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Full Length Research Paper

Farmer's perception on landslide occurrences in Bududa District, Eastern Uganda

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This study assesses the farmer's understanding and perception of the causes and impacts of landslides in Bududa district in Eastern Uganda. Open-ended questions were designed to guide farmers in providing their experiences, understanding and observations in relation to the scientific findings. Steep slopes, areas with concavities and those with flow of water from underground were identified as areas prone to landslides. The soil characteristics for areas prone to landslides are stoniness, sandy and high water infiltration. Low lands and areas with sticky and strong soils were identified as stable. Rainfall was listed as the main triggering factor and most landslide occurrences are in rainfall events of low intensity but prolonged for days. Terraces are not popular in some of the areas because they promote water infiltration and trigger landslides. Loss of income from farms was mentioned as the main impact from these landslides. However, the damage to infrastructure such as roads and bridges was not identified as a problem to the farmers. Farmers in areas without landslides are less knowledgeable about the cause-effect issues related to landslides.

Key words: Farmers' perceptions, landslides, Bududa District.

INTRODUCTION

Degradation of slopes through soil loss due to landslides in Bududa District which lies in Eastern Uganda is a problem with fatalities, environmental consequences and food shortages in the future. During the period 1997 to 1999, landslides killed 48 people and displaced 10,000 (Kitutu et al., 2004) . Farmlands and infrastructure such as bridges and roads were also destroyed. The causes of landslides were in the early days dominated by speculations and myths of some mysterious animal. These myths seem to be fading away as farmers understand their surroundings better. Developing countries such as Uganda have a difficulty in spatial and temporal prediction of landslide disasters because of the high costs and technicalities involved. Therefore, the use of Indigenous Knowledge captured through farmer participatory methods, could be of used if found to be in line with the scientific explanations. Tim Hart in 2005 concluded that greater understanding of the utilisation of appropriate indigenous knowledge would improve the success of future agricultural interventions.

Farmer participatory methods have been used in natural resource management in Uganda (Nicoliene et al., 2003). According to Nathalie (2003), through experiences often going back for generations, farmers have developed local systems for appraising land resources, which are surprisingly accurate. In many ways, their knowledge is obtained by approaches that are similar to those of scientist's observation and experimentation (Chambers et al., 1989). Several participatory approaches have been developed to involve farmers in an interdisciplinary approach to agricultural research (Nicoliene et al., 2003). These give greater attention to actual farming practices, farmer's needs and farmer's

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knowledge. However, despite recognition in principle that local knowledge is a valuable source, its contribution is often limited due to a general lack of understanding of what local knowledge actually is and how it can be explored. For example Maila (2007) observed that, although indigenous knowledge whether scientific or non-scientific enables people to address their diverse ills (challenges) in society, sometimes it is marginalized in education because it is seen as non-scientific and non-engaging in formal education.

There is a growing interest in involving the local population in technology development. Farmers' participation has been used to identify improved rice varieties in South- East Tanzania (Kafiriti et al., 2003). Similarly, these approaches can be used to involve farmers in landslide hazard assessment and management. Farmers' observations on land characteristics, climate patterns and landslide hazard areas can lead to cheaper evaluation and reduce risks, especially in situations of limited financial support. According to Kirsten et al. (1990) there was close connection between farmer's assessment of landslide hazard and their land use decisions in Kathmandu valley in Nepal. Farmers are often good observers and integration of their knowledge may be essential in sustainable development. This study assesses the linkages of two sets of knowledge and that is the scientific and the farmer's assessment of the causes and effects of landslides in Bududa District. Farmers were also asked to give the impacts and losses from landslides since no official records exist. There has also been a big debate in government on whether landslides are the main cause of land scarcity or there are other causes which would guide decisions on what the best intervention would be.

Study area

The study was carried out in Bududa District in Eastern Uganda (Figure 1). The area is geographically bound by the latitude 1º 04'N and 1^{0} 00'N, longitude 34º 15'E and 34º 26'E (Figure 1). The altitude ranges from 1250 to 2850 m a.s.l and is characterized by steep slopes with V-shaped valleys indicating river incisions. The annual rainfall is above 1500 mm with peaks in May and October. This area has a high population density of about 952 persons per square kilometer in some areas and the main land use is subsistence agriculture and the main crops grown are bananas, coffee, beans and vegetables.

Data collection

Semi-structured questions were designed to test the information known by farmers on landslides. The design of the questions was based on the scientific observations already made by Knapen et al. (2006), where it was observed that steep slopes that are plan-concave in shape and oriented to the dominant rainfall direction (north to northeast) and at a certain distance from the water divide are most prone to landslides in the area. Further still, Kitutu et al. (2009) observed that areas where sandy clay loams are underlain by the sandy clay soils were also prone to landslide occurrences. This is because the sandy clay loams which are lighter promote faster flow of water into the lower horizons richer in clay this stagnates water flow through the soil thereby causing water to accumulate increasing hydrostatic pressure which causes slope failure.

Another observation made by Kitutu et al. (2009) is that in some areas, the parent rock is nearer to the surface and the porous saprolite froms an abrupt discontinuity with the complex granite. In here, the conditioning factors are soil horizon differentiation and the saprolite forming a discontinuity with the parent granite rock. During rains, drainage of water through the soil profile is stopped at the point of discontinuity, thereby causing water to accumulate, resulting in a semi-solid soil material that will easily slump or flow under pressure. Also, Knapen et al. (2006) observed that, the main triggering factor is rainfall. Fifteen farmers in each of the sub counties of Bududa, Bulucheke, Bubita, Bushika and Bukigai were interviewed. The main questions to be answered were "what are the causes of landslides?" Where do landslides occur? And what are the conditioning and triggering factors? People interviewed were of both old and young. This was not a straightforward task because of the kind of situation that people are in. Many of them wanted to give the information on condition that they are given a token. They appear to have been conditioned to material items promised for distribution to landslide victims and this can bias the answers. In order to overcome this, sample questions were fast tested and also the local leaders were sensitized about the importance of these research questions. Another setback was the suspicion among the local people that government might make the areas to be part of the Mount Elgon National Park. This also sometimes biases the answers, to an extent that some of the farmers even support activities which they know have lead to mass movements in the area. This was encountered in familiarization tours around areas close to the National Park when farmers denied problems of landslides on their farms but later on confessed to have landslides after sensitization.

