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Original article

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ABSTRACT

An assessment of the socio-economic implications of landslide occurrence in the Kigezi highlands of South Western Uganda was conducted. Landslide occurrence is on the increase and threatens community livelihoods in these highlands. Detailed field investigations were undertaken with the help of local communities between June 2018 and May 2020 to identify and map recent and visible landslide scars in Rukiga uplands of Kigezi highlands. In the course of field inventories, 85 visible landslide scars were identified and mapped using handheld GPS receivers to produce a landslide distribution map for the study area. A socio-economic analysis was conducted to establish the effects of landslide damage on people's livelihoods as well as their existing coping and adaptation mechanisms. The assessment was administered through field observations and surveying, focus group discussions, key informants and household interviews as well as the use of Local Government Environmental Reports. The study established an increase in the spatial-temporal distribution of landslides over the Kigezi highlands in the past 40 years. The landslides have resulted in a reduction in the quality of land, loss of lives, destruction of transport infrastructures, settlements, farmlands, crops and other socio-economic infrastructures. Therefore, it is important to look for reliable and sustainable measures to prevent landslide hazards. Total landscape reforestation with deep-rooted trees can possibly reduce the landslide risk. It is also important to undertake policy implementation for preparedness and mitigation plans against landslides in this region and in the country at large. Proper soil and water conservation measures could help in enhancing soil strength against landslide hazards.

KEY WORDS: landslide damage, socio-economic spheres, Kigezi highlands, Uganda

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1. Introduction

Landslides are global environmental hazards that cause social and economic disruptions especially in mountainous and highland areas of humid regions (Broothaerts et al., 2012; Kirschbaum & Zhou, 2015). An increase in the occurrence of damaging landslides globally has affected human life and caused extensive damage to socio-economic infrastructures and property (Meyer et al., 2013). Landslides have resulted in great problems and serious challenges to development processes (Kirschbaum et al., 2015; Pfurtscheller, 2018). It is estimated that the annual total global economic cost of landslides is approximately 250 billion USD dollars (Unisdr, 2015). Landslides are expected to cause more environmental problems due to increasing highland and mountain populations coupled with land degradation (SUSANA ET AL., 2017). This heightens the anxiety of how to sustain livelihoods in montane and highland ecosystems (WIJAYA & HONG, 2018). Globally, the most affected countries in terms of landslide occurrence and fatalities include India, China, Nepal, Indonesia, Philippines among others (KIRSCHBAUM ET AL., 2016). Landslides tend to dislocate objects that they come into contact with by way of uprooting trees (TURNER, 2018). Landslides also cause blockages to rivers forming natural dams and the debris in streams can adversely affect aquatic habitats (MEYER ET AL., 2013). Indirect damage includes reduction in tax revenues on devalued properties, negative effects on water quality and psychological trauma to people causing productivity losses (WIJAYA & HONG, 2018).

Due to the humid climatic conditions, steep topography, and thick weathered rock mantle on slopes, the East African highlands are prone to landslides (KNAPEN ET AL., 2006; KITUTU ET AL., 2011). The highlands have experienced a number of landslide occurrences, some of which have been catastrophic (KITUTU ET AL., 2009; MUGAGGA ET AL., 2012). Landslides are a serious hazard in Uganda's highland and mountainous areas with great socio-economic, physical and environmental impacts (NEMA, 2016). They are prevalent in Eastern, Western and South Western parts of the Country (NEMA, 2017). Landslides have significantly affected the incomes of smallholder farmers in Uganda (NEMA, 2018). This has been mainly through loss of farmlands, crops, soil fertility and therefore leaving farmers highly impoverished (KITUTU ET AL., 2011; MUGAGGA ET AL., 2012; NEMA, 2017). Landslides have also caused enormous damage in the highlands and mountainous parts of the country (NEMA, 2016). For example, in the Ruwenzori region in Western Uganda, landslides have caused 55 deaths and made 14,000 people homeless over the last 50 years (JACOBS ET AL., 2015). MERTEN ET AL., (2015), also report that 174 households had been affected by landslides in the same region with significant percentage loss of income from agriculture.

Due to its high population density (409.8/km^2), which is one of the highest in Uganda (UBOS, 2017), the Kigezi highlands in South Western Uganda are comparable to other mountainous and highland regions in tropical Africa where landslides are common disasters (BAGOORA, 1988; NEMA, 2016). The increase in landslide occurrence in the Kigezi highlands is attributed to poor environmental management practices (BAGOORA, 1993; NEMA, 2014). Landslides have caused anxiety and made the sustainability of livelihoods in this fragile ecosystem difficult (NEMA, 2018). Several people in these highlands have been forced to settle elsewhere (NEMA, 2017). This study therefore sought to examine the socio-economic damage caused by landslide disasters on community livelihoods in the Kigezi highlands.

