International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 733-737 www.ijaem.net ISSN: 2395-5252

(A Systematic Review of landslide Disaster and Assessment of their Susceptibility in Rulindo District)

E.Hategekimana*, Dr C Mupenzi, J.Ndayambaje, E.Mujanama

Faculty of Environmental studies, University of Lay Adventists of Kigali (UNILAK),Kigali,Rwanda

Date of Submission: 05-04-2023 Date of Acceptance: 15-04-2023

ABSTRACT: This research paper is about a Systematic Review of Landslide Disaster and Assessment of their Susceptibility in Rulindo District. The main objectives of this study is to analyse the landslide damage and its susceptibility in Rulindo District. The study focuses on three Sectors (Bushoki, Cyungo, Kisaro) in Rulindo District as it is one of the mountainous areas in particular which resulted into a great number of life losses, property damages and environmental degradation in localized areas by those landslides' events. The specific objectives are: the assess the household's landslide damages in the district, the identification of areas which are susceptibility to the landslide in the district, to recommend landslide hazard mitigation and prevention measures in the district.

This research will be significantly benefits to MoE, MINEMA, MINALOC, community, different institutions. During this study, field surveys (Primary data) and secondary data sources will help to identify the damages and losses caused by landslide disaster and produce susceptibility landslide area maps. The survey was conducted with 388 randomly selected household using lists obtained from statistical agent at Sector level. Both quantitative and qualitative data from households were collected using structured questionnaires. The questionnaire and interview guide will be used during field surveys where these will be used to provide further explanations regarding the damages, the landslide prevention and mitigation measures, the level of awareness of households, the time of occurrence, prevention measures to prevent landslide, identification of prone areas to landslides, the quantitative will be summarized and categorized in tables, percentage and frequencies will be computed using appropriate softwares (the Statistical Package for social Science (SSPSS 16.0) Lastly, the Geographic Information System (GIS) will be used to produce the maps of area with their levels of suscessibilty to landslide risks. The findings of results show that the household interviewed most of them are male 231 (59.5%), majority completed primary 240 (61.86%), household respondents are aged ranked between 40-50 (39.17 %), the majority of household during landslide disaster lost chickens 288 household (74.22%) and 191 households (49%)their maize crops damaged by landslide disaster. Furthermore, Sectors had the area with susceptible to the landslide, among of three Sectors Bushoki and Cyungo Sector has more area susceptible to the landslide due to heavy rain and has steep slope from 1,348 to 2,341 m and NDVI is ranged from 0.8479 and 0.2278. This study had the recommendation to the Government, the development partners, the local authorities.

Key keywords: Landslide, Disaster, Landslide Susceptibility

I. INTRODUCTION

In this paper the downward movement of masses of rock and soil is landslide. They are caused by one or a combination of the following factors: change in slope gradient, increasing the load the land must weathering of shocks bear, shocks and vibrations, change in water content, ground water movement, frost action, removal or changing the type of vegetation covering slopes. Landslides are therefore requiring extensive soil datasets and they proved not appropriate for large areas or where there is little data (Chen et al. 2017c). The examination of the existing literature related to the disasters will be done but among the greatest deadly natural hazards throughout the world (Chen et al. 2018a; 2018b). The landslide disaster induces the losses and fatalities are

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 733-737 www.ijaem.net ISSN: 2395-5252

continuously numerous.The human activities and climate change are most pvovoke the landslides (UNISDR 2016).

These are consequently very common in most countries especially in mountainous areas.

T0 put in place strong and appropriate measures to control and minimize all impacts induced by landslides is requires. The area mapped with their occurrence to the landslide is how to deal with landslide disaster. The landslides are mainly triggered in mountainous and steep regions in prolonged period of intense rainfall events (Godt et al. 2008; Valentino et al. 2014). Some models proved rather promising approaches in modelling landslide susceptibility such as deterministic models though particurality will attribute to review landslide and its susceptibility in Rwanda, Rulindo District.

I.1. T**he Objectives of the Research**

I.1.1 General objective

The general objective of the research is to analyze the landslide damage and its susceptibility in Rulindo District.

Specific objective

To assess the household's landslide damages in the District

To identify areas susceptibility to landslides in the District.

To establish the relationship between household's damages and susceptibility areas.

I.1.2 Specific objective

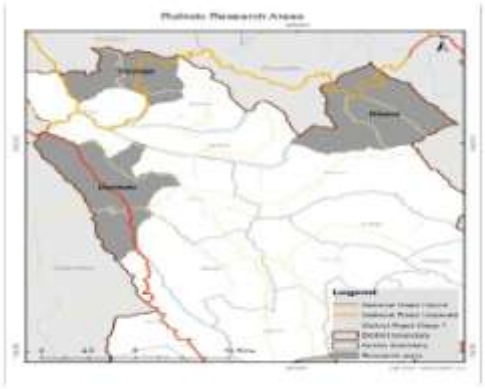
To assess the household's landslide damages in the District

To identify areas susceptibility to landslides in the District.

