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ANALYSIS OF PARTICIPATORY DIMENSIONS OF LANDSLIDE DISASTER AND RISK MANAGEMENT IN SOME RURAL COMMUNITIES OF SOUTH EASTERN NIGERIA

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Abstract: Landslide disaster is increasingly receiving severe attention because of their devastating effects on the environment and people's economic interests despite the mitigative efforts made by stakeholders to minimize their impacts. The study assesses the effectiveness of several interventions to reduce the adverse effects of landslides in parts of southeastern Nigeria. Data were collected from purposively sampled locations, including Boki, Obanliku, Calabar and Biase in Cross River State, using a questionnaire survey, participatory rural appraisal, field inventory and measurement. The study used both descriptive and inferential statistics for data analyses. Results revealed that climate change and human activities were the primary causes of landslides attracting 98% and 95%, respectively. Results further show that landslide occurrence has significantly affected socio-economic activities in the areas and is the primary cause of biophysical degradation. Also, the study indicated that the efforts of various stakeholders in terms of financial support (65%), building materials (60%), and food items (64%), were not yielding sustainable results. The one-way analysis of variance of the results of stakeholders' involvement in landslide risk reduction measures shows an F-ratio of 2.02, which is less than the calculated value of 2.87 at 0.05 levels of significance. Therefore, there is no statistical difference in the effectiveness and commitment of stakeholders. Furthermore, the empirical results obtained from ANOVA on the efficacy of landslide risk reduction measures produce an F-ratio of 1.171, which is less than the tabulated value of 2,69 at 0.05 level of significance. This result confirms that the effectiveness of landslide reduction measures across the sample communities does not vary significantly. This implies that all the respondents gave an almost equal rating of the risk reduction measures. It is recommended that environmental awareness activities be promoted, and human activities that are likely to enhance occurrence in vulnerable areas should be discouraged.

Keywords: Landslide, Participatory, Occurrence, Risk management, Disaster, Nigeria.

1. INTRODUCTION

Landslide is a geological phenomenon with widespread damage to the landscapes. Their effects are increasing due to expansion in development and rapid population growth. Recently, landslide occurrence frequency seemed to be rising and had gained momentum due to climate change (Fowze et al., 2012). According to Spiker & Gori (2000), the landslide trend will persist, and its consequences will continue due to changing climate patterns, expansion of transportation infrastructure, development in our areas, and deforestation of landslide-prone areas. Landslides occur in all landscapes of the globe due to various circumstances and triggering mechanisms, such as earthquakes, storms, and human activities. Despite scientific and technological advancements in prevention, landslide disasters continue to cause human

misery, environmental harm, and property loss.

As the population grows out of control and civilization gets more sophisticated, the economic and social consequences of landslides and other ground collapses continue to skyrocket unmanageably. A report from the National Research Council (2004) and a survey conducted by De Graff et al., (2016) revealed that landslide risks in the United States kill about 25 to 50 people and cost about $1 to $3 billion annually. It also causes much damage to the environment and aggravates social problems. However, Spiker & Gori (2000) observed that most landslides' losses accrued from numerous widespread events. Thousands of these could be ignited by earthquakes and intense rainstorms, which might cause spectacular damage in a short time. For instance, they noted that the United States had experienced many landslide disasters lately. However, the 1997–1998 El Nino rainstorms in the San Francisco Bay region resulted in hundreds of landslides, resulting in over $150 million in direct private and governmental costs.

Global estimates of landslide impacts revealed that in 1992, 1.3 million casualties happened, adding to 4.4 billion other people affected; more economic loss of about US$2 trillion, and between 1998 to 2017, landslides directly affected an estimated 4.8 million people and likewise caused over eighteen thousand deaths (Chen, 2022; Schuster & Highland, 2007; Senanayake et al., 2022; Von Einsiedel et al., 2010). For example, it is estimated that 2.2 billion residents in China were affected by various forms of disasters, while Haiti, one of the most vulnerable nations across the globe, recorded approximately 230,675 deaths in a landslide event (Alam & Ray-Bennett, 2021; Dewan, 2015; Sarker et al., 2022). In a study by Baum & Johnson (1996), it was observed that the damage associated with landslides has become increasingly costly as development in urban areas has advanced more and more on hillsides.