2. Materials and methods

2.1. Study area

The study was conducted in the Rukiga uplands within the Kigezi highlands of South Western Uganda situated between 01° 21' 25" and 0° 58' 08" South, and 29° 43' 30" and 30° 05' 51" East (Fig. 1). The topography of the Kigezi highlands comprises mainly extensive flat-topped ridges and hills, broken by short, steep-sided dip valleys and numerous subsidiary strike valleys separated by fluted spurs, usually 3-6 km long (BAGOORA, 1993). The Rukiga upland region with an area of 427 km^2 (UBOS, 2017) form part of the Kigezi highlands and was selected for this study on the basis of its unique topography. The topography is extremely rugged, consisting of narrow steep convex slopes and high valleys between hills, many of which constitute drainage lines connecting to the main valley (BAGOORA, 1993). The Rukiga upland region was also selected on the basis that it is an area where landslide scars are still visible unlike other parts of the highlands and therefore easy to map and characterize. The geology of the highlands is composed of a sedimentary rock system of the Precambrian age (BAGOORA, 1989). The rocks underlying slopes in the study area have been categorized by BAGOORA (1988), as phyllite, shales, sandstones, quartzite, granites and gneisses of granitic composition. Other rock types include various grades of schists such as quartz-schists and fine textured mica-schists belonging to the Ankole-Karagwe rock system and the Achaean basement complex (BAGOORA, 1989). Slope sections underlain by relatively weaker rocks like shale have deep soil profiles due to the high weathering rates (BAGOORA, 1993). Slopes underlain by quartzite and granitic intrusions are covered by shallow soils, and in some cases bare rocks, making them less prone to landslide occurrence. Miscellaneous alluvia of sands and clay occupy many drowned water courses in the highlands, the texture of which depends on the rock in the area (NEMA, 2018). For example sands occur in the warped valleys flanked or underlain by gneiss and granite intrusions, while shales and phyllite have given rise to clay deposits (BAGOORA, 1993). The study area comprises numerous highland streams which drain valleys incised in the ridges and hills (NEMA, 2014).