RESULTS AND DISCUSSION

Farmers' understanding of the characteristics of areas with landslides

The factors mentioned by farmers are mainly three and these when ranked are steep slopes followed by flow of water from underground and then concavities (Figure 2). Most farmers in Bulucheke and Bubita mentioned steep slopes and concavities as the main factors. In Bushika, where landslides are not common, a high percentage of farmers gave no answer (Figure 2). Knapen et al. (2006) observed that, steep slopes and Plano concave slopes had more landslides. Concavities on slopes are areas where eroded soils and water collects. These areas develop thick soil profiles and are also cultivated frequently, hence more vulnerable to landslides. Slope shape influences the distribution of soil water content, particularly in the rapid recharge of water in certain parts of the soil mantle during rainstorms. Area of concavity in plane-form concentrate recharge water into small areas of the slope which develop perched water tables and pore pressures rise more rapidly resulting into failure. According to Westerberg (1999) in Uluguru Mountains in Tanzania, mass movements occur in slopes in concavities indicating the importance of converging

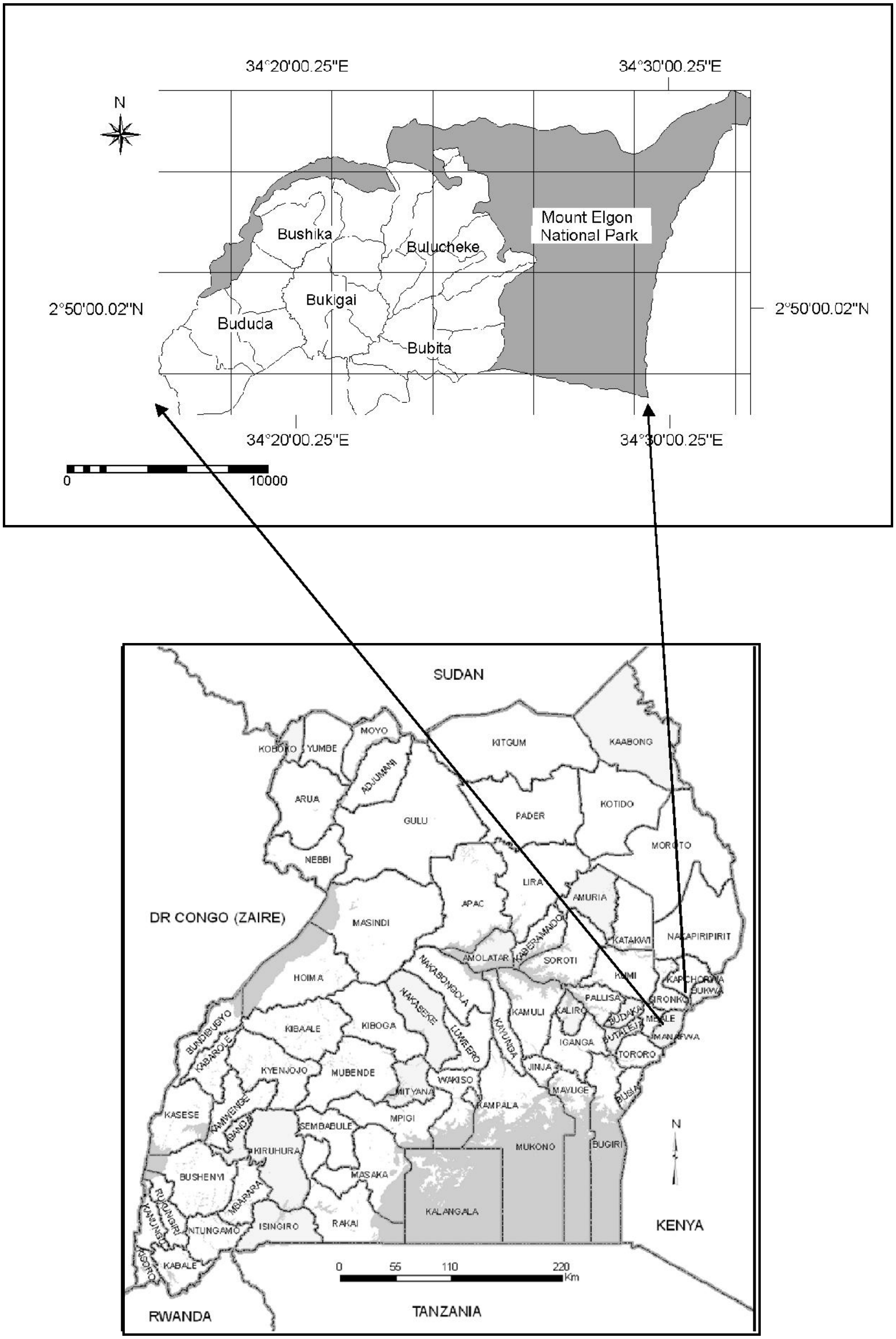

Figure 1. Location of Bududa District in Eastern Uganda. Note: Manjiya County formerly under Mbale District is what became Bududa District.

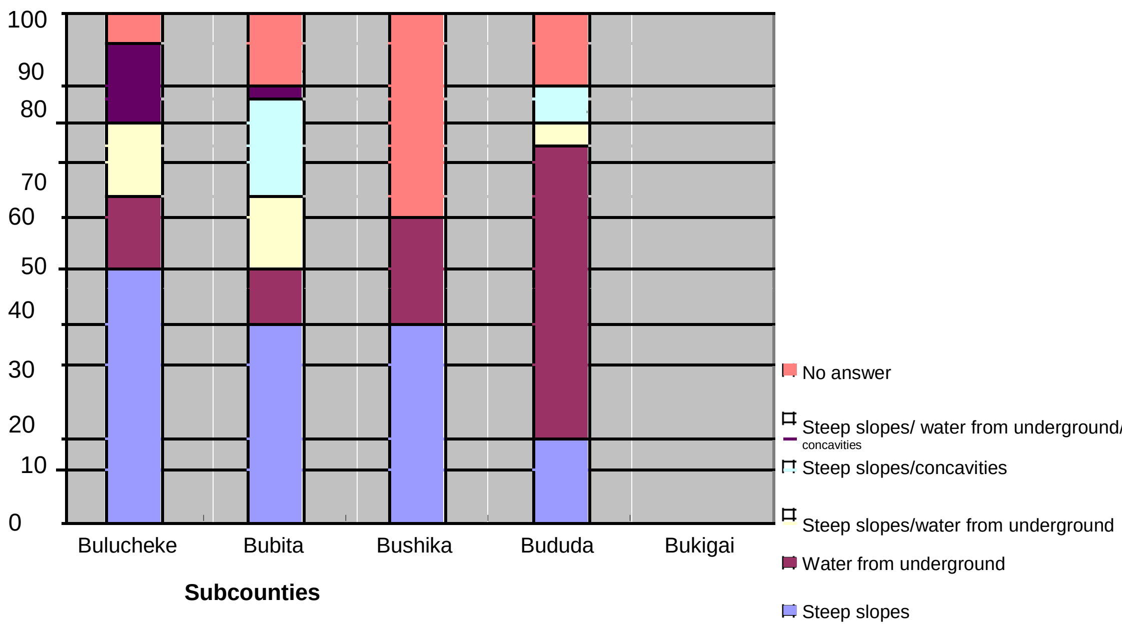

Figure 2. Characteristics of areas with landslides.

subsurface flow. He further states that the formation of the overburden of critical thickness, determines the recurrence period of mass movements, which seems to be the case in Bududa, where farmers estimated the recurrence period of about 100 years for the slumps. During this period, the soil profile would have developed to the critical thickness.