Landslide causes several indirect (which are more difficult to quantify, contain loss of tax revenues, business disruptions, lower property values and productivity, and legal damages) and direct costs (contain the damage to buildings and properties) to society. Similarly, indirect costs usually surpass direct costs, and most of the economic loss experienced is borne by government agencies in the affected communities (Sarker et al., 2022; Senanayake et al., 2022; Spiker & Gori, 2000). The landslide occurrences are rapidly disturbing, with significant adverse consequences on infrastructures, lifelines including fuel and energy conduits, transportation corridors, and communication linkages like roads, railways, bridges, electric, pipelines, and communication lines. Recent reports on landslides showed that in 2015, a landslide at an industrial park in southern China left about 27 people missing and buried more than 20 buildings. In Rio de Janeiro, Brazil, about 610 people died. In India, it was estimated that 24 people were killed in 2014. In Nigeria, studies on the effects of landslides are skeletal. However, for an extended period and until now, landslides associated with gully erosion have destroyed several houses, properties and lives in Agulu, Anambra State. In 2016, landslide occurrences in Katsina State killed four persons, and several properties were lost. A few studies in Cross River State, southeastern Nigeria (Igwe et al., 2015; Akpan et al., 2015, 2016; Efiong et al., 2021; Nneji et al., 2021) indicated that landslides destroyed farmlands, buildings, schools, and infrastructures.

For several decades, many stakeholders, including governments, non-governmental organizations, donors, and local communities, have been grappling with understanding the processes and impacts of landslides to reduce hazards and risks. According to Baum & Johnson (1996) and Akpan et al., (2015), many people have neglected landslide risk for several reasons, such as unawareness of the increasing danger of landslides, having other priorities instead of tackling landslide hazards, inadequate economic and technological resources to develop landslide risk reduction programs in their areas and lack of local capacity to respond to and address landslide risks. However, Spiker & Gori (2000) noted that in order to attain the goals of reducing the casualties from landslide risks, there is a need for a more comprehensive knowledge of landslide occurrence and dynamics, includes a thorough monitoring mechanism to warn of the looming potential of active landslides, an adequate public understanding and awareness of the possibilities and risk for reducing the actions and risk at all levels.

According to Anderson et al., (2008) and Anderson & Holcombe (2013), given the escalating expense of landslides, the problem for local governments is to build institutional structures for landslide risk management that are judged efficient and realistic by those affected. Furthermore, long-term and sustainable approaches to decrease losses associated with landslides and additional ground failures need a national and international commitment from both the private and public sectors. Spiker & Gori (2000) suggested that different arms of government need to provide suitable leadership, support for research, coordination, incentive programs and sufficient resources to motivate individuals, groups, communities, regions, and businesses enterprises to undertake mitigations in order to reduce likely losses and to use mitigation strategies in the recovery from

natural disasters which also includes landslides. The National Research Council (2004) opined those partnerships for minimizing landslide hazards should promote risk analysis procedures in setting standards, evaluating methods, and advancing guidelines and techniques for landslide hazard assessment and mapping. Furthermore, they recommended a substantial increase in funding to implement national landslide mitigation via guidelines, research development, and enhancement of partnership-based implementation of loss decline measures and strategies. However, mitigation of landslides requires understanding landslide impacts facilitated by using research-based thresholds (Chowdhury & Flentje, 2014; Silva et al., 2008).

Landslide disasters and risk reduction need interactive cooperation across the societal borders of the private sector, academics, and the government. For instance, the Asian Disaster Preparedness Centre (ADPC) 2013 recommended empowerment and capacity building as sustainable strategies to ensure the continuation, tenure, and further spread of information about mitigations (Ahmed & Basnayake, 2022; Kitagawa, 2020, 2021; Mavrodieva et al., 2019) They observed that the primary goal of the capacity building approach is to build ownership over solutions that the host communities may likely implement by themselves to facilitate partnership and cooperation between the people and the government. These are meant to raise community knowledge and awareness of certain components, such as landslide hazards, dangers, and preventions. Kitagawa (2020, 2021) and Mavrodieva et al., (2019) noted that community engagement had been acknowledged as an additional component in disaster management, which is necessary to reverse the global trend of the exponential rise and increase in catastrophe occurrence. The local communities are considered the primary emphasis of attention since they are the standard unit affected by catastrophe and, more significantly, the response to the occurrence or event. Also, whether the disaster is significant or insignificant, the people living in the community face its adverse consequences. They often employ several coping and survival methods to face and adapt to the circumstances long before outsiders' aid from non-governmental organizations (NGOs) and government agencies.

