by farming and overgrazing have led to large mass movements, generalized washouts on some slopes of high mountains like oku, Bangou, Sabga and Metchoue mountains (Tchindjang Mesmin, 2012). According to Lambi, (2001), Tsou (2007), Tchindjang (2012), more than 300 landslides occurred in Cameroon since 1954 with more than 122 people killed and damages effected on farm land, excavation, destruction of houses, road infrastructure and water tower.

An analysis of the frequency and magnitude of landslides and mudflow in Cameroon make it obvious that the phenomenon is on a net increase. This increase occurred within three decades that is from 1978-1987; 1988-1997 and 1998-2003 with losses in human lives recorded mostly in Dschang and Mélong where a total of 70 deaths was recorded from 1978-1987. In addition, within the second decade (1988-1997) 28 people lost their lives in six landslides while during the third decade (1998-2003) there were already 82 deaths recorded out of which 35 occurred in 2003 alone. While the area of Kekem was affected in 2007 and 2008 with many environmental damages and 01 dead (Aboubakar Balla 2007). The rate of landslide occurrence may be higher if one considers the number of landslides registered per scene. In fact, landslides are becoming more frequent and affect progressively larger areas. The general trend manifested itself in the landslides that occurred in Limbe in 2001(A. Zogning; C. Ngouanet and Ojuka.T 2010). In this specific case, more than thirty scares could be

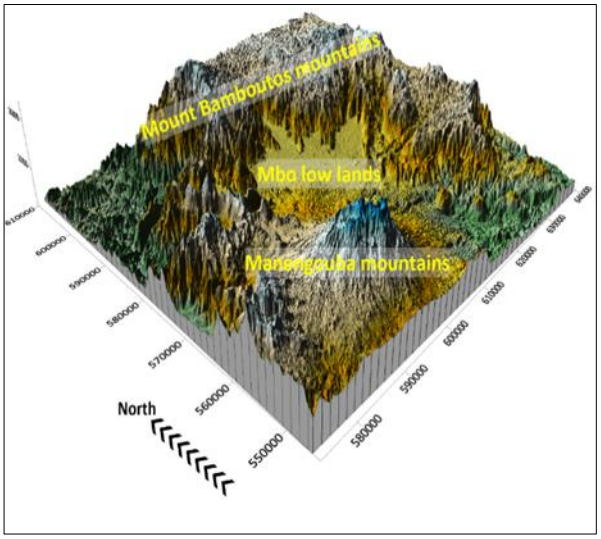
counted, like in the case of Magha and its neighborhood in 2003 several hundreds of scares could be counted, stretching over a few square kilometers. In the Batie saddle area (Bachepang) and Djedem numerous landslide scares can be identified along the roadside.

On October 20, 2007, the Kekem community experienced a landslide whereas on 10 September 10, 2002 Bana was hardly hit by a landslide with the destruction of farmland. Fossong-Wentcheng (south-west of Dschang) was also affected by a landslide in August 1978 which resulted to the death of 6 persons and destruction of farms. According to Zogning et al. (2007) it was the same for Limbe (1989, 1992-1996 and 2001); Nkongsamba (1998) and Mélong (1986).

Material and methods

Localization of the study area

The Mbos plain is located south of Dschang between latitudes 5°7′ and 5°23′ North and between longitudes 9°4′ and 10°7′ East, (figure 1).



Source: Ediamam Epalle, 2022

Figure 1- Digital Elevation Model (DEM) of the Mbos plain- shows the general morphology of the tectonic ditch

The DEM reveals a "smothered" collapse basin between two volcanic masses (Manengouba and Bamboutos Mountains) with significant elevations opening to the south-east.