To establish the relationship between household's damages and susceptibility areas.

II. MATERIAL AND METHODS

This study was conducted in 3 Sectors (Bushoki,Cyungo and Kisaro) of District. The researcher used the questionnaire and interview to gather the required information. The researcher selected respondents purposefullyaccording to the affected area in 3 sectors of Rulindo District.The interview guide was used for the sample size taken randomly among the community in the most affected areaof Rulindo District.



In this research the Arc GIS 10.0 was used toidentify areas susceptibility to landslide, the following steps was used: historical landslide and field visit, data preparation (rainfall, land cover, data on soil) stage, Digital Elevation Model was used to found the elevation and slope, Landset8 was used land cover Land Use (LCLU), Meteological data was used to found the mean rainfall.

II.1 The sample size

To determine tha sample size the following formulae was used:

$$n: \frac{N:}{1+N\,(e)^2}$$

Thus the sample size was:

$$n: \frac{12{,}078}{1+ 12{,}078\ (0.05)^2} : 388$$

To determine the sample size for each Sector the following formulae was used:

$$ni: \frac{Ni*n}{n}$$

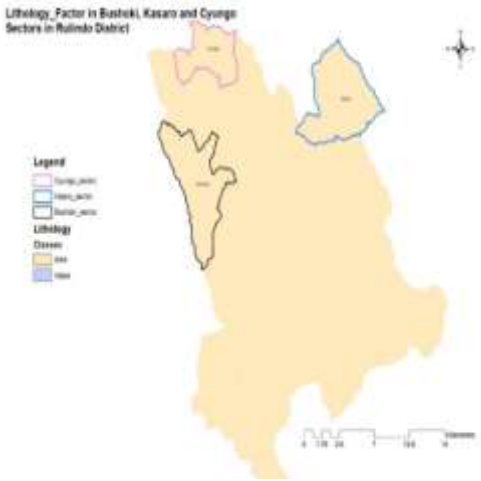
Sectors	Total households	Sample size
Bushoki	4537	145
Cyungo	3057	99
Kisaro	4484	144
Total	12,078	388

The findings of the study showed that many households lose chickens (74.22%), secondly household 49.84 % their beans damaged by landslide, thirdly 44.84 % household lost cows, Fourth, 40.20 % loses the goats, 34% of household loses pigs, 30 % of household their maizecrop have been damage, 30% of household lost their houses and 28% and 26 % household their crop were damaged respectively patatoes and vegetables.

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 733-737 www.ijaem.net ISSN: 2395-5252

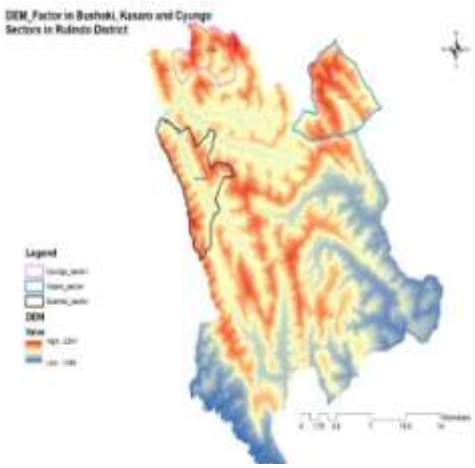
The study showed that the household with proportion of 35.6% confirmed that the causal factors of landslides is the slope, 30.9% household said that the causal factor of landslide is heavy rain, 10.3 % of houssehold said that the cause of landslide is non land cover representing and infrastracture with non-measures harversting water presents 24.7 % of household, resulting from human activitiessuch as building development, changing in vegetation cover lead to higher water saturation in soil reducing the strenght of the soil.

The study showed that 42% of households interviewed confirmed, radical terraces are the most appropriate measures of landslide metigation, 42 % of households interviewed confirmed planting trees is landslide metigation measures, 37.4% of households confirmed that digging trenches are landslide metigation measures, 10.8 %of households, interviewed confirmed ressetle in model village as interventions measures of landslide



Lithology factor in Bushoki, Kisaro and Cyungo Sectors in Rulindo District

The figure above showed the lithology factor of Rulindo District in the Sectors in study area. Data showed that the three Sectors are largely dominated by MA4 (Mineral and Organic soil type) soil type that has a moderate level in terms of landslide susceptibility. The tree Sectors have the same lithology which is dominated by MA4 while water covers the smallest surface. Based on these data we can see that the three Sectors such as Bushoki, Kasaro and Cyungo are affected equally by landslide.