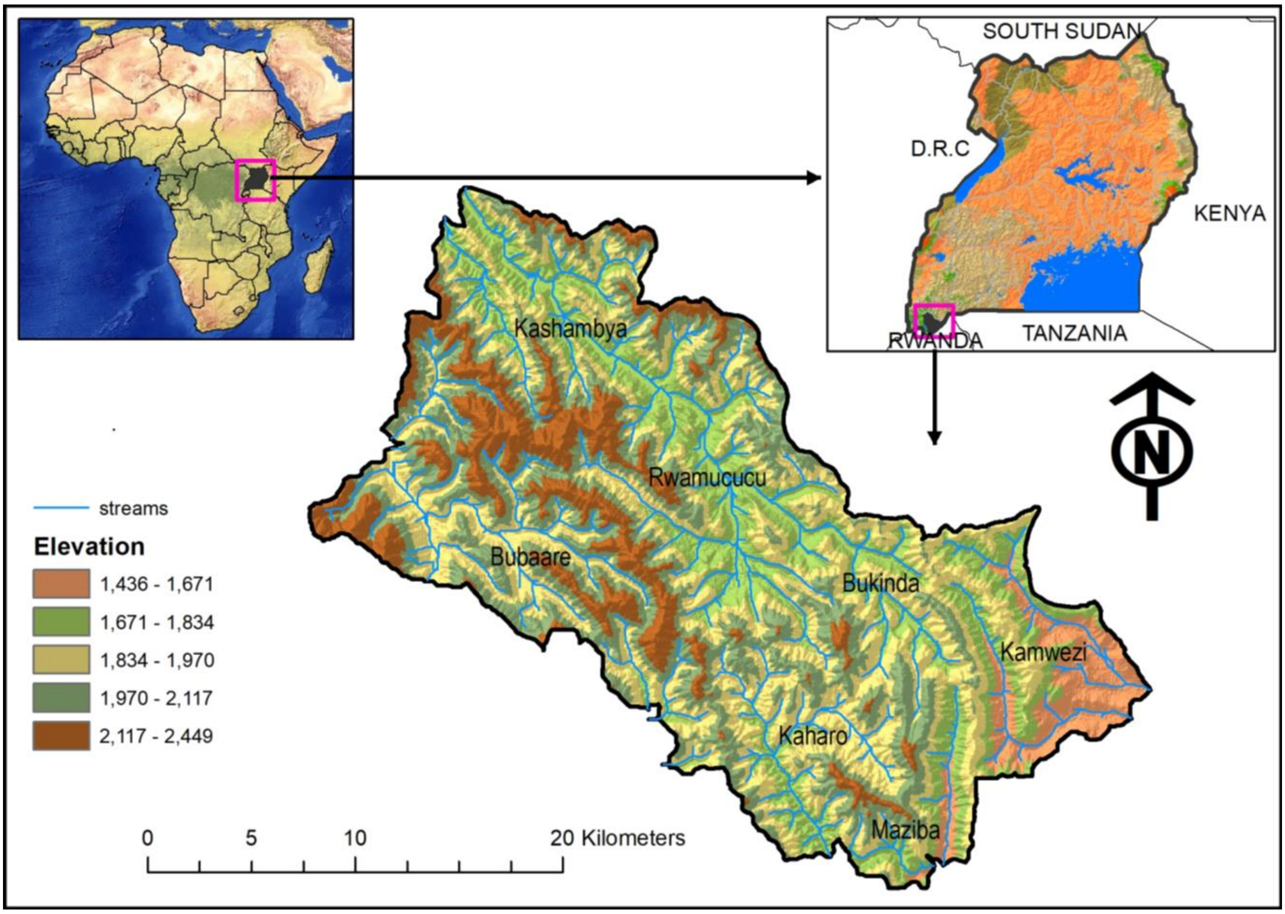

Fig. 1. The location of the study area

The climate of the Kigezi highlands is warm to cool humid characterized by a bimodal rainfall pattern with an annual rainfall of 1092 mm (UBOS, 2017), which can be classified as moderate. Rainfall, however, increases to 1250-1540 mm or more in high altitude areas of higher than 2000 m above sea level (UBOS, 2016; NEMA, 2018). Over the past 40 years, the lowest annual rainfall recorded was 400 mm in 1981, while the highest was 1800 mm in 2010 (Fig. 2a).

The main rainfall seasons are from mid-February to May with a peak in March-April, and September to December with a peak in October-November (NEMA, 2017). Whereas April (158 mm) and November (142 mm) are the wettest months, June (33 mm) and July (37 mm) are the driest in the study area (Fig. 2b). Whereas rains in the Kigezi highlands are generally of moderate to low intensity, occasional extreme rainfall events are also experienced, especially in the eastern part of the highlands (the present study area). Events of over 25 mm in 24 hours are not infrequent (NEMA, 2018). Rainfall distribution has an implication for landslide occurrence especially its influence on the behaviour of soil characteristics.

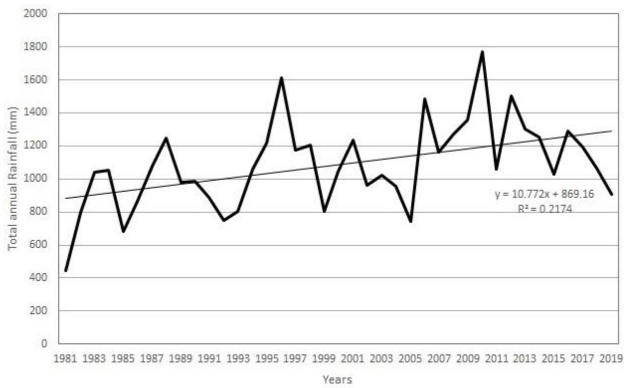

Fig. 2a. Annual rainfall variation for the study area from 1981 to 2019

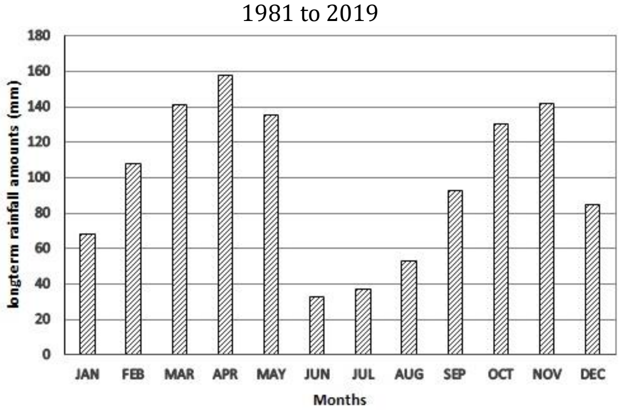

Fig. 2b. Long term monthly rainfall amounts for Rukiga highlands

The vegetation cover of these highlands was until about a century ago characterized by montane forests (BAGOORA, 1993). Centuries of human interference has led to serious degradation and in some cases depletion of vegetation cover (CARSWELL, 1997). Currently, except for the few natural vegetation patches surviving under legislative protection, the rest of the vegetation cover in the highlands is either very poor or long gone (NEMA, 2014). The high population for the Rukiga upland region of 105,400 people and a density of 268 people/km^2 (UBOS, 2018) has put tremendous pressure on the land cover and land use in this region, leading to resource overuse and subsequent degradation (NEMA, 2018). Most of the highlands now comprise poor vegetation cover with various human manipulated or impacted types (Fig. 3).

Many parts of the hillslopes are already bare due to degradation (LINDBLADE ET AL., 1998). Hillslope degradation and intensity of extreme rainfall events during the last decades has increased the problem of increased runoff coefficients and landslide occurrences in the highlands (NEMA, 2018).

Fig. 3. Intensively cultivated slopes with high vulnerability to landslide occurrence (*Photo credit: D. Nseka*)

2.2. Mapping landslide dimensions and spatial distribution

Detailed field investigations were undertaken with the help of local communities between June 2018 and May 2020 to identify and map recent and visible landslide scars in the catchment. During the field inventory, 85 visible landslide scars were identified and mapped using handheld GPS receivers (Garmin GPSMap 64s GLONASS High-sensitive receiver). Although some of the scars have been concealed by the high rates of vegetation regeneration in the catchment, many of the landslide scars are still visible and therefore easy to map and characterize. This study focused on recent landslides including both active and inactive landslides but with clear signs of movements within the last 10 years. Coordinates for the mapped landslide scars were imported into ArcGIS 10.1 software (HERBERT & RYAN, 2002) to produce a landslide distribution map for the study area. During the field surveys, analysis of the landslide scar dimensions was established by way of measuring key features including average width, depth and overall length from top to bottom using a tape measure.