The flow of water from underground is scientifically associated with areas with very weak rocks (Selby, 1993). Farmers specially in Bududa subcounty mentioned that areas affected by landslides normally have a lot of water flowing out during seasons of intense rainfall. This phenomenon was observed in the field and indicator plants for water stagnation and ponding have developed. The cause could be due to the soil horizon differentiation. Some deeper horizons have high clay content of more than 50%. Sidle (1985) observed that high clay content in deeper soils may increase the water holding capacity and give rise to slow failure or more rapid failure in extreme cases.

Characteristics of soils where landslides occur as depicted by farmers

A high percentage of farmers in all the sub counties give stony and sandy soils as most vulnerable to landslides (Figure 3). A stony soil according to farmers is one with coarse texture. The farmers also mention diverse properties of soils which are comparable to properties such as texture, colour and infiltration of water in the soil. According to Sidle (1985), the soil properties that affect slope stability are those that influence the rate of water movement in the soils and the capacity of the soil to hold water. These properties include, particle and pore size distribution of the soil matrix. The farmers in their assessment use particle size in differentiating vulnerable soils. Farmers have the experience with the top layers of the soils which they cultivate. Sandy soils will allow fast flow of water into the soil which in this case is held in the deeper layers, which have high clay content causing water saturation and slope failure.

Characteristics of areas without landslides

Farmers were also asked to name characteristics of areas that do not suffer from landslides and many characteristics were grouped by farmers (Figure 4). A high percentage of farmers in all subcounties combined no stones, sticky soils and no water as characteristics of less vulnerable areas. These factors are comparable to texture, cohesion and water saturation. Other factors mentioned are strong soils, red soils and lowlands. The area without landslide is the central sub county of Bukigai and the soils in this area have a distinct red colour. The soils are also sticky and do not allow water infiltration, resulting in more runoff than infiltration. Farmers were able to observe this difference in the soil strength as compared to soils that suffer from landslides.

Influence of rainfall

In all the sub counties all the farmers mentioned rainfall as the main cause. The type of rainfall that is more

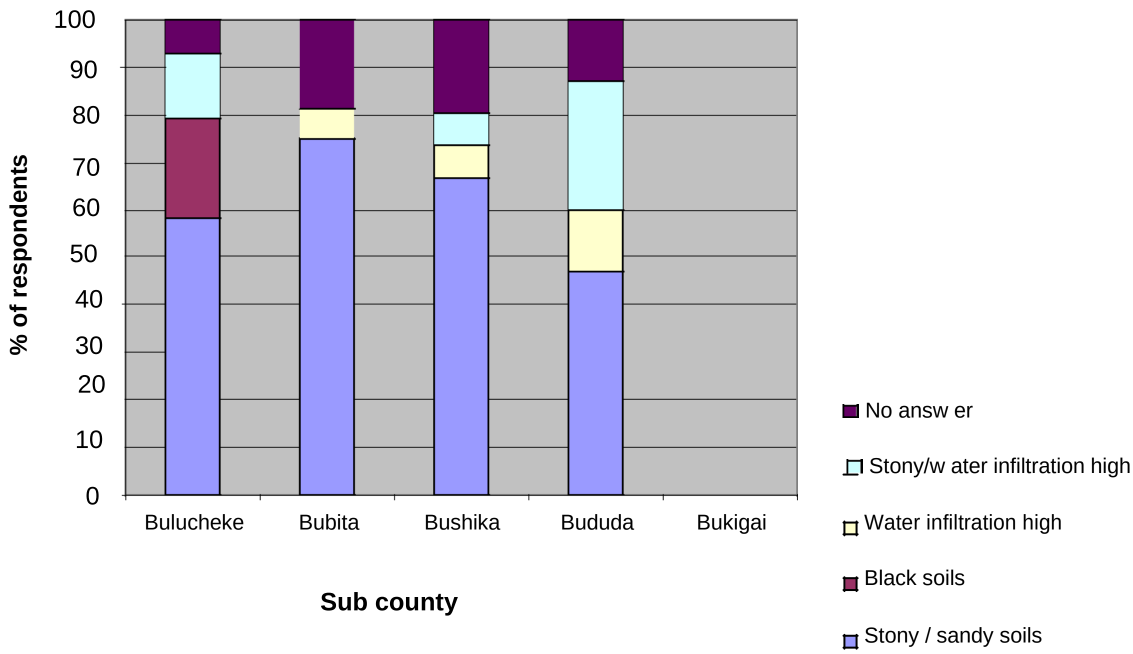

Figure 3. Characteristics of soils with landslides.