Methodology

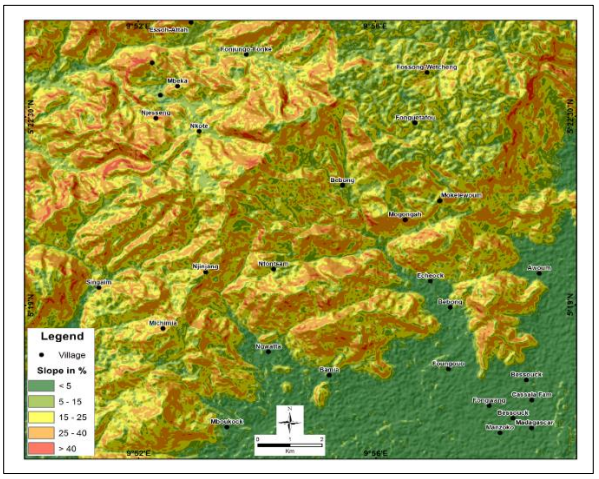
The methodology used to study the landslide in Mbos plain encompasses geomorphologic analysis of the terrain throughout the Digital processing, multidate analysis of Landsat images (1978, 1988, 2017), morphometric parameters of the topography of the area such as slope, curvature plans and relief complexity. QGIS and ARCGIS software were used for the realization of maps and images processing. Statistical analysis of climate data, mainly daily, monthly and annual rainfall data of Santchou and Dschang helped generate graphs. Researcher performed field trip on the upstream and the downstream, as well as interviewed the victims. Focus group discussions with traditional and administrative authorities and photographs were taken with the help of a camera. Thickness of mud-flow and level of water in the mud-flow was also measured.

Results

Predisposing factors

-The slopes

The slopes are shown on the slope map (figure 2)



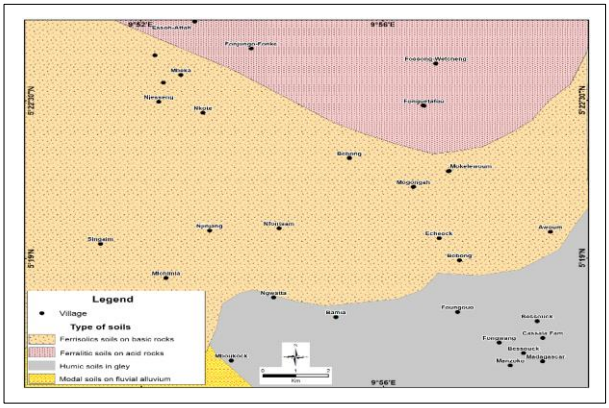
Source: Ediamam Epalle, 2019

Figure 2. The relief map of the study area

Slopes vary between 5°-25°-40° and more. Slope angles are weak in the plain at the level of Echiock, Foungwo (5°), and then they gradually increase to 25° or even 40° in places like Bebong, Funjungo-Fonge, Essoh-Attah among others. The final descent into the plain is made on the orthogneiss whose slopes reach 20° to 30° in some places and huge scree cones often metric blocks packed in gravel and arkose, located at the foot of the large slopes which surround the plain (Nguiffo, 2013). These slopes favor the start of mass movements as well as control the movements of the products on them, they determine the speed of movement, and particle travel distance, the volume of the products torn off, the nature of the materials and the configuration of the flow corridor (Kuete et al. 2021).

- Soils

Different types of soil from the area are represented on (figure 3).



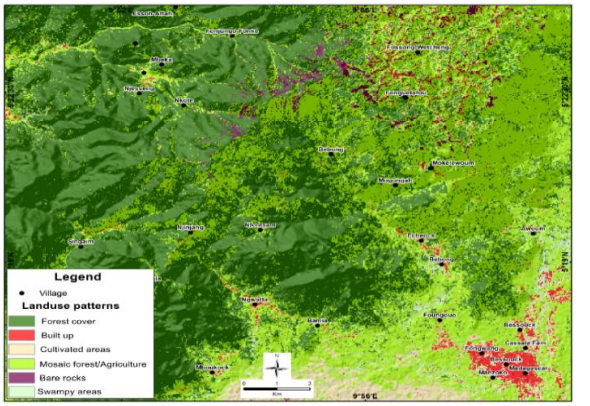
Source: Ediamam Epalle, 2019

Figure3. Types of soils on the study area

The Ferrisolic soils on basaltic rocks, the ferralitic soils on acid rocks are located on slopes varying between slope angles of 15° and 25° overall, while the wet soils at Gley, the modal soils on fluvial alluvium are found between slope angles of 5° and 15°. The nature and the structure of these soils predispose them to mass movements. The upper layer promote a high rate of infiltration. But their retention capacity is limited by their low thickness (<2m). A large and sudden supply of water quickly leads to their saturation and make them more or less unstable depending on their inclination and the configuration of the contact surface with the lower layer (Kuete et al. 2021). The lower layer is decisive because it's impermeable, it slows down the infiltrated water and promotes the saturation of the upper layers. It lubricates and sets the unstable mass in motion.