In Nigeria, landslide occurrence and disaster issues are the same as in other parts of the world but not given adequate and direct attention, rather subsumed under general disaster management emergency dimensions, which grouped all forms of disaster like drought, flooding, desertification, epidemics, dam failure, coastal erosion, oil spillage, fire, building collapse, Landslide, communal clash, bomb explosion, amongst others as mitigation focus (Agbola & Falola, 2021; Eneyo et al., 2022; Oyinsan, 2012). A few studies on landslide occurrence in Cross River State concentrated on the causes of the Landslide, which could be attributed to impaired percolation at the interface of the rock causing weakness, mechanical transmission of wind (Akpan et al., 2015) and a decrease in slope soil shear strength as a result of high precipitation intensity activities (Ajake, 2015; Eneji et al., 2015; Igwe et al., 2015; Oyinsan, 2012). Efiong et al., (2021) suggested an immediate restoration of the biophysical environment and livelihoods as mitigation measures for landslide hazard victims. Recently, Nigeria has appropriated a significant part of its budget to disaster mitigation and risk reduction, including landslide disasters. Several stakeholders have adopted different landslide risk reduction measures, including financial support, ecological and mechanical methods, and livelihood alternatives. However, little is known about the efficiency of these strategies, especially about the people most affected by the consequences of the disaster in Southeastern Nigeria.

Despite the increasing understanding of landslide processes, the considerable amount of funds expended, and technical progress made toward mitigating its impacts, livelihood activities are still affected whenever landslide strikes. The impacts of landslide disasters on the local communities remain an issue to be resolved. Thus, could this be attributed to piece-meal information, lack of participation of the affected people and non-evaluation of the strategies employed in landslide disasters and risk reduction measures? Although several efforts are made to reduce the risk associated with landslides (Anderson & Holcombe, 2013; Spiker & Gori, 2000), the efficiency of these efforts by the stakeholders, especially in Cross River State, South Eastern Nigeria, is not yet ascertained. Again, the most widely used approaches for landslide mitigation worldwide are limited to slope repairs using rock blankets, boulders, concrete blocks, or other traditional erosion prevention and slope protection and stability (Fowze et al., 2012; Sotir, 1994) and bio-technical slope protection involving bio-technical stabilization and soil bio-engineering stabilization (Ajake & Enang, 2012; Akers & Akers, 2015; Gray & Sotir, 1996). However, the recent economic approach of appropriating funds to landslide victims, provision of building materials, food items, and household utensils and their sustainability are rarely documented in the literature. This study was initiated to assess the effectiveness of the participatory dimension of landslide risk reduction measures in Southeastern Nigeria. It will further investigate and evaluate several intervention measures' efficiency and

stakeholders' efficiency in the area.

2. STUDY AREA

The study area is Cross River State in southeastern Nigeria. The area is positioned between longitudes 7º40'' and 9º50'' East of the Greenwich Meridian and latitudes 4º40'' and 7⁰00'' North of the Equator (Figure 1). The area is about 23,074.43 km^2 and lies within Nigeria's tropical rainforest ecological zone, which is climatically disposed to support forests (Ajake & Enang, 2012; Effiom & Obong, 2013; Eneyo et al., 2022 a, b; Eneyo & Edward, 2018; Eneyo & Ekong, 2019; Igwe et al., 2015; Obong et al., 2012). The mean monthly temperature of the area is between 24.2 and 27.4ºC. The yearly rainfall is between 2000 to 3500 mm. The study areas have an estimated population of about 2,888,966 inhabitants, with an overall population density of 93 per km^2 and an average growth rate of 2.5 (Eneyo et al., 2022 a, b).

The topography of the study falls within the Cross River plains. The relief is gentle sloping except in areas where granite intrusions rise above the immediate environment to a height between 300m and 1500m. Outstanding relief features include the Oban hills, Sankwala Mountains, Obudu Plateau, Mbe mountains, Afi mountain and some gentle undulating plains with occasional hills. The mountains were rocky massifs containing several distinct rock peaks characterised by steep slopes with hanging rocks. The mountains include occasional moderate slopes where human activities have significantly affected the environment and the steep slopes and hanging rocks that characterise the western and eastern axes of the mountain range. The area is drained by the Cross River and several other rivers and streams with steep river banks, especially at the upper courses, including the Cross River and its tributaries that have dissected the landforms. Most notables are the Calabar River, Afi River, Qua River, Ikpan River, Okpon River, Bansara River, and Okwo river, among others. The rivers and streams are potential sources of water resources, which constitute the basis of rural population livelihood (Figure 1).

The rock types are igneous and sedimentary, spread across the study area. The igneous rocks in the area are characterized by heavier soil texture. Most soils are formed by old metamorphic rocks of basement complexes and sedimentary rock formations, ferrasols with free iron oxide and no lateritic iron pan layer. The lithosols are derived from crystalline acid rocks found around the mountainous areas of Obanliku, Boki and Obudu. In contrast, some areas are covered by highly ferruginous soils associated with sedimentary and crystalline rock structures. Other common soils across the study area are acrisols, cambisols and hydromorphic soils. According to Ajake & Enang (2012), the soils are usually made of ferrasols and old metamorphic rocks. In some areas, such as Calabar and Akpabuyo, the soil types are dominated by hydromorphic and sandy soils.