2.3. The socio-economic analysis

A socio-economic analysis was conducted to establish the landslide damage on people's livelihoods. The analysis was also conducted to establish community coping and adapting strategies to the increasing occurrences of landslide disasters. The assessment was conducted through field observations and surveying, focus group discussions, key informants and house-hold interviews.

Field observations and surveying

A direct field observation method was used to establish the number and nature of destroyed houses whether permanent, semi-permanent or temporary. During field surveys, analysis on the nature of socio-economic destroyed infrastructures was also undertaken. Observations were also made to establish the size of farmlands and gardens of crops destroyed, streams, wetlands, roads and other infrastructure affected by landslide debris (Fig. 4). An observation checklist was constructed, and systematic observations were made with the help of a checklist.

Focus group discussions

Administration of focus group discussions (FGD) involved recruiting participants from the affected areas in Rukiga highlands with the help of community leaders. A group of 6 to 10 male and female adults of 18 years and above was selected with the guidance of the local council chairperson for FGDs in each of the selected villages. A total of 10 FGDs were administered in 10 villages purposively sampled due to their high vulnerability to landslide hazards as guided by the local leaders. The discussions were administered with the help of 2 research assistants' familiar with the study area and fluent in the local language and English. The research assistants were trained in the FGD technique and oriented on the FGD guide to ensure quality of the data. Each discussion was administered for a duration of 1 to 1⅓ hours. The discussions focused on landslide causes and damage to people's welfare. Discussions also focused on socio-economic infrastructures, farmlands and crop destruction as well as community vulnerability, adaptation and coping mechanisms. All FGDs were recorded (with consent) and transcribed into English thereafter. During the data collection phase, debrief meetings were held at the end of each day to ensure good quality data. Unexpected emerging issues were discussed and followed up in subsequent FGDs.