-Land uses

Land uses can be analyzed at different scales. The slope seems to be less use than the plain as presented on the figure 4.



Source: Ediamam Epalle, 2019

Figure 4. Land use map of the study area

The built-up areas are grouped around Nfongwang, located in the plain with a grouped habitat in Santchou town but also, an area of strong agricultural activities. They decrease as the slopes increase and become a dispersed habitat at the level of Bebong, Fonjungo-Fonke and Essoh-Attah. The degradation of forest cover is inversely proportional to the evolution of built space. The Bebong, Fonjungo-Fonke and Essoh-Attah areas show an alternation between forest-agriculture mosaic and dense forest cover. From this forest-agriculture mosaic, we have fallow cycles following deforestation, cultivation and then land rest. This fallow prepares the ground for the landslide. In fact, the degradation of the plant cover exposes the soil to the ''splash'' phenomenon, modifies the circulation of rainwater and the fixing of roots of trees in the soil (Ngouanet 2017). Plowing the soil destroys the cohesion of the surface layer and facilitates the movement of the lower layer, also called the ''soap layer'', which causes landslides.

Triggering factors

-Rainfall: The region has superficial aquifers (Aboubakar 2010) which are rapidly supplied, given the cracked structure of the formations which surmount it. Fluctuations in water level, due to weather conditions contribute to the increase in the water content of soil and subsoil materials. The daily rainfall histogram is as shown on (Figure 5):

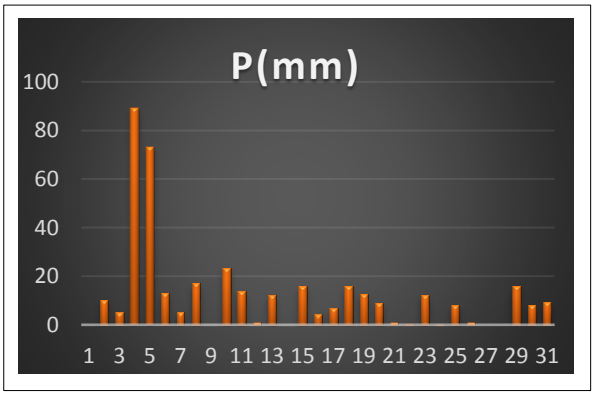


Figure5: Histogram of daily precipitation for the month of August 2017 in Santchou.

The rainfall is unevenly distributed throughout the month. However, there is an abnormal phenomenon, an exceptional precipitation. During two days, (4th and 5th), rainfall was 89.1mm and 73.2 mm respectively. In all, 162.3mm or 40.09% of the total monthly rainfall during the month of August in Santchou was concentrated in just the two days. Upstream, the consequences of this exceptional rainfall are: landslides, mudslides. Downstream, in the Mbos plain, catastrophic floods with 6 dead, numerous material damages and 257 displaced people were registered.

-Anthropogenic factors

The human actions that have contributed to weakening the stability of the slope are as followed:

-The deforestation and cultivation of this steep slope contributed through regular plowing to loosen the surface levels and increase the infiltration rate.

-The gneiss exploitation for the foundations of dwellings. People dig the rocks for healthier blocks. These hollows are then filled by rainwater and help to feed the deeper layers.

-The fallow: there is an influence of fallow, even young ones, on the mineralization cycles and nitrogen immobilization; organic matter on the soil formation aggregates; the transfer of nutrients to assimilable forms or the soil constituents' organization.

The Bebong landslides

Causes: The relief played a big role in the speed and on the orientation of these slides. The main causes are: 1-the nature of the source rock consisting of little or no evolved soils, especially migmatites, gneiss and clay soils, 2-topography with very steep slopes> (30°), climatic conditions with very abundant precipitation (1500-2000mm) over the watershed, during the month of August which constituted the detonator of the disaster, 3- forest vegetation which gradually regresses. Indeed, the landscape changed following multiple requests for agricultural and livestock needs which modified the plant cover of the watershed with an increasingly accentuated deforestation. The phenomenon occurred in three different phases:

The niche or ablation area

Aggregating a main escarpment concave belly and face turned to the sky at the foot of which rests an impressive amount of cleared land, ready to be transported. Tear-off and swirl niches that rest on a bedrock traversed by a sliding surface, in the rowdiest part. Soil surgery. This mass of soil is loaded with blocks of gneiss, often tape-like, and tree trunks torn off. This transport takes place along a transit corridor.