The high forest characterizes the vegetation of the area (which is dominant), mangrove forest, derived or guinea savanna and the montane. The rainforest in the study area is the largest in Nigeria and constitutes the premier Cross River National Park (CRNP). The forest is rich in flora and fauna species. However, the tropical high forest in the area has been significantly altered due to the anthropogenic activities vis-à-vis pave the way for different formations such as primary, secondary, distributed, open, and presumably forest fallows.

The landslide in the area is caused by the sliding and spreading outward of slope materials such as soil, rock, artificial fill, or any combination of these three. These materials move due to collapsing, falling, sliding, or flowing down steep slopes, mountain summits, high cliffs, and slopes cut by rivers. Also, the landslide occurrences in the area are associated with slopes of hilly environments and areas significantly affected by gully erosion. The hilly slopes, when attacked by human activities, removed the vegetation cover, thereby exposing the loosely hanging soils on the steep and fragile slopes to increasing risk of a mass movement, where tons of water were observed carrying mud materials, rock boulders. trees, shrubs, herbs, crops, buildings and other materials to great distances from 1 to 15km away from the point of origin. Thus, the landslides in Agwagune, Buanchor, Ikwette and Ukpe-Alege are influenced by human activities on fragile slopes, while those of Ikot Ansa and Edim Otop, all in the study area, are due to gully erosion that was stimulated by construction work and loose soils (Table 1).

These mechanisms are consistent with Brevik (2002) and Easterbrook (1999) hypothesis that large rocks often initiate debris slides near the mountains' peaks, which start to disintegrate as they tumble down the slope into the valley below. In addition, Schuster & Highland (2007) said that debris avalanches move extremely quickly, and it can be seen that the whole mass liquefies as it travels down the slope. The severe rains and steep slopes in the vicinity have contributed to the saturation of the materials that produced the landslide. The saturation of slopes is the key factor that leads to landslides in the region under investigation. It happens when there is much rainfall, changes in the groundwater levels, changes in the water level along the shoreline, and an increase in runoff. In a broad sense, the slope in the area is more

likely to become prone or unstable to collapse or failure owing to geological elements such as human actions, biophysical processes, and morphological features occurring in the area.