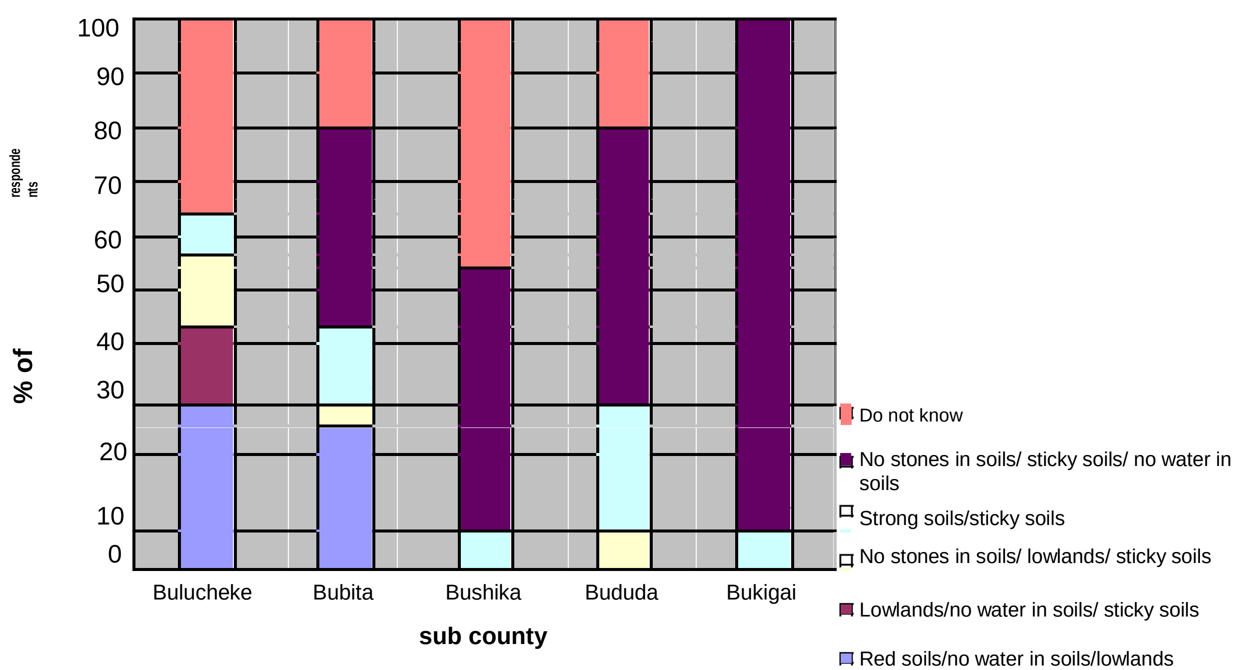

Figure 4. Characteristics of areas without landslides.

disastrous is low and prolonged for many hours (Figure 5). In Bubita and Bulucheke where landslides are very common, more farmers can differentiate the type of rainfall as compared to those in Bududa and Bushika, where they are less common. Rainfall records in the landslide years are not available, so it is difficult to compare the farmer's observations with scientific findings. Associations of landslide occurrences and heavy rainfall have been documented by many authors (UNESCO/UNEP, 1988, Westerberg, 1999). Rainfall influences slope stability in many ways. Among these is the wetting of the slope forming material, which increases the ground water table resulting in increased water pressures in the soil. Prolonged rains with a lower

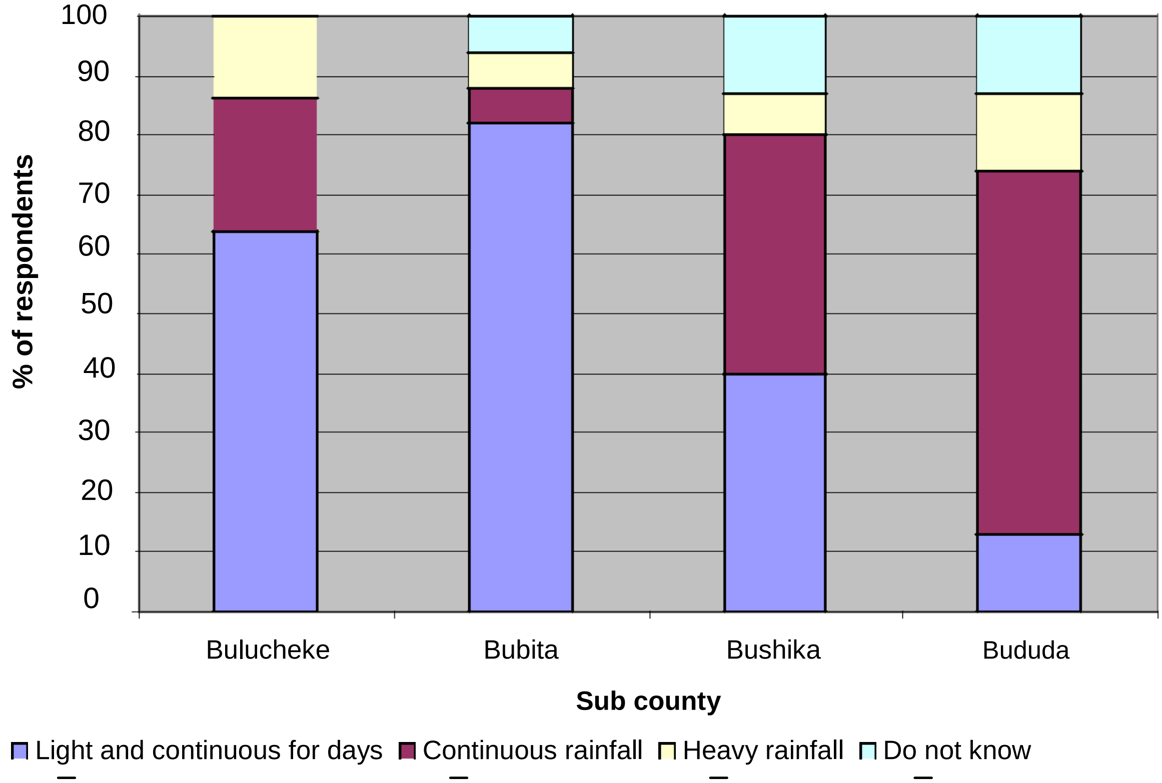

Figure 5. Influence of rainfall type on landslide occurrences.

intensity result in higher and deeper infiltration and lower run-off in sloping areas (Smedema, 1983; UNESCO/UNEP, 1988). High moisture content can increase the specific mass of rocks and at the same time lowers their shear resistance due to increased pore water pressure. Ayalew (1999) further states that, the influence of precipitation is more complicated because landslides are more common when rainfall is continuous and exceeds the field capacity of the soil. Landslides are more likely to occur when high amounts of rainfall are preceded by low but continuous rainfall. In Uluguru, Westerberg (1999) observed that mass movements occur during intense or prolonged rainfall events.

Farmers' observed that most landslides occur during low and prolonged rains, which is similar to the scientific observations. The only shortfall is that farmers cannot get the threshold of the intensities of rainfall that can trigger landslides. One elder revealed that in the olden days, the hunters were able to predict rainfall using one stream from the forests. When there was foam on the water surface, then word would pass around for people to expect landslides which in most cases was true. Scientifically, the farmers were using the water recharge in the stream to predict disastrous rains because foam would appear when the rainfall intensity exceeds a certain threshold. This indigenous early warning system has been long forgotten and the forest has been gazetted as a National Park.

Months when landslides occur

The months of August to November are reported to have the highest number of landslides (Figure 6). This when further analysed, it was found to be in reference to 1997 El Niño period. Dates of landslide occurrence are a problem in all the sub counties because farmers tend to forget and there are no official records. Farmers tend to remember landslides occurrences associated with loss of their relatives. This is set back in the use of farmers experiences in dating landslides. In some years, they would use certain activities such as the circumcision rituals or harvest seasons to associate with some landslides but this was only in the areas of Bulucheke, where there are more frequent landslides. Still, this was applicable to years before the 1970's when these activities followed strict schedules or seasons. Currently, circumcision rituals are performed at anyone's convenience and also due to climate variability, the harvest seasons vary. In areas with less frequent landslides such as Bududa and Bushika, only the 1997 to 1999 landslides were used to mention the months and these occurred from May, July, August to November.