The transit corridor

The transit area or flow channel serves as a bottleneck with the general appearance of a death row. On average, the slope of this corridor is (> 25 °), stretched over more than 500m with a width of 3-6m upstream with an average depth of 2m. The transit zone follows the course of the valley and contributes to its widening by its edges and to its depth by modifying its thalweg towards the deposit zone.

The deposits zone and accumulation

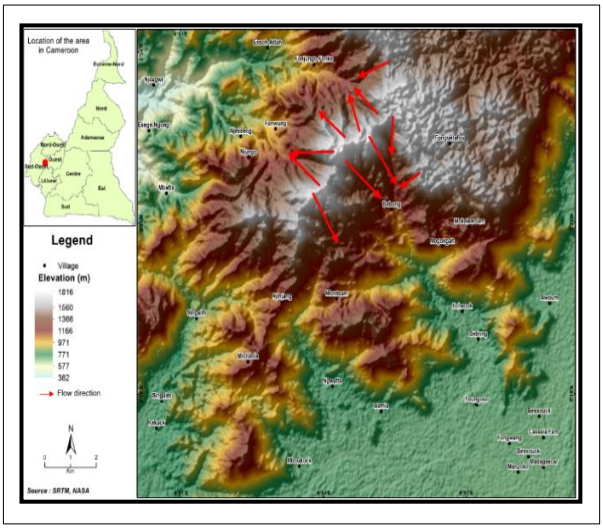
The deposition zone or the dejection cone which is located at the base of the slope is the zone where the products mobilized from the clearing zone and the products uprooted during transit to the foot of the slope are deposited. The dry floods observed in the plain are the direct consequence of this multitude landslides observed on the escarpment as presented on photo 1.

Source: Ediamam Epalle, 2017

Photo 1: Landslides in Bebong

*Photo1 shows the different phases of the landslide. The dropout niche **A** with the tearing of blocks of materials and earth, the transit zone **B** through which the cleared materials pass and the deposit zone **C** where there is an accumulation.*

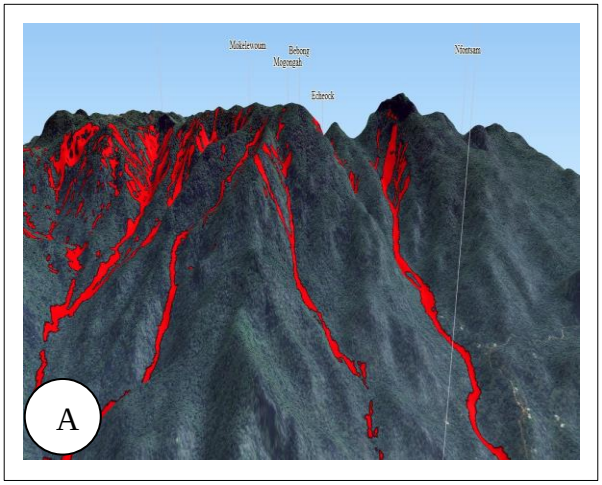
This landslide occurs more often on the separation line that divide the area into two oppose directions marked by inclination of the slope as indicated on the figure 6.



Source: Ediamam Epalle, 2019

Figure 6: Map of the crest line

Figure 6 shows the curvature of the area and the topographic elements of the relief. The crest line appears clearly and shows two oppose anticlines favourable to landslides occurrence. The separation zone is located on a crest line which divides the Mounts. This gives the direction to mass movements as shows on plate 1.



Source: Ediamam Epalle, 2020

Plate1 A: Upstream Directions of mass movements Plate1B

Downstream directions of mass movements

There is an occurrence of blocks detachments and landslides on the two slopes on the west side, notably of Njungo and Fonjungo-Fonke and Mbetta further south plate A. On the east side plate B, the localities of Bebong, Mogongah and Echiok are affected. The red color shows the path of mass movements on the steep and abrupt slopes toward the Mbos plain. The consequences of these mass movements are the flash floods occurrence in the Mbo plain.