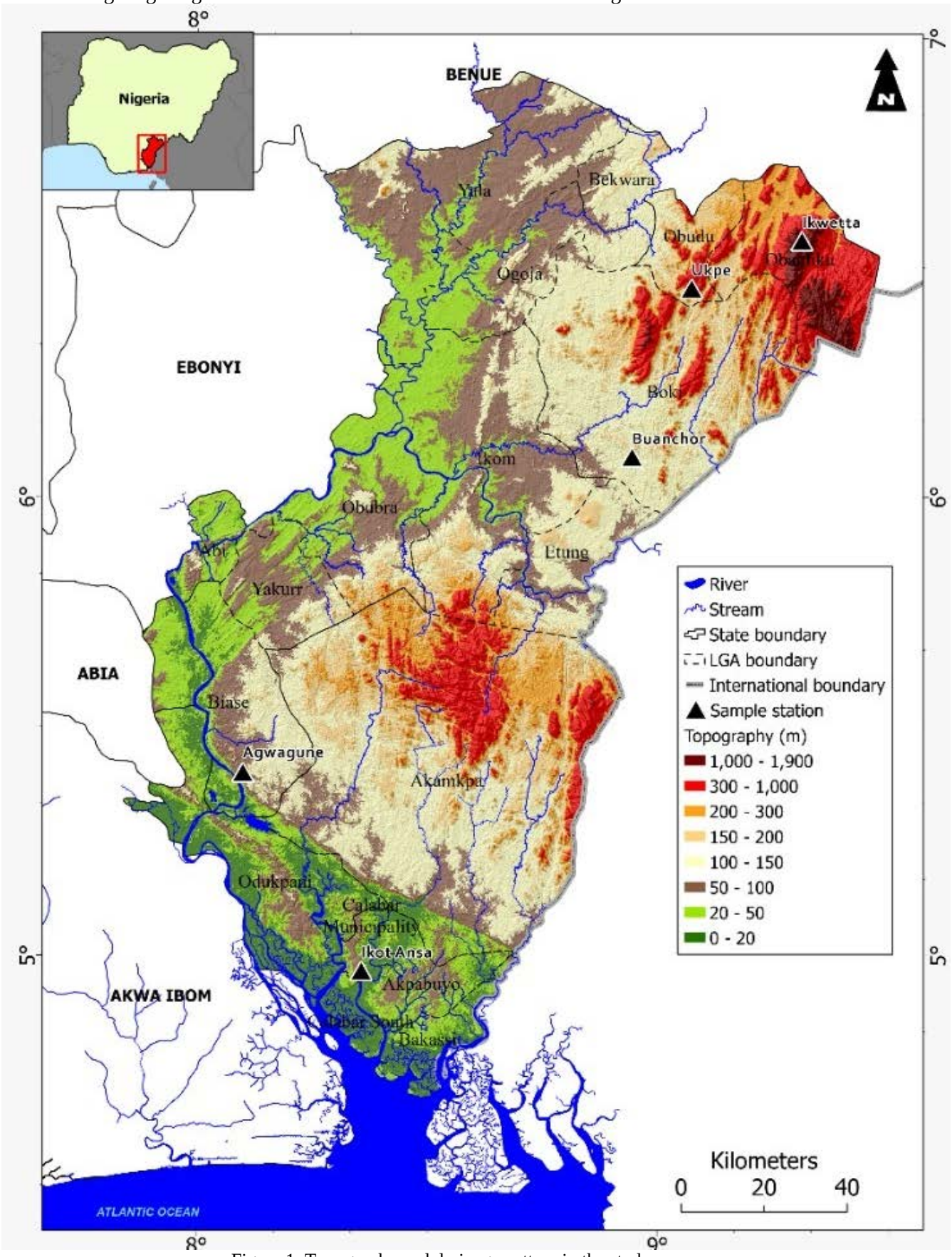

Figure 1. Topography and drainage pattern in the study area

Table 1. Answers on the causes of landslide hazards across the sampled locations

S/N	Causes	Agwagune	Buanchor	Ikwette/ Bendi	Ukpe-Alege	IkotAnsa/ Edimotop	Total
1	Climate change	82	66	73	48	120	389 (21%)
2	Bush fire	04	50	40	24	00	118 (6%)
3	Human activities	81	65	72	48	118	384 (21%)
4	Soil erosion	50	03	12	22	116	203 (11%)
5	Deforestation	34	60	10	26	03	130 (7%)
6	Fragile slopes	04	60	72	40	20	196 (11%)
7	Spiritual dimension	18	30	12	18	00	78 (4%)
8	Land use change	50	58	52	42	10	212 (12%)
9	Construction work	00	00	00	00	110	110 (6%)
	Total	323(18%)	392 (22%)	343(19%)	268(15%)	497(27%)	1823 (100%)

Source: Fieldwork, 2021

3. MATERIALS AND METHODS

The study design incorporated the use of both descriptive and quantitative techniques in data collection and data analysis. The research relied heavily on primary data and secondary data. Data collections were carried out in two phases. The first phase involved a reconnaissance survey of the study locations, ascertaining the extent and dimensions of landslide occurrences, the nature of the study population, and their characteristics. While the second phase involved the use of participatory research methodologies, using tools such as semi-structured interviews, participant observation, direct observation, transect walk, key informant interview, and preference ranking. Also, field measurements and questionnaire surveys were adopted for data generation. The semi-structured interviews were carefully controlled and structured to learn more about the landslide occurrence and the nature of its impacts on the people. A predetermined checklist concerning landslide occurrence guided this; causes, damage extent, and mitigation measures were also assessed.

Several stakeholders were identified, including governments, NGOs, donors, churches and communities involved in landslide risk reduction measures. Their activities were evaluated to ascertain whether there are variations in their level of commitment to ensuring sustainable mitigation approaches. As a result, an interview was performed with them based on the items on the checklist. The interviews focused on the key informants, group discussion, chiefs, elders, youths, women leaders, and individuals to build representative knowledge of the people and their interaction with the environmental damages caused by landslides. The direct observation and transect walk were used to determine the area coverage of the landslide spread, types and nature of resources damage, changes in the landscape and mitigation measures adopted by the affected population. The transect walk and participant observation help us know the alteration in land use and the specific land resources that were severally altered due to the occurrences. The preference ranking, such as verbal ranking and manual ranking, were used to assess the scale of the effect of landslide occurrence on the people and the effectiveness of the landslide risk reduction method in the area. Also, field measurements and questionnaire surveys were likewise adopted for data generation. Interviews were guided by predetermined issues concerning landslides, causes, damage extent, and mitigation measures. The key informants comprise youths, elders, women leaders and village chiefs. The questionnaire also captured the issues of the interviews, and specific questions were on Likert -scale used to evaluate the efficiency of the mitigation measures and the stakeholders. The respondents were household heads who were requested to score the perceived performances of the stakeholders in their risk reduction measures. Observations and inventory or stocktakings on the number of buildings and farmlands were carried out.