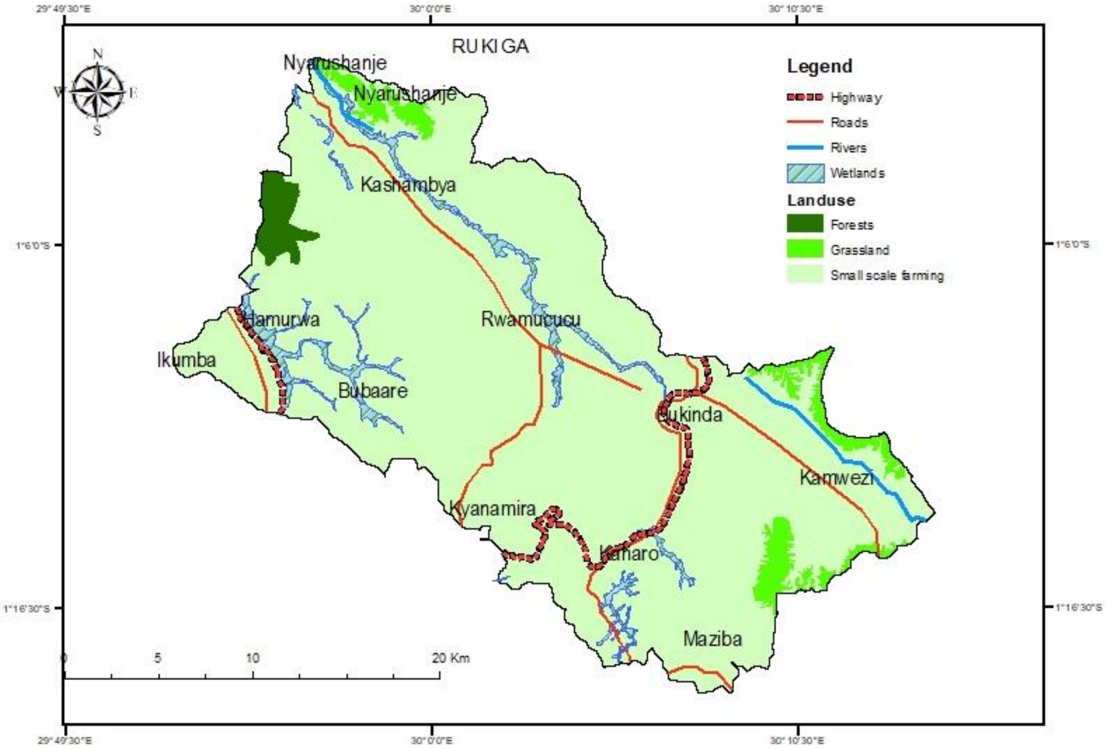

Fig. 4. Land use, roads and other infrastructure distribution in the study area

Interviews

Household interviews were administered to specific people within Rukiga highlands in order to gain special data on landslide hazards. Such people included those affected directly by the landslides including those who lost family members, houses, crops, livestock and farmlands. A total of 200 household heads including both males and females were identified from 10 villages (20 respondents per village) within Rukiga highlands for the interviews. A sample size of 200 was considered adequate to provide ample data that was used to generate reliable, valid and generalizable results. These provided valid inferences representative of the population in the study area. The households interviewed in each village were selected based on purposive and snowball sampling techniques. The previous interviewee provided details and contact details of another potential two to three households that could be interviewed. A list of those suggested was made and were contacted to fix an appointment for interviews. In addition to the household interviews, key informant interviews were also administered to selected individuals in the community. The key informants were purposefully selected due to their presumed knowledge in landslide occurrence and their socio-economic implications. Semi-structured interviews were administered to a group of 25 key informants selected from local governments and communities. The key informants included environmental managers, local leaders, forest, agricultural, natural resource and disaster response officers, community workers, teachers, opinion leaders among others. The key informant interview method was useful as it provided an opportunity for open expression of opinions and more probing on the issues raised during the discussions. Just like FGDs, the interviews focused on broad issues of landslide hazards and their socio-economic damage.

This socio-economic analysis helped in establishing among others the number of people killed and injured by landslide disasters in the region. The analysis further established the number of livestock, size of crop gardens, woodlots and farmlands destroyed (in hectares). Other properties destroyed by the landslides including number of houses, schools, health centres, lengths of roads (in kms), and bridges were also established. The study also established the level of community awareness on landslide occurrence and their damage. During the analysis, community coping, adaptation and mitigation mechanisms to landslide disasters were also ascertained. The damage on transport and communication infrastructures including roads, bridges, and culverts was also analysed.

3. Results

3.1. Landslide characteristics and distribution

The spatial and temporal distribution of landslides in the Rukiga catchment is illustrated in Figs. 5 and 6. From Fig. 5, it can be detected that landslides have a clustered pattern with high concentration towards middle upper slope elements in the catchment. There has been an increase in landslide occurrence in the region over the past 40 years (Fig. 6). The overall trend shows that the study area is becoming increasingly vulnerable to landslides. For example, whereas the period between 1980 and 2005 experienced only 36 landslides, 294 occurrences were experienced between 2006 and 2020 (Fig. 6).