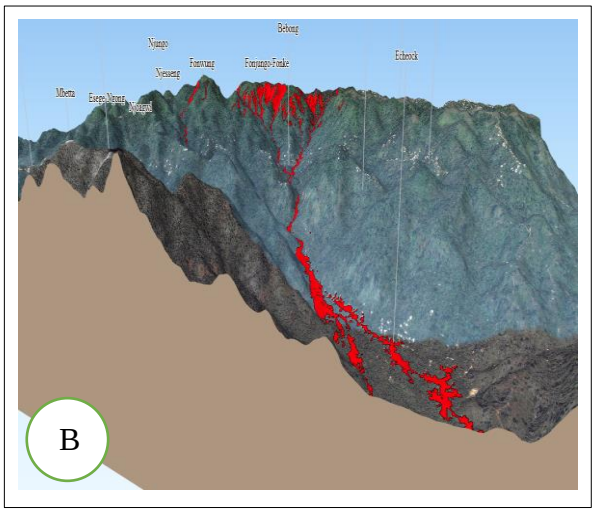


Plate1B

The flash floods in the Mbos plain

The causes of flash floods

From August 4th to 5th, 2017, catastrophic floods, unique in their kind, occurred; a sort of an apocalyptic spectacle above imagination. Indeed, torrential rains that fell on watershed on the night of August 4th from 3:30 am to 6 am caused many landslides. The said landslides created dry floods downstream, as there was no rainfall in the plain. The phenomenon can be understood through the study of the following stages plate 1:

Time

The time and the force of the phenomenon are told by Mr. Ekango (2017) with a thoughtful look: “the rains started at 3:30 am and accelerated at 5 am and stopped around 6 am. They are fine drops of rain at Bebong level. But towards Ndjango, rains were longer and heavier. Water flow was for 45 minutes. The noise was deafening like a plane that crashed".

Photo. Ediamam Epalle, 2017

Plate 2: Flooding process from upstream to downstream

Plate 2 ***A*** *shows the ablation niche with material tearing out. Plate 2* ***B*** *shows the transit zone through which this material is transported; the average depth is 8m with a width of 3m to 5m on the slope. During transit, the material, often consisting of huge blocks of earth and trees, is torn off in the transit corridor. There is an increase in the load as the transport takes place. Plate 2 C shows the discharge area. The blocks of land and the tree trunks are unloaded at the entrance of the plain as the water loses its intensity due to the less and less vigorous slopes and the widening of the flow channel, the heaviest materials are abandoned. The soil is easily transported. The flow channel is 150 m wide.*

The floods consequences

The damages caused

The damages generated, created stress, teeth grinding and hard times to endure among the downstream population. The entire fields of life was buried. Human: 02 missing. Houses: 05 houses destroyed or washed away. Plate 2 illustrates the phenomenon.

Photo: Ediamam Epalle, 2017

Plate3: Houses destroyed by the floods

Plate3 ***A*** *shows a semi-clay house whose walls and pillars are completely destroyed and almost buried in gneiss from landslides upstream. They are deposited by the floods. This house built by a retired man was also used for pigsty (35pigs), goat (17), a chicken coop (155 chickens) which was destroyed by water.* Plate3 ***B*** *shows the partially destroyed public school in Bebong. This school is located on a slope. The water height is (1.5m) on the walls.* Plate3 ***C*** *shows a brick house completely destroyed by the floods.*

The level of water

The floods reached record heights over 8m upstream.

Photos: Ediamam Epalle, 2017

Plate4: level of water

Plate4 ***A*** *shows a gentleman (1.80m tall) standing at the foot of a coffee tree over 4m high from the thalweg. However, he does not measure up to the coffee tree which has been engulfed by water. On* Plate4 ***B****, we read the water height on the palm tree. Arrow indicates the level reached 3.5m from the banks. In reality, the total height is 8m.*

Thickness of erosion sludge

The thickness of the sludge varied according to the slope. Upstream, the average thickness is around 1.5m while downstream, due to the dispersion of water; it is 1m on average plate 5.

Health effects

We noted during discussions and interviews that drowning two people to dead, several injured, in contact with water, it was revealed that they have respiratory and heart problems following the violence of the shock. Enquiries confirmed that these People had physical and emotional stress with a susceptibility to psychological disturbances and cardiovascular events. These incidents were linked to loss of property and family members or those they were acquainted with.