The study purposively sampled some landslide-endemic communities in Cross River State, including Agwagune (Biase), Buanchor (Boki), Bendi and Ikwette (Obanliku), Ukpe–Alege (Obudu), and Ikot Ansa and Edim Otop (Calabar Municipality) (Fig. 1) for data collection. 10% of the estimated household heads of 3960 population were sampled for the questionnaire survey, while the entire population was recognized for participatory research and other studies. The sample size used for data collection was 396 respondents with details such as Biase (84), Boki (68), Obanliku (74) and Calabar Municipality (120). In all, a total of 21

questions were structured. Some were leading questions, while others were in Likert scale format. Also, a checklist on participatory dimensions of landslide disaster and risk management in rural communities of South Eastern Nigeria was prepared with six main issues raised from the study's aim and objectives under consideration. Descriptive statistics such as tables, graphs and pictures and inferential statistics, including ANOVA, were used for data analyses. For scientific verification, two hypotheses were formulated in a null form to establish the degree of variation in landslide mitigation across the study area. The formulated hypotheses are stated as follows:

H_0: There is no significant variation in the effectiveness of landslide reduction measures across the sampled locations.

H_0: There is no significant difference in the effectiveness of stakeholders' involvement in landslide mitigation across the sampled villages.

The ANOVA was used to test the two hypotheses to establish variations in the effectiveness of landslide risk reduction measures and the different stakeholders involved in mitigation in the area.

4. RESULTS AND DISCUSSIONS

This section discusses the causes of landslides, effects of landslides, measures of landslide risk reduction, the effectiveness of landslide mitigation measures, stakeholders' involvement, and the challenges of landslide risk reduction in the study area.

4.1. Perceived Causes of Landslide Hazards

To understand the causes of landslides in the area, the participatory study identified several factors that made landscapes in these areas vulnerable to failure, which predisposes the slopes to become unstable. These factors are geological, morphological, mechanical and human-induced factors. Table 1 and Figure 2 present the causes of landslide hazards in the area. The study scored these factors based on the people's perceived impacts. It indicated that climate change and human activities were the most rated landslide causes during the participatory group interview, receiving 98% and 95%, respectively (Figure 2). This finding aligns with Spiker & Gori (2000) that the landslide trend will persist, and its consequences will continue due to changing climate patterns, expansion of transportation infrastructure, development in our areas, and deforestation in landslide-prone areas. Moreover, despite technological and scientific advancements in mitigation, landslide disasters continue to cause human misery. In disagreement with the findings, Akpan et al., (2015) attributed the cause to impaired percolation at the rock interface, causing weakness and mechanical wind transmission.

It was observed that the occurrence of landslide hazards across the sampled communities was the aftermath of intense rainfall. Most affected areas have concentrated human activities such as farming, timber harvesting and population pressure on vulnerable and fragile slopes (Figure 2). Other primary factors for landslide hazards are soil erosion (60%), land-use change (55%) and fragile slopes (50%) (Figure 2). The questionnaire survey indicated climate change and human activities as the primary factors of landslide occurrence, attracting 21% above others. In contrast, the spiritual and construction factors were rated or scored least because their imprints were indicated in a few study locations (Table 1).

Furthermore, detailed observation of the communities indicated slight variations, where all the respondents significantly considered certain factors. In contrast, some communities did not mention other factors such as construction work, spiritual dimension, and bush fire. However, deforestation, bush fire and construction factors were considered by a few respondents. Thus, there is a need to regulate these processes caused by man, especially in vulnerable areas, to avoid the most severe hazards.

4.2. Consequences of Landslide Hazards in the Study Area

Results show that landslide impacts were severe in Buanchor, Agwagune and Ikot Ansa/Edim Otop communities. Furthermore, these communities attracted 85%, 82% and 80% of the impacts, respectively (Figure 3). The participatory study indicates that the landslide occurrence at Buanchor in 2012 typically destroyed 55 buildings, including secondary and primary school blocks.

The impact and extent of damage affected Katabang, Enyi, Asuben, and Ebok, among others. In Agwagune communities, it was an experience of repeated landslides that occurred in 2005, 2006 and 2009, while in Ikot Ansa and Edim Otop in Calabar Municipality, it is a yearly occurrence, especially in those areas affected by gully erosion.

The landslide in Ukpe-Alege was massive, and the impacts severely affected properties and human lives. At the same time, the occurrence at Ikwette in Obanliku in 2013 hindered and stopped the movement of 20 tourists from the Obudu Ranch Resort. Furthermore, the study considered the effects of landslides across the study locations in a threefold dimension such as biophysical, social and economic