Influence of slope undercutting

Under cuttings refer to excavations made in the slope

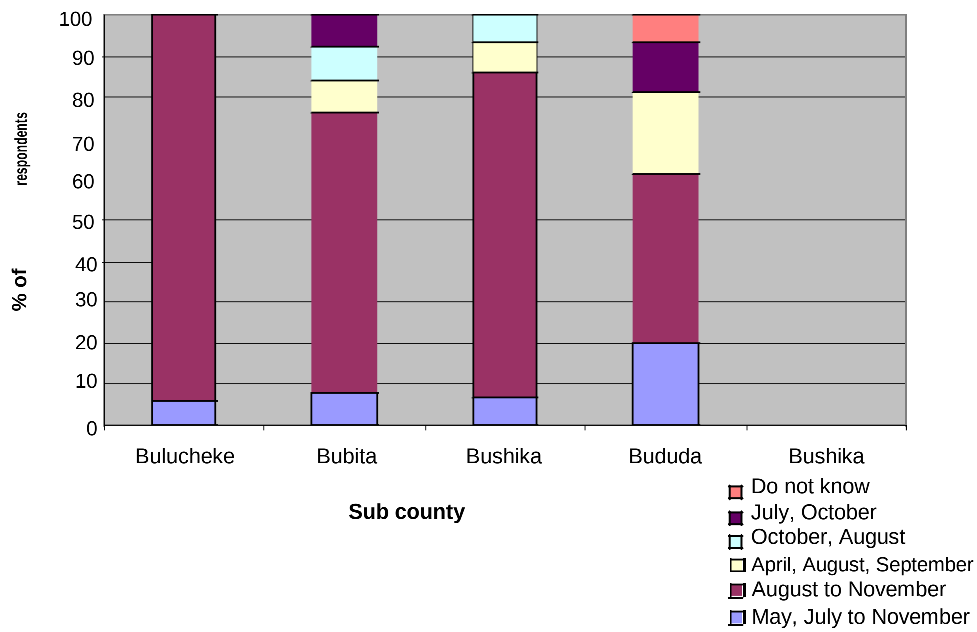

Figure 6. Months when landslides occur.

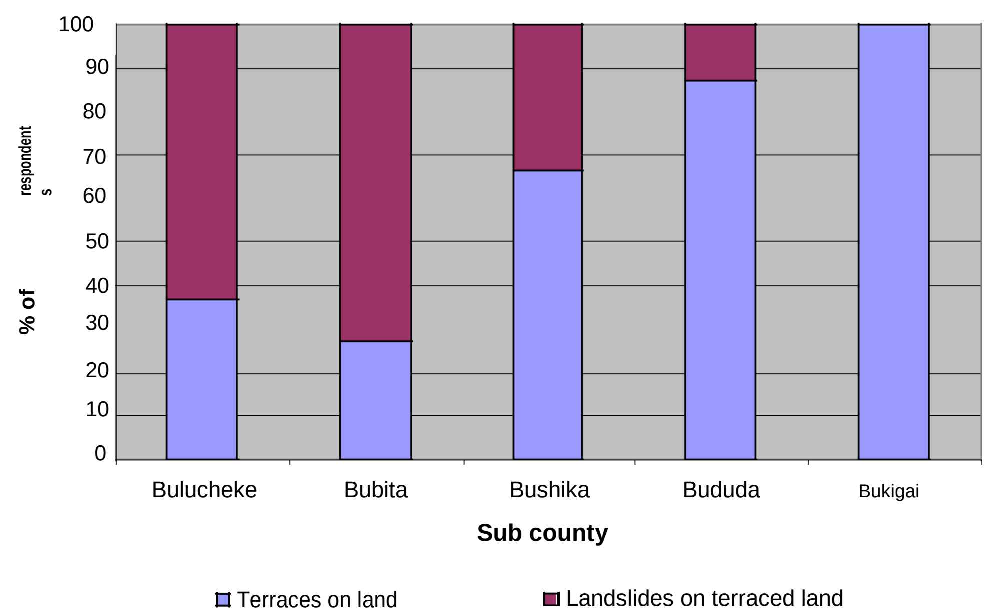

Figure 7. Influence of terraces on landslides.

such as terraces or flat areas made on slopes for house construction. Terraces are most popular in Bukigai, Bududa and Bushika (Figure 7). The main reasons why they are unpopular in Bulucheke and Bubita are fear of landslides (Figure 8). The regulations for the management of mountainous and hilly areas in Uganda were gazetted in 2000. Among the recommendations given for soil conservation when cultivating steep slopes above 150 are building of terraces, contour cultivation, crop rotation and agro-forestry. In Bulucheke and Bubita, farmers believe terraces cause landslides. According to FAO (2000), it is observed that retention terraces, also called absorption or level terraces (Morgan, 1986), which are designed to accumulate and retain runoff in the terrace channel, so that it eventually infiltrates and the sediment accumulates. These terraces are recommended for low rainfall areas, permeable soils, and for land of less than 8% slope. Bududa is hilly and has high

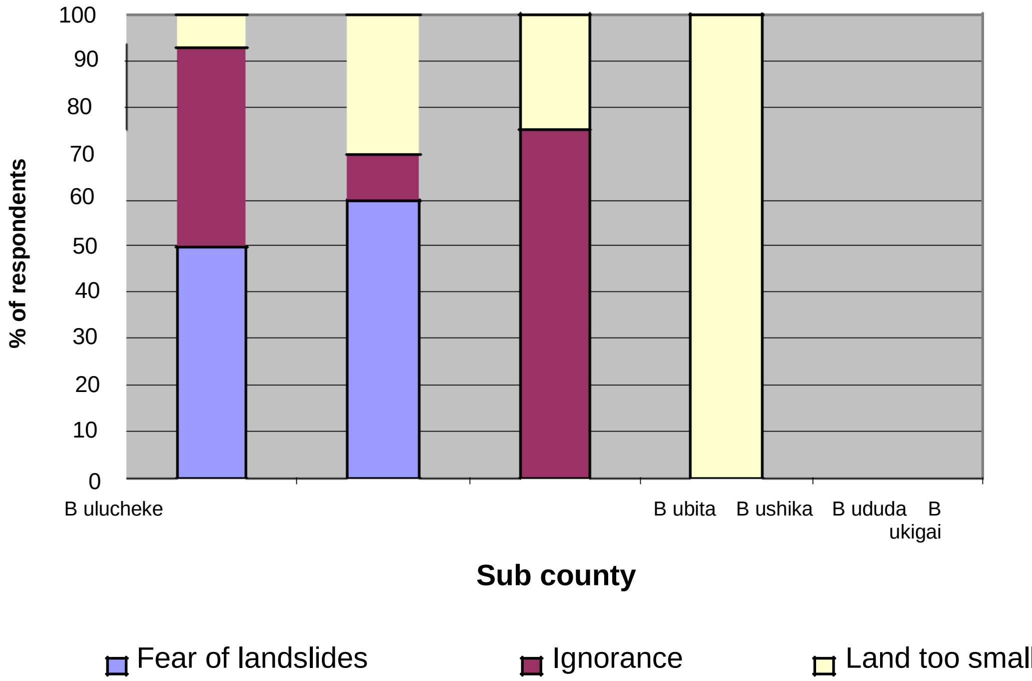

Figure 8. Reasons why terraces are not made on their land.