Photos: Ediamam Epalle, 2017

Plate 5: Depth of sludge

Plate5 ***A*** *shows a house destroyed by floods at Echioc village. The thickness of the mud, around 1.5m, shows the extent of deposits of material torn upstream.* Plate5 ***B*** *shows a coffee farm trees completely covered with silt more than 1m thick.*

Representation of the phenomenon

The representations of the phenomenon are summarized by Mr Elat testimony (2017)

"*In human memory, no catastrophe of this kind has ever occurred in our locality. If our ancestors rose from the dead, they would be just as surprised as we are. The phenomenon is strange. One cannot easily accuse witchcraft. The men with the ''four protective eyes of the sanctuary'' would have seen mystically and predicted. In addition, several villages (Nfontsam, Ndjongo, Fondonera) are affected. The farms are destroyed (cocoyam, plantains, food, coffee, cocoa, date palms for wine). Next year will be difficult. See for example; yesterday, after 11 days staying at home because of the landslides, 07 women went to the farms to get something to eat. They came back in tears because the farms were devastated. Even ten herds of elephants would be less devastating. Food shortages will ruin people lives here. It's horrible*!"

Another witness said:

"*The worst thing is that the irreparable happened in the area where the cocoyam is grown. However, our Bebong village is the grain band that supplies Santchou town and even the markets of cities like Douala, Dschang, etc. Without cocoyam, we are dead, life has stopped at home. It's a tragedy*! ".

Psychosis has taken hold of the population

According to Mr. Atioki (2017), "*fear has won everyone here. It becomes impossible to go from one village to another. We can no longer visit a brother as in the past. Even I, the Lion of the village, two days ago, I took a false courage; I went to visit my cousin. Returning at night, crossing the river was a nightmare. An indescribable fear won me over. Fortunately, on the other side, a man's voice comforted me. It's horrible*!"

According to the chief of the village,

"*the sacred minor places were affected but not damaged. To most people, water seems to have destroyed them. But insiders said the site remains almost intact, the damage is minor*".

According to an insider,

"*the damage from these disasters is manifold. People whose totems were in the wrong place have been hit, some are really in danger. But we use all means to treat them. Those who "came out" after the tremor and those whose invisible body feared and went away; we are also working on them so that they can find their harmony. We are doing everything possible to put everything back in order* ".

Discussion and suggestions

According to the observations and studies carried out during this work, several factors have contributed to the loss of stability of the slope at Bebong. These can be grouped into natural and anthropogenic factors.

Natural factors

The natural factors are divided into predisposition and trigger factors. Predisposition factors: They are linked to tectonics, lithology and slope.

-Tectonics: studies of landslide materials highlight rocks of a cataclastic nature, strongly mylonisitized and densely fissured. This structure makes them easily crushable, with water infiltrating to significant depths.

-Lithology: the mineralogical composition of these rocks is dominated by feldspars, amphiboles and biotites, minerals whose weatherability index remains greater than or equal to 4 (Godard, 1962). The chemical weathering process therefore remains very advanced with the formation of well-developed and very thick soils (more than 10 m). Balls and angular blocks of large rocks isolate themselves in these loose alterites and constitute enormous loads which are added to those of the thick and moist soil. The abundance of clays in the slope materials has repercussions on its stability. The materials are in a very plastic clay and silt limit. These materials are very fluid and likely to act as a "soap layer". However, the significant porosity, the fissured and chaotic structure of the formations allowed the appearance of water circulation networks between the particles and the deep imbibition of these clay soils (59-88%); which resulted in the degradation of the mechanical parameters (low cohesion and high internal friction angle).

-The slope is very steep (15-25°) in this site, high enough to create the gravity contrast and induce mass movement.

Triggering factors

-Exceptional weather conditions: the landslide is the result of two almost consecutive days of rainfall of varying intensity, it's the real external stimulus. In a normal year, the amount of rainfall in August is about 300mm. However, local topographic conditions can induce exceptional slices (Kuete et al. 2021). Indeed, the locality emerges at the bottom of a cul-de-sac, open towards the Tombel graben (Bandji, 1994). The rainfall ranges between 80-100mm retained as the necessary threshold for triggering mass movements can be reached, or even exceeded (Ngouanet, 2017). Using data from Africa Rainfall Climatology Version 2 (Novella and Thiaw1, 2012), (Ngouanet, 2017) showed that most of the large mass movements that occurred in Cameroon were consecutive to daily slices of 75-100mm. This was the case during the Magha mudslides on July 20, 2003 and August 5, 2005 in Ngueng. Some authors (Costet & Sanglerat, 1975) agree on the fact that as soon as the clays water content exceeds the bound water content and free water appears, the resistance of the materials drops. They go from a solid state to a plastic state and then to a liquid state. All of this weakened the ground stability and triggered the instantaneous and sudden displacement of a large quantity of materials on the plain slope (Aboubakar et al. 2013).