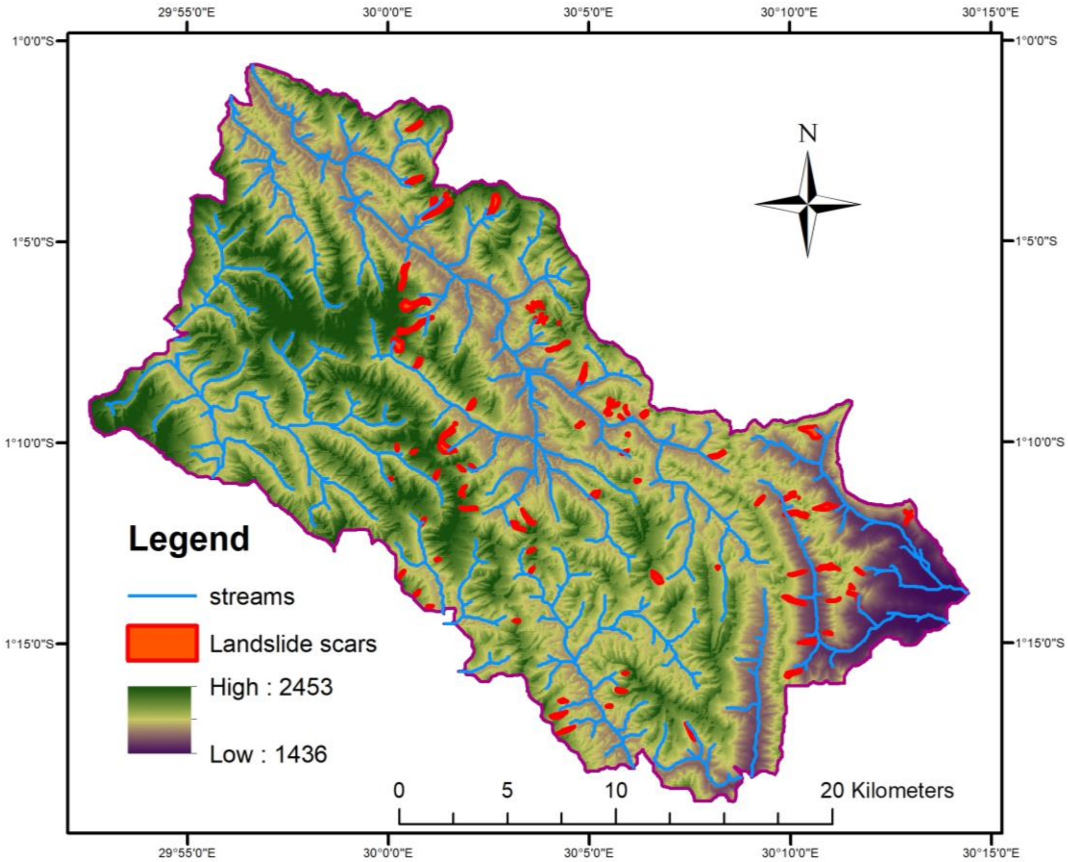

Fig. 5. A landslide distribution map for Rukiga catchment

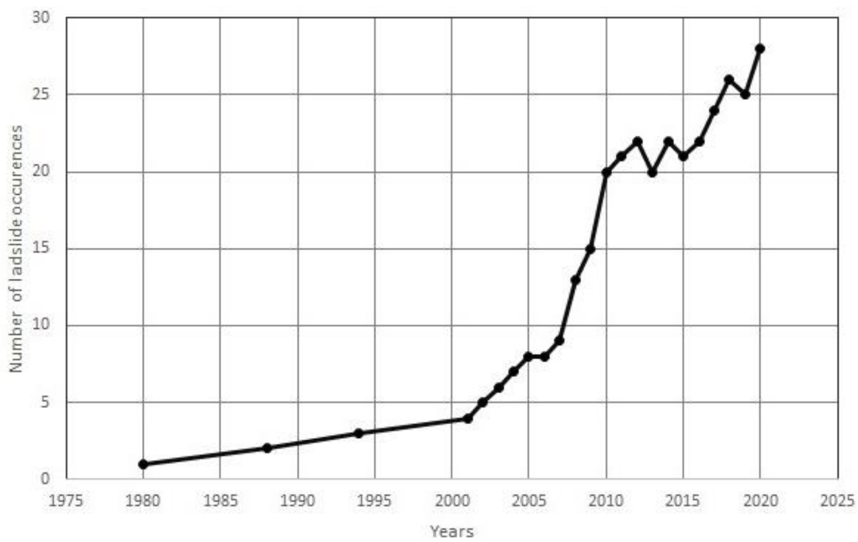

Fig. 6. Temporal landslide distribution between 1980 and 2020 in the study area (Source of data used: Kabale Local Government Disaster Reports, 2010, 2012, 2014, 2018 and 2020)

The landslide scars in the catchment varied from small 12.5 m slides to longer complex flows that extended in some cases to more than 890 m. Whereas the average width of the landslide scars ranged between 0.9 to 17.5 metres for small and complex occurrences respectively, the average depth was between 0.5 to 5.3 metres for shallow and deep seated landslides respectively. The mean area covered by each landslide occurrence varied from 125 m^2 for the smallest landslides to about 6000 m^2 for large scars. The estimated volume of hillslope materials displaced by individual landslides varied between 62.5 m^3 and 30 000 m^3 for small and large occurrences respectively. Most of the displaced materials ended up in river channels leading to flow blockage and consequent flooding of the valley floors and flood plains (Fig. 10). Most of the studied landslide scars were initiated in the middle part of slopes rather than in the upper section (Fig. 7). The crown and areas close to the main scarp are commonly marked by the presence of open tension cracks that are between 30 cm and 100 cm wide and were observed at, or close to, the head scarps of most of the slide scars.

Fig. 7. Landslide occurrence in the study area, 2019 (*Photo credit: D. Nseka*)

In this study, landslide scars were considered to be those features which resulted from past failures but were still visible. Recent landslides were considered as those failures which have occurred within the past 3-5 years and are still active with signs of reactivation especially during the periods of high moisture supply. Out of the 85 visible landslides surveyed in the study area, less than 30% are older landslide scars where margins and head scarp have been degraded. More than 70% are recent slides with well-defined margins, head scarp, and no, or partially developed, drainage channels. Most of the recent scars show signs of reactivation (Fig. 7).

3.2. Socio-economic implications of landslides

Following an interaction with local communities as well as field observations, this study has established that landslides have negatively impacted the livelihoods of people in the region both directly and indirectly. For example, landslides have directly resulted in the deaths of more than 77 people over the last 10 years. From the household interviews conducted, the study has established that 18% of the respondents had lost a family member to landslide disasters within the last 10 years.

Destruction of farmlands, crops and livestock

All 200 respondents in the household interviews reported the loss of prime arable land leading to food insecurity. The study also found that landslides have led to the destruction of farmlands (376.1 hectares), gardens of crops (241.2 hectares) and woodlots (29 hectares) which were covered by material deposited by debris flows and mud flows over the past 10 years (Figs. 8 to 11).

Fig. 8. Farmland and crop destruction by landslide debris, 2019 (*Photo credit: D. Nseka*)

From the FGDs conducted, the study has established that arable land has reduced causing land-scarcity and property conflicts in the region. Following the household interviews with farmers, 190 (95%) respondents reported to have lost entire gardens of sorghum, vegetables, maize, Irish potatoes, beans and bananas to landslides (Fig. 8). More than 96 (48%) respondents reported losses of livestock including cattle (36), pigs (49), goats (55) and several chickens over the last 10 years. They further reported that such losses greatly affected their incomes from agriculture. Landslides have therefore affected agriculture which is the main source of livelihood in the region. They have therefore resulted in food shortages leading to increased food prices.