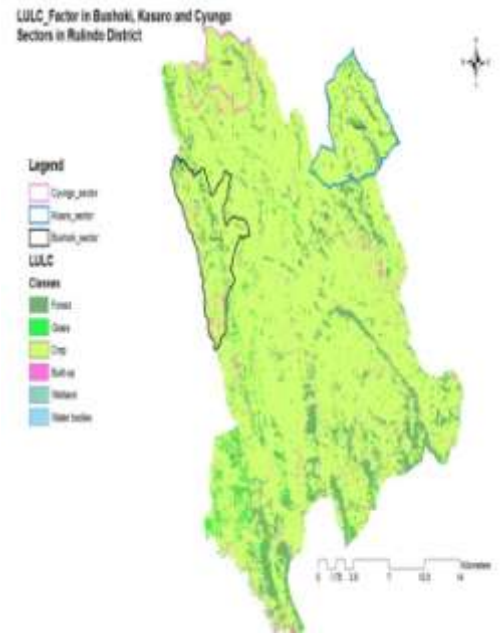


The Rulindo digital Elevation Model presented here above expresses the District land surface morphology. It varies from 1,348 to 2,341 which defines the high slope steepness of the District that in turn has a huge impact on landslide. Cyungo and Bushoki are the steepest Sector when compared to the other two Sectors, which implies its high susceptibility of landslide. Because of the high slope observed in the three Sectors, their land should be covered by dense vegetation to prevent landslide and soil loss in the area.

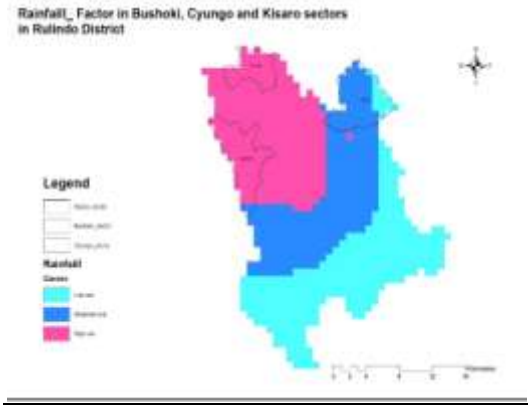
III. LANDSLIDE IN RULINDO DISTRICT

Landslide in Bushoki Sector

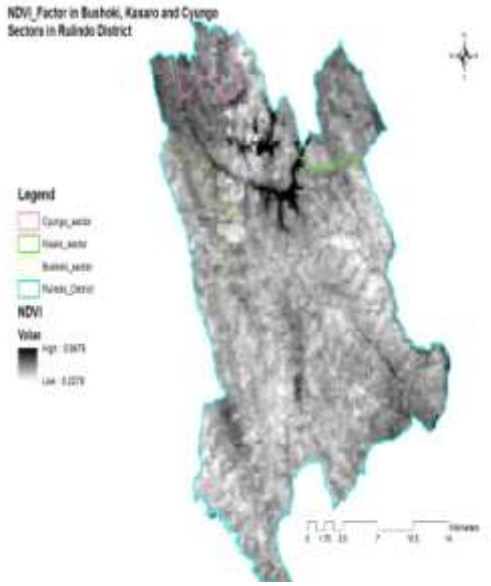
International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 733-737 www.ijaem.net ISSN: 2395-5252

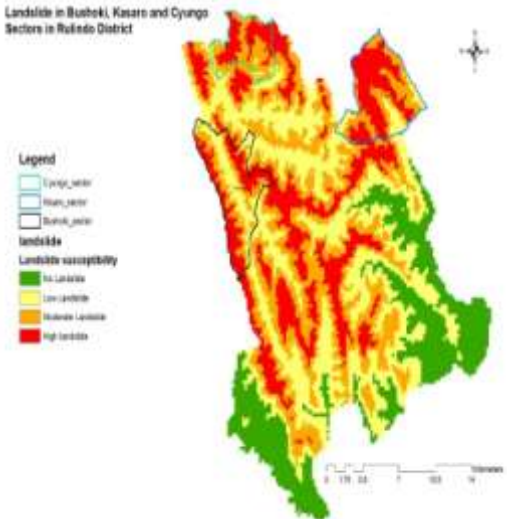


The land use change is the main anthropogenic factor, the natural hazard factor heavy rains, deforestation, land use change, climate change, etc,) and anthropogenic activities.