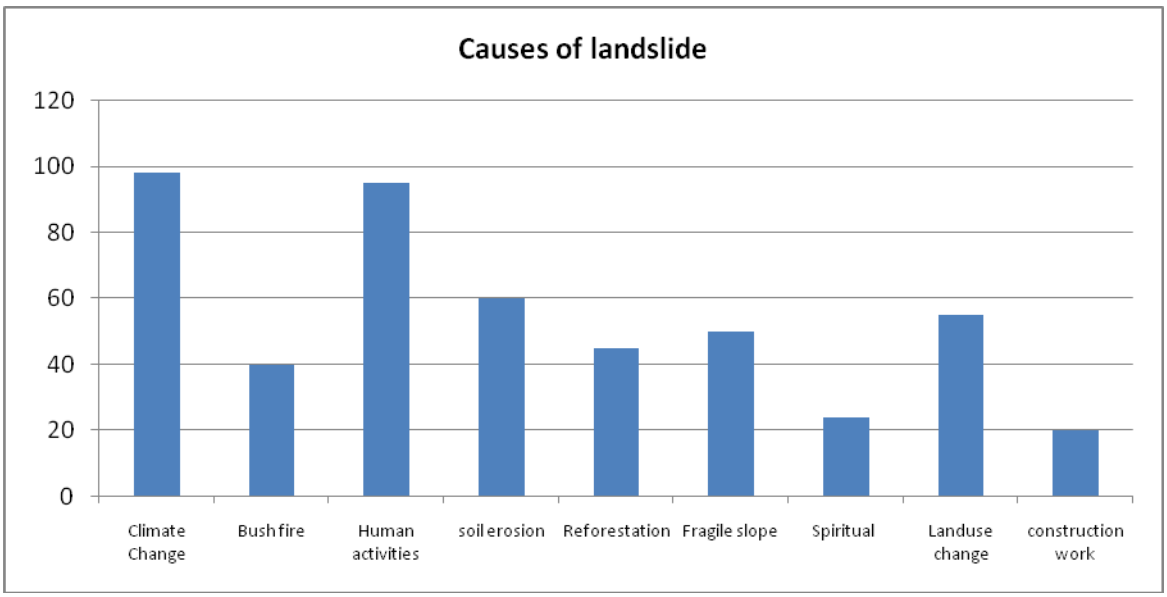

Figure 2. Percentage of answers on the causes of landslides in the study area

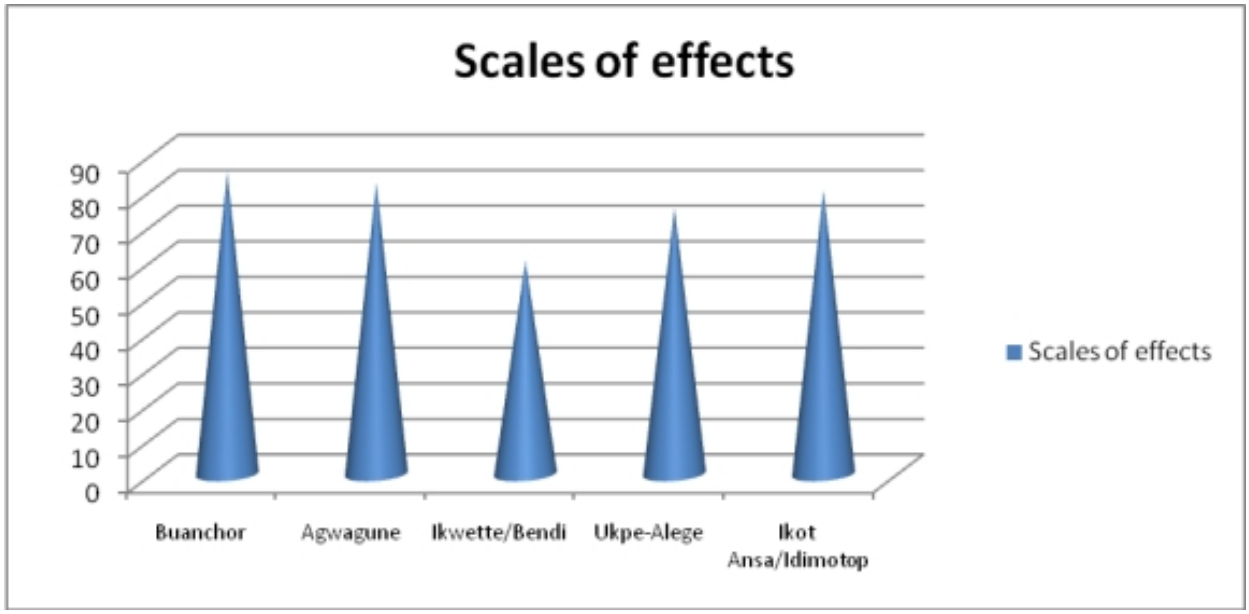

Figure 3. Perceived scale of the effect of landslide hazards across the study locations with a robust monitoring programme.

effects (Tables 2, 3 and 4) based on the slide's nature and gravity and the perception of the people over the impacts on landscapes and properties.