rainfall, a reason why terraces cannot be good for conservation and hence are rejected by farmers. Similarly, Westerberg (1996) in the Nyandaura ranges found that, construction works and soil conservation structures caused landslides. Furthermore, Temple (1972) observed in Tanzania that, the construction of bench terraces was inappropriate because the topsoil was too thin, so that the construction exposed the infertile subsoil. In addition, the bench terraces hold back too much water and induced landslides. Luuk and Freddy (1997) recommend that, if terraces are necessary to protect an area, a study should be carried out on the nature of the soils which should be the case for Bududa.

Many farmers in the sub counties accept that houses are constructed on steep slopes (Figure 9). House construction involves creating a flat surface on the slope, which disrupts the slope and forms a hanging wall without support (Figure 10). During seasons of intense rainfall, the soil above the slope of the house collapses on the houses. This was very common in Bulucheke and Bubita in 1997.

Losses from landslides

Losses have occurred from these landslides but the question is "Do farmers realise it as a problem"?. Loss of life was reported only in Bubita (Figure 11) which is in agreement with a report released in 1999 by the Member of Parliament. In this report, out of 48 people killed, 43 were from Bubita subcounty. The highest percentage of farmers from all the sub-counties reported loss of bananas and coffee farms and the highest losses were in Bulucheke and Bubita. The loss in monetary terms was estimated from the farmer's annual income before the landslides (Figure 12). In the entire sub counties except for Bukigai where no landslides occur, farmers have reported losses in their incomes and this is due to losses of banana and coffee farms. Coffee is a traditional cash crop introduced in the 1930's and it is intercropped with bananas for food. Bananas are crops that need a lot of water and they grow on concave slopes which are also areas where water concentrates and therefore vulnerable to landslides. Landslides caused a lot of damage to infrastructure such as roads and bridges but farmers do not mention this as a problem. In 1997 to 1999, it was costly to open the roads and also reconstruct bridges. Farmers do not see this as a problem because they are more concerned with problems that concern them as an individual and damage to roads is viewed as a concern of political leaders.

In 1997, ten thousand people were reported to be landless and displaced by landslides and by 2004 the figure had risen to fifteen thousand (Kitutu, 2004). This was alarming in a way that, landslides had to be taken as serious effect on the livelihood of the people. This survey was to assess the problem of land scarcity and also its causes. The high number of people without land were in the sub counties of Bududa, Bushika and Bulucheke (Figure 13) . High population and selling of land was singled out as the main causes of land scarcity (Figure 14). It is only in Bududa, Bubita and Bulucheke where a

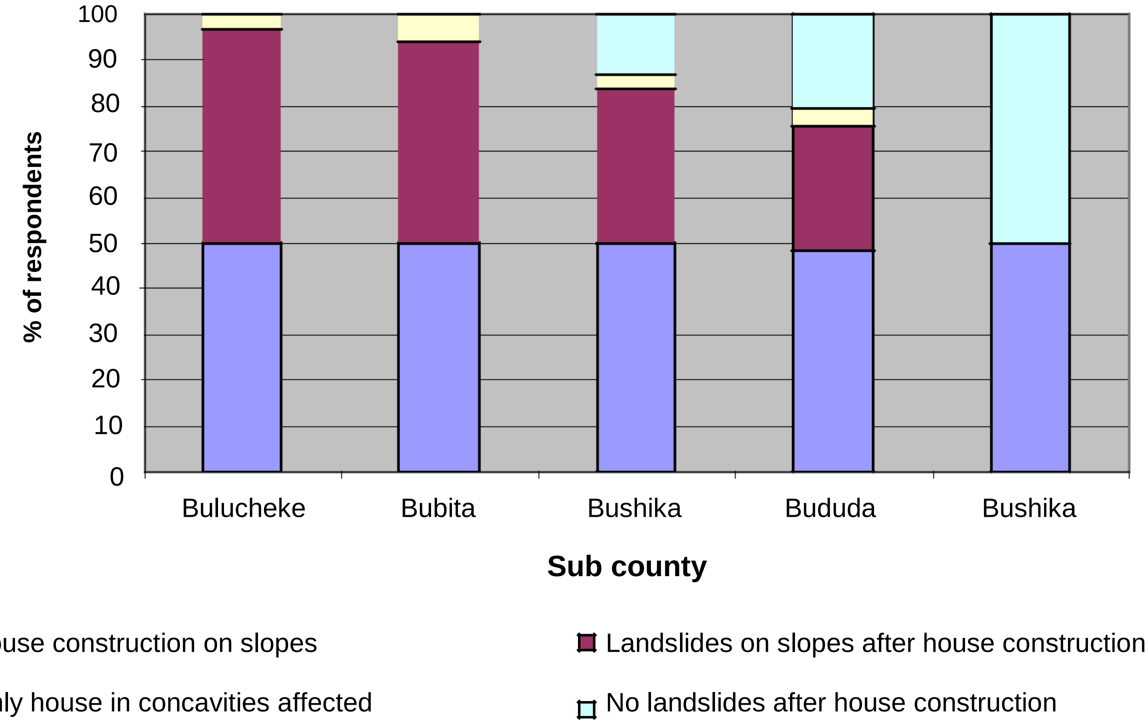

Figure 9. Influence of house construction on slopes on landslide occurrences.

Figure 10 A. Landslide due to house construction. Two children were killed in 2007.