This figure showed that in Bushoki and Cyungo Sector there was heavy rain, rainfall is one of those factors that have been found to trigger landslides because high rainfall events result in high water saturation in soils reducing the strength of the soil. Increase in water content increases pore water pressure. The influence of precipitation is even more complicated because landslides





This figure described the NDVI of the study area. As displayed in the figure, NDVI varies from 0.2278 to 0.8479. More the NDVI is closer to 1, more the land or soil is less vegetated. This shows that Bushoki sector is highly vegetated with its NDVI closer to 0.2278, while Kisaro and Cyungo sectors are moderately vegetated with their estimated NDVI of 0.523. This means that high lindslides can be observed in Kasaro and Cyungo sectors than in Bushoki sector

The landslide Susceptibility map of Bushoki, Kisaro and Cyungo the colours are used to categorize the area risk to the landslide by using the following colours green, pink yellow, yellow and red, the green whowed the area with stability, pink yellow with low risk to the landslide, yellow

International Journal of Advances in Engineering and Management (IJAEM)
Volume 5, Issue 4 April 2023, pp: 733-737 www.ijaem.net ISSN: 2395-5252

represents the area with moderate risk to the landslide and red high risk to the landslide.

IV. SUMMARY OF RESULTS, CONCLUSION AND RECOMMENDATION

IV.1 Conclusion

The result of this study showed that the majority of household of Bushoki, Kisaro and Cyungo 74.22 % lost the chickens, 44.84 % lost the cows, 49 % of households agriculture and infrastructure development cause rapid Land Use Cover Change. increases the trends in landslides disaster confirmed that their maize crops were damaged by landslide, 30% of households their house were destroyed due to the landslide. The analysis of landslide factors showed that the Digital Elevation Model was arranged from 1,348 to 2,341 m which defines the high slope steepness of the Distict that in turn has a huge impact on landslide, the rainfall factor showed that Bushoki and Cyungo received heavy rain and it found that in those Sectors the trigger landslides, the analysis of NDVI varies from 0.2278 to 0.8479. More the NDVI is closer to 1, more the land or soil is higher vegetated. This shows that Bushoki sector is less vegetated with its NDVI closer to 0.2278, while Kisaro and Cyungo sectors are moderately vegetated with their estimated NDVI of 0.523. This means that high landslides can be observed in Kasaro and Cyungo sectors than in Bushoki sector. The perception of households to the intervention's measures of landslide mitigations, 42% of households interviewed confirmed that radical terraces are the most appropriate measures of landslide metigation, 42 % of households interviewed confirmed that planting trees were landslide metigation measures, 37.4% of households confirmed that digging trenches were landslide mitigation measures lastly, 10.8 % of households interviewed confirmed ressetle in model village as interventions measures of landslide.

V. RECOMMANDATION

To enhance, to omprove metigation measures concern the area under risk the, Ministry of Environment and other institutions must mobilize the funds to differents partners, the active participation is required and availing the map showing the area risk to the landslide To mobilize the household und risk zone to landslide to shift that area to place with non-risk to landslide, to ensure that the households are put in place the measures of landslide metigation in their community, household should emphasize on improving the knowledge about the landslide disaster to be more affective and efficiently.

Buildclimate resilience of vulnerable households, promote the mitigation measures radical terraces, progressive terraces, land planted with protective forestry (river banks, roads, gullies.) Planting agroforestry, to cope with disaster, to a large extent,minimizes theirvulnerability and susceptibility to an exposure

REFERENCE

[1]. Lamek N. et al P1-14, 2018, Spatial Distribution of Landslides Vulnerabilityfor the Risk Management in Ngororero District of Rwanda;

[2]. Nahayo, L., C. Mupenzi, A. Kayiranga, F. Karamage, F. Ndayisaba, E. M. Nyesheja, and L. Li. 2017. Early alert and community involvement: approach for disaster risk reduction in Rwanda. Natural Hazards 86 :505- 517;

[3]. Nsengiyumva, J. B., G. Luo, L. Nahayo, X. Huang, and P. Cai. 2018. Landslide susceptibility assessment using spatial multi-criteria evaluation model in Rwanda. International journal of environmental research and public health 15 (2):243;

[4]. Nahayo, L.; Mupenzi, C.; Kayiranga, A.; Karamage, F.; Ndayisaba, F.; Nyesheja, E.M.; Li, L. Early alert and community involvement: Rainfall-Induced Landslide Prediction Using Machine Learning Models: The Case of Ngororero District, Rwanda;

[5]. GoR,2018, National contingency plan for floods and landslides, Kigali, Rwanda;

[6]. GoR, Rulindo District Development Strategy (2018-2022), Kigali, Rwanda

[7]. UNILAK, Prof. Professor Jacinta Agbarachi Opara,PhD, 2020, Research Methodology note, Kigali, Rwanda.

[8]. The Use of Remote Sensing to Map Landslide Prone Areas in Makhado Municipality of Limpopo Province, South Africa, University of Venda, School of Environmental Sciences, Private Bag X5050, Thohoyandou, 0950, Limpopo, South Africa P2-6

[9]. Landslide Susceptibility Assessment Using Spatial Multi-Criteria Evaluation Model in Rwanda Jean Baptiste Nsengiyumva 1,2,3, Geping Luo 1,2, *, Lamek Nahayo 1,2, Xiaotao Huang 1,2 1and Peng Cai 1.