Impact on infrastructures

Landslide occurrences have led to serious impacts on the socio-economic infrastructure of the region. From the field surveys conducted, the study established that many roads (totalling 247.3 km) were covered by landslide materials and rendered impassable for 3-7 months while 7 bridges were swept away by debris flows and floods over the last 10 years (Fig. 9). From the FDGs and interviews conducted, the study found that landslides have led to the disruption of livelihoods due to destruction of transport infrastructures. There is vivid evidence that such destruction of transport infrastructures hinders movement of agricultural produce to markets. From the interviews conducted, all the 200 (100%) respondents reported a disruption in the transportation of their agricultural produce to markets due to crippled transport infrastructures.

Fig. 9. Destruction and blockage of roads by landslide debris, 2019 (*Photo credit: D. Nseka*)

Destruction of settlements and personal property

Landslides have destroyed over 821 houses, 3 schools, 2 health centres and other forms of property in many parts of the Kigezi highlands over the last 10 years. From the household interviews conducted, over 80 (40%) respondents reported to have lost their houses to landslides or resultant floods. Among the houses destroyed by landslide disasters, more than 675 (82%) were either temporary or semi-permanent, constructed using mud and wattle. It was reported during FGDs that the damming of streams by landslide tongues had resulted in flooding of the valley floors upstream the natural dams. For example, from the field surveys conducted, the study established that an entire township in Kyerero Parish within the Rukiga highlands was ravaged by floods resulting from blocked streams (Fig. 10). Consequently, many people lost their businesses, which initially served as their main sources of income and livelihood.

Fig. 10. A flooded township due to stream blockage by landslide debris, 2020 (*Photo credit: D. Nseka*)

From the FGDs conducted, the study established that community members who once owned shops and other forms of businesses in the townships lost everything and became stranded. Personal property including shops, stored food and other household items were destroyed (Fig. 11). The FGDs and local government reports revealed that over 10,000 people had become homeless over the last 10 years. This had created a situation of environmental refugees in the region.

Fig.11. Stranded community members who lost their properties and homes to landslides (*Photo credit; D. Nseka*)

Other indirect impacts of landslides

The indirect impacts reported included the outbreak of disease in the communities. For example, all the 200 (100%) interviewed respondents reported an increase in the prevalence of malaria in their families due to flooding associated with landslides. From the FGDs conducted, the study further established that landslides destroyed sanitation facilities such as latrines and water sources. This left the communities vulnerable to the outbreak of diseases including dysentery, cholera and diarrhoea. More than 95 (43%) respondents reported an increase in water borne diseases. From FGDs and interviews conducted, the study established that the destruction of transport infrastructures disrupted trade, health and education activities. More than 30 (15%) respondents reported to have been psychologically and emotionally traumatized. This was due to the loss of their family members and witnessing the excavation of their dead relatives from the landslide rubble. From the FGDs and field surveys conducted, the study established that landslides had eroded major foot paths and plot boundary markers resulting into community conflicts.

Local adaptation strategies by communities

From the FGDs, interviews and field surveys conducted, this study found that local communities have devised a range of adaptation strategies to mitigate landslide related disasters. In Karorwa village, for example, communities had dug, and have been maintaining, a storm storage ditch to divert runoff and landslide materials from destroying their houses and farmlands (Fig. 12b). This shows awareness by the people about the likely occurrence of landslides and their associated impacts. The common adaptation strategy was found to be piling soil behind the house, on the upper part of slope so that it can act as a barrier to landslide debris. From the FGDs, interviews and direct field surveys conducted, this study found that farmers have tried to use a number of soil, water and land conservation measures to prevent landslide challenges and also to keep soil fertility. The conservation measures practiced by farmers included mulching involving the covering of top soils with grass, digging water trenches, intercropping, contour banding and terracing among others (Fig. 12a). Close to 90 (44%) respondents interviewed indicated that they had tried to construct terraces to control runoff and landslides (Fig. 12a). More than 120 (60%) farmers interviewed were practicing intercropping to maximize the land available since most of the land has already been destroyed by landslides.

From FGDs and interviews conducted, the study also established that temporary migration was another local adaptation strategy to landslide disasters in the region. It was reported during discussions that when landslide disasters strike the area, people opt to temporarily migrate to relatives and friends to escape such disasters. After some time, however, such people return to their homes. This, however, seems not to offer any reliable solution. This study further established through interviews and FGDs that when landslides hit the region, some of the affected people resort to seeking casual employment within and outside their communities. This was usually undertaken to earn income to meet their family's basic needs during post disaster periods.

Fig. 12 a, b. Soil, water and land conservation measures to reduce landslide impacts, 2020 (*Photo credit; D. Nseka*)

4. Discussion

4.1. Landslide characteristics and distribution

The morphometric characteristics of landslide scars in the study area denote the presence of a simple or composite slide plane surface. The morphometric characteristics of the landslide scars diagnosed included the overall length, average width and depth, scar area as well as the volume of materials removed by each occurrence.