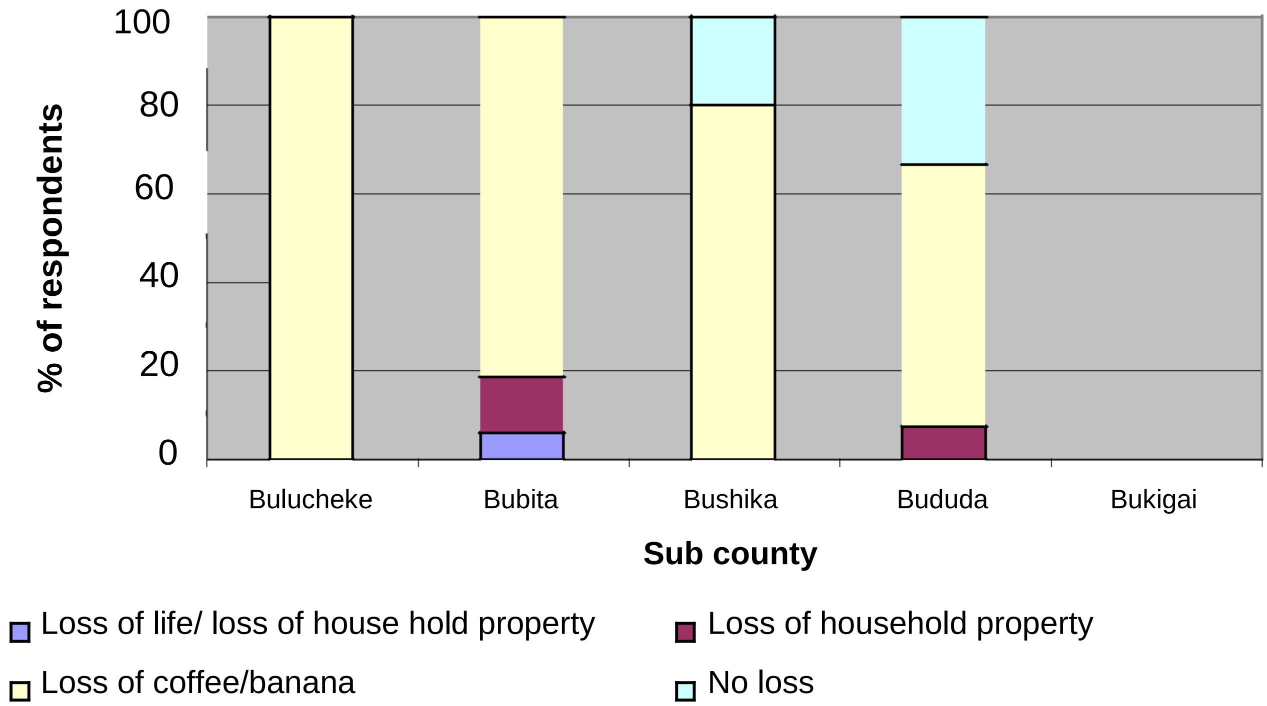

Figure 11. Loss from landslides.

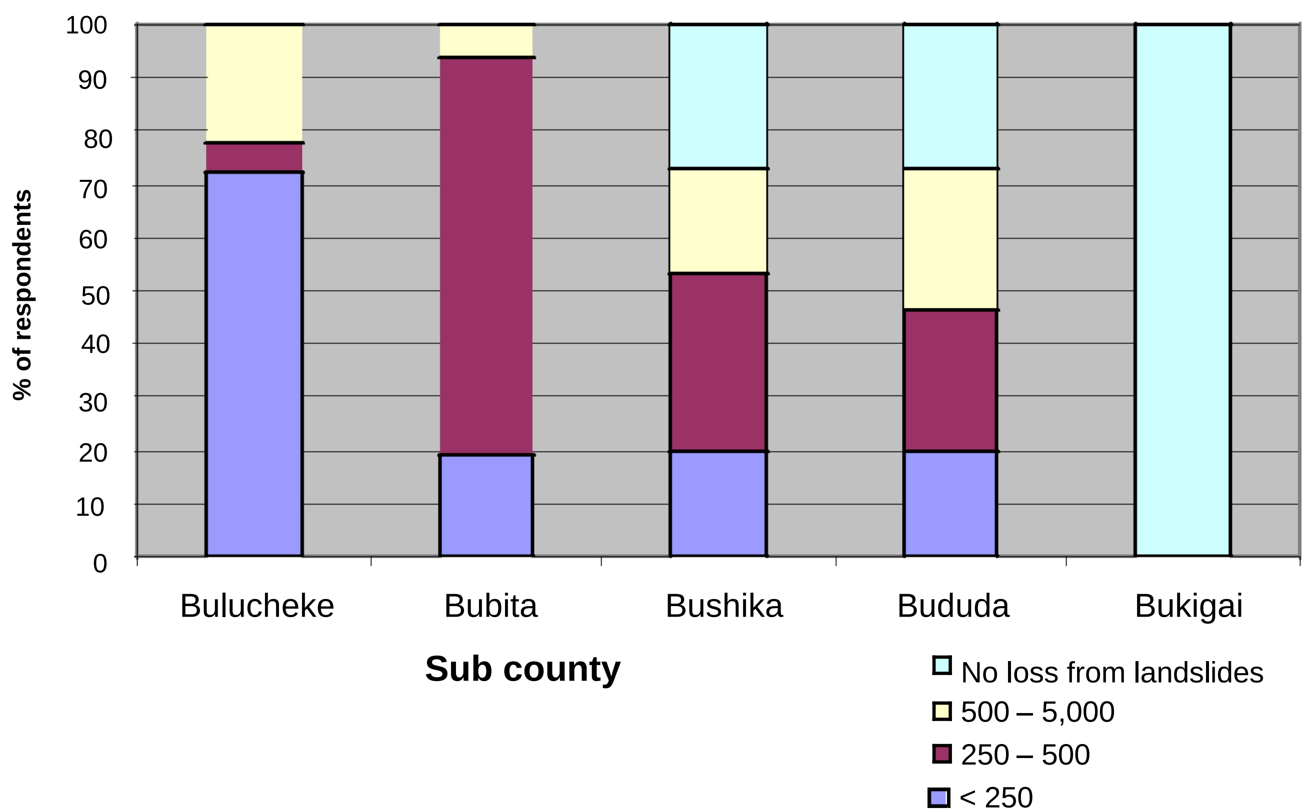

Figure 12. Loss in Monetary terms US dollars ($) .