Fallow: It seeks to discover the mechanisms that make fallow land the preferred areas of occurrence of landslides and mudslides. Between the fallowing of a slope and the triggering of a mass movement, there is a delay of medium to long duration. Thus, landslides and mudslides that occurred around Dschang in 1978 and studied by J. F. Tchoua occurred on slopes that had been invaded in the late 1940s and early 1950s by coffee growing before being abandoned due to the unsuitability of the plant on these steep slopes. This delay, over more than 30 years, could constitute a scale of preparation and then occurrence of the phenomenon. Also, (Kuete et al, 2021) advocate that, the numerous landslides occurring on the Bamboutos mountain are consecutive to the long period of fallow following heavy agricultural activities in the area.

Deforestation: it's a factor that favor the landslide occurrence because through the splash phenomenon. It's the step to the passage from the stability to the instability of the soil. It has contributed to loosen of superficial layer. According to Aboubakar (2010), the plant cover of mountain forests is destroyed by man in favor of its agro-pastoral activities, where plowing is commonly practiced, as well as haphazard urbanization. This causes the soil instability, and triggers mass movements.

Floods

The Bebong landslides occurred in exceptional conditions, in the middle of the basement where the weathered-basement transition is made by a ball horizon which provided blocks like rams to smash the coarse alluvial products (Kuete et al. 2021). Multiple erosion corridors scoured down to the source rock at the start of the slope served as a transit for the coarse materials scouring the decomposition front or horizon with balls. This erosion is more like a regressive erosion. As a result, in the plain, a vast cone of huge mineral blocks and ligneous trees has been built, a bed of accumulation of basement blocks of metric order of decreasing size, coarse and fine sands, a glacis of accumulation of blocks and tree trunks intruding between those of the trees which have escaped the fury of the blocks (Epalle 2018). In the end, a vast field of soft mud which extends under the coffee plantation and which has destroyed the crops, carried away domestic animals, almost engulfed the houses, making the flash floods catastrophic.

Suggestion to fight against landslides on the slopes and floods in the Mbos plain

In order to reduce the risk of landslides on the slopes surrounding Mbos plain and their consequences, we suggest:

-To reduce deforestation speed on the slopes at Bebong and other areas by reducing agricultural activities

-To control the fallow by making it shorter, to avoid soils exposition

-The cartography of risky zones with the delimitation and the materialization of the zones susceptible to instability, presenting a great difficulty and /or an impossibility of planning;

-Mapping of vulnerable areas susceptible to flooding in the plain

-A planning of the Mbos plain

-The education and awareness raising of the population living on the slopes and in the Mbo plain also from the surrounding localities on the risks incurred when they build habitats on and above the risky slopes, mouths of valleys which run down slopes and flow into the plain.

Conclusion

This work was aimed at studying landslides and their impacts on flash floods. Our results shows that, water is the main triggering factor of the Bebong landslide, with exceptional weather conditions the landslide is the result of two almost consecutive days of rain of varying intensity. Also, deforestation and cultivation on this steep slope have contributed through regular plowing to the loosening of surface levels and increase the rate of water infiltration; this is followed by the use of fallow by the population. In addition, blocks of land and tree trunks are unloaded at the entrance of the plain the heaviest materials are abandoned as water loses its intensity. The thickness of the sludge varies according to the slope. Upstream, the average thickness is around 1.5m while downstream, due to water dispersion; it is 1m on average. Properties have been destroyed among which houses and agricultural lands. In addition, two dead, several injured, in contact with water, respiratory and heart problems, physical and emotional stress, psychological disturbances and cardiovascular events, Psychosis and phobia has taken hold of the population. Landslides are disasters not yet mastered and can pose a real threat to humans and their activities; it's the same with floods often consecutive to the said mass movements. Despite the patenting of floods linked to landslides in this area, they cause fatal impacts. The understanding of natural disasters like landslides, and the limitation of their consequences on man and his activities are major weapons for controlling the flash floods and the environment and therefore for development.

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