The morphometric characteristics of the scars observed are important in establishing the magnitude, type of mass movement and the likely socio-economic damage. This in turn has an implication on community livelihoods. In the study area shallow translational and rotational slides account for over 85% while debris flows, and complex slides constitute less than 15% of the landslides experienced. The distribution of these different mass movement forms is related to the morphology, inclination, altitudes, lithology, land cover and land use of the slopes. According to the landslide classification scheme by CRUDEN & VARNES (1996), the most common landslide processes in the study area are rotational slides, where the surface of rupture is curved concavely downward. In Rukiga highlands, landslide scars are being concealed by soil materials mobilized from the hilltops and spur slopes. The soils accumulating within the landslide scars encourages rapid vegetation regeneration, owing to the high rainfall amounts in the study area (NEMA, 2018). These landslide scars are disappearing from the landscape due to the high rates of vegetation regeneration (NSEKA ET AL., 2019). Most of the shallow landslide scars are no longer visible on the landscape. The high rates of landslide scar revegetation may lead to the underestimation of landslide occurrences in the study area.

4.2. Socio economic implications of landslides

Landslides are some of the costliest and damaging natural hazards of the world (KIRSCHBAUM ET AL., 2016). They have a direct and indirect influence on a number of human activities (SUSANA ET AL., 2017). As already noted, the spatial-temporal distribution of landslides in the Kigezi highlands has increased. Due to the high population density of 268/km^2 in the study area (UBOS, 2018), the socio-economic damage to livelihoods is enormous and calls for urgent measures to reverse them (NEMA, 2017). As indicated, landslides have directly resulted in the death of more than 77 people in these highlands over the last 10 years. The loss of family members has implications on household livelihoods. First, it means loss of family labour especially for agriculture. Secondly it is also associated with other psychological and emotional effects to some family members. The majority of households in these highlands, like the rest of Uganda, depend on agriculture for their livelihood (UBOS, 2017). Agricultural systems in these highlands are, however, increasingly becoming vulnerable to landslide disasters (NEMA, 2018). This study has established that most landslides in these highlands occur on farmlands. They burry crops and make farmlands partly useless for several years. They lead to the demise of small prime agricultural lands due to the deposited debris (Fig. 8). Consequently, farmland has become scarce and pressure on the remaining land is higher. Land shortage due to landslides is indeed one of the main problems facing farmers in the Kigezi highlands (NEMA, 2017). Landslides also remove the productive top soils and render post landslide areas less productive. The loss of fertile soils and farmlands therefore renders these landscapes highly impoverished. It is clear that landslides in these highlands is a significant problem for the local farmers (Figs. 7 to 9).

Landslide occurrence in the study area also leads to flooding in valley floors in the lowlands (Fig. 10). The floods result from blockages of streams, wetlands and other drainage channels by landslide materials, and debris flows. The floods destroy farmlands and damage crops especially root tubers (NEMA, 2017). The direct costs of landslide disasters include damage to property and infrastructures (KIRSCHBAUM ET AL., 2015; PFURTSCHELLER, 2018). Similarly, this study established that landslides destroy socio-economic infrastructure especially roads. Landslides have therefore undermined poverty reduction strategies among rural communities which depend on agriculture in these highlands (NEMA, 2018). This study has established that landslide disasters continuously result in human suffering, property damage and destruction of transport infrastructures. Several people in the Kigezi highlands have been forced to settle elsewhere (UBOS, 2018). Landslides in these highlands are therefore associated with many other aftermath effects. The aftermath effects include homelessness, emergence of environmental refugees, famine, reduction in water quality and quantity and huge government expenditure (NEMA, 2014).

The study also identified poverty as another factor that aggravates the impacts of landslide processes in these highlands. During field investigations, it was established that the type of houses destroyed by landslides and floods were mainly from mud and wattle buildings and temporally in nature. This is due to the fact that poor families are unable to construct permanent houses. Such poor families entirely depend on small plots of land which are intensively cultivated (UBOS, 2018). Poor families have no alternative sources of food and income to support their families (UBOS, 2016). They are the least educated with relatively more dependants and thus are more vulnerable to the shocks of landslide disasters

(NEMA, 2018). In addition, the fact that some families sought refuge with close relatives and other social networks, this undoubtedly increased the burden of the recipient families. This implies that landslides have spill over effects to other areas which are not necessarily hit by such disasters.

5. Conclusion

The occurrence of landslides and other related forms of mass movement in Rukiga uplands within the Kigezi highlands is on the increase. These mass movement processes are associated with great socio-economic damage. The potential damage from landslides include loss of lives, destruction of farmlands and livestock, socio-economic infrastructures, settlements and environmental depletion. Therefore, the need to build community resilience to landslide hazards in these highlands cannot be over-emphasised. It is important to adopt reliable and sustainable measures to combat landslide hazards in these highlands. Proper soil and water conservation measures could help in enhancing community resilience against landslide hazards. Total landscape reforestation with deep-rooted trees can possibly reduce the landslide risk. It is also important to undertake policy implementation for preparedness and to promote mitigation plans against landslides in this region and the country at large.

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