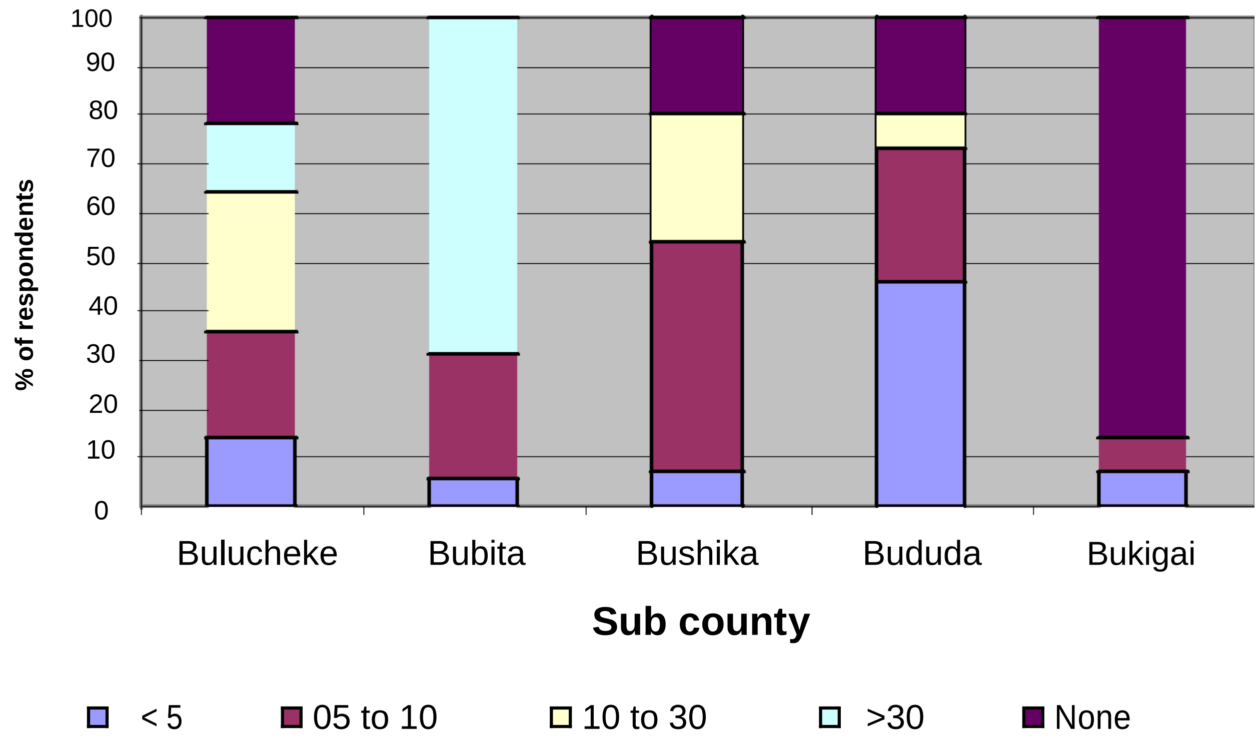

Figure 13. People who are landless.

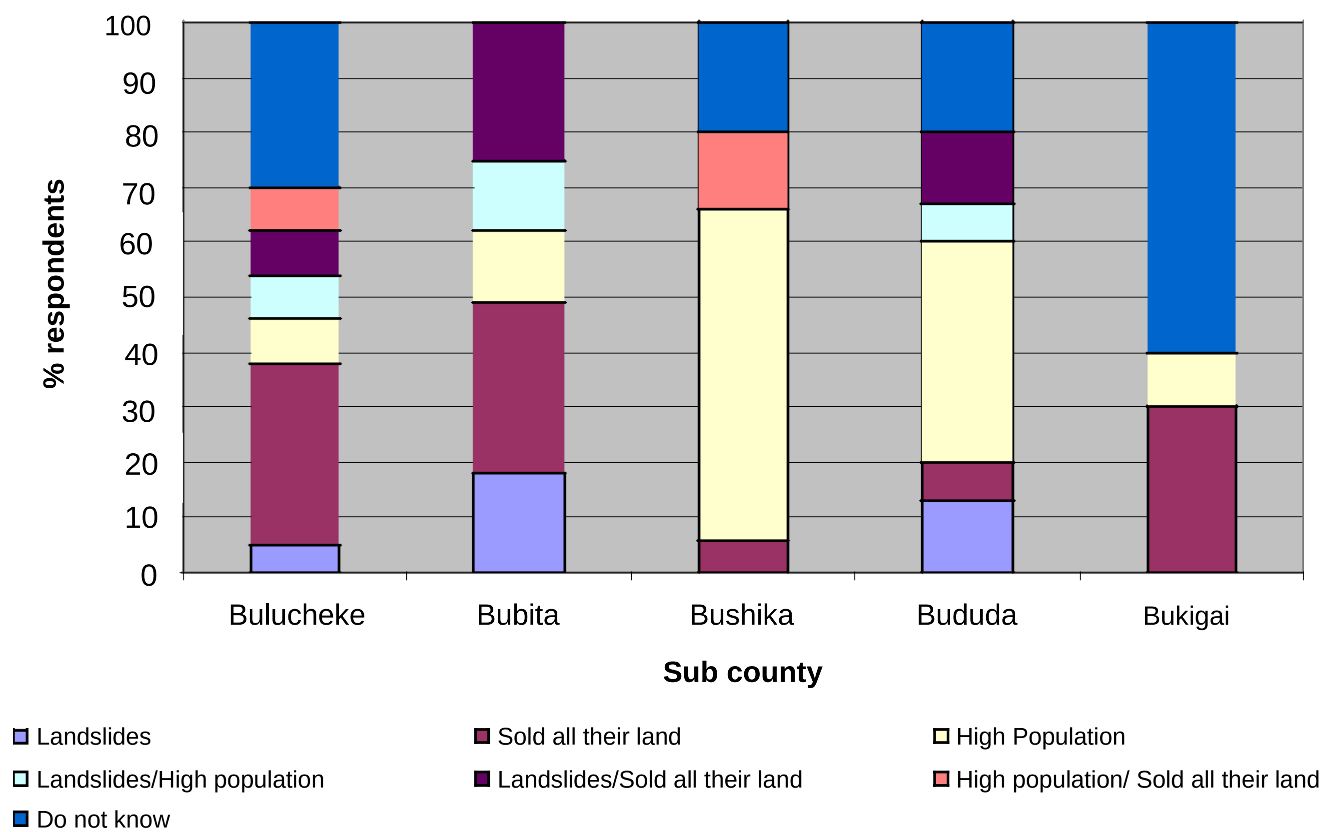

Figure 14. Reasons for having no land.

small percentage mentions landslides (Figure 13).

Conclusion

The experience with the farmers on landslide problems is that, exploring and understanding local knowledge from the perspective of the holders of that knowledge is a challenging task and a learning process. One has to acknowledge the diversity of the individual accounts of farmers with regard to their experiences and linkages of landslide occurrences to factors such as terrain, soil characteristics, water movement and rainfall patterns and types. Farmers have the ability to observe and draw conclusions on the causes of the landslide disasters.

For example, they choose to avoid certain conservation methods such as terracing because it promotes landslides. Rejecting certain methods show that the farmers have an insight in promoting what is good for their surroundings. However, they have limitations especially in predicting the thresholds such as terrain and rainfall characteristics. This then calls for integrated approach to merge the knowledge from science with the farmer's experiences. The main conclusion is that farmers have a rich diversity of knowledge which should be used to enrich the scientific findings.

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