Apart from being a threat to people, a landslide can cause considerable damage to land, vegetation, and water resources. It destroys everything in its path, including removing the topsoil, trees, herbs, shrubs, animals and blocking stream channels. In Table 2, the result indicates that landslide is the primary cause of erosion, flooding, pollution of water, vegetation loss, loss of wildlife, stream channel displacement, and non- timber forest products (NTFPs). These accounted for 10% and 18% of the population response across the study locations. All these issues raised are the basis for the livelihood security of the people. The effects vary from one community to another. The findings also revealed that Ikot Ansa /Edim Otop, Buanchor and Ukpe-Alege experienced the most significant biophysical impacts, accounting for 29%, 28%, and 21% of the perceived impacts. Agwagune attracted 18% of the study population (Table 2). For instance, while Ikot Ansa/Edim Otop in Calabar Municipality is regularly faced with the challenges of gully erosion, flooding, and loss of soil, Buanchor in Boki was severely affected by stream channel displacement, loss of wildlife resources, pollution of water sources and loss of NTFPs, which are the sustenance of the people, and Ukpe-Alege was affected with the problems of scarcity of NTFPs, loss of wildlife resources and vegetation loss (Table 2).

Table 2. Answers on the biophysical consequences of landslide in the study area

S/N	Effects	Agwagune	Buanchor	Ikwette/ Bendi	Ukpe-Alege	Ikot Ansa/Edim Otop	Total
1	Vegetation loss	15	26	8	22	04	75(11%)
2	Stream channel displacement	6	30	00	10	20	66(10%)
3	Loss of wildlife resources	18	28	02	28	00	76(11%)
4	Flooding	15	24	00	00	42	81(12%)
5	Pollution of water	20	32	02	00	28	82(12%)
6	Erosion	16	15	06	22	60	119(18%)
7	Loss of NTFPs	14	28	00	30	00	72 (11%)
8	Soil loss	13	5	10	24	38	90(4%)
	Total	117 (18%)	188 (28%)	28 (4%)	136 (21%)	192 (29%)	661 (100%)

(Source: Fieldwork, 2021).

Table 3. Answers on the social impacts of landslide hazards in the area

S/N	Effects	Agwagune	Buanchor	Ikwette/ Bendi	Ukpe-Alege	Ikot Ansa/ Edim Otop	Total
1	Property damage	60	68	12	28	102	270 (19%)
2	Injury	32	25	10	18	15	100(7%)
3	Death	20	40	00	20	10	90(6%)
4	Displacement of families	40	68	15	22	100	245(17%)
5	Tourism activities	00	68	70	5	10	153(11%)
6	Food shortages	60	65	05	35	00	165(11%)
7	Loss of drinking water	03	60	00	20	00	85(6%)
8	Transportation problem	15	66	70	16	30	197(14%)
9	Loss of farmlands	40	60	5	38	05	148(10%)
		272 (17%)	520 (36%)	187 (13%)	202 (14%)	272 (17%)	1,453 (100%

(Source: Fieldwork, 2021)

Table 4. Answers on the economic impacts of landslide hazards in the area

S/N	Effects	Agwagune	Buanchor	Ikwette/ Bendi	Ukpe-Alege	Ikot Ansa/ Edim Otop	Total
1	Loss of farmlands	70	68	10	30	00	178(17%)
2	Loss of income opportunities	50	68	5	20	60	203(20%)
3	Cost of repairs of damaged structures	35	68	15	10	105	233(23%)
4	Loss of property value	00	00	00	00	110	110(11%)
5	Loss of timber/NTFPs	26	68	05	45	00	144(14%)
6	Low commercial activities	00	40	60	00	65	165(16%)
	Total	181 (17%)	312 (30%)	95 (9%)	105 (10%)	340 (32%)	1,033 (100%)

(Source: Fieldwork, 2021)

Regarding the social effects of landslide hazards, the result revealed that property damage, displacement of families, transportation problems, shortage of food, tourism and loss of farmlands were the most challenging social impacts of the hazards across the different zones. These issues accounted for 10% and 19% of the population response (Table 3). The other social effects, such as injury, death and loss of portable water, were less significant. For instance, the study indicates that not more than 20 deaths were recorded against the landslide hazards in Cross River State, South Eastern Nigeria, between 2005 and 2016. However, several properties were lost, including residential and primary and secondary school buildings. In Buanchor, Agwagune and Ukpe-Alege, the study observed that one side of the settlements was submerged by landslide materials such as rock boulders, water, trees, etc.

This resulted in several families' displacement, many of whom are yet to re-establish and re-integrated into social systems, for example residential houses and schools for their children. The most affected community was Buanchor accounting for 36% of the study population. This was followed by Agwagune (17%), Ikot Ansa/Edim Otop (17%) and Ukpe-Alege (14%) (Table 3). It was observed that these communities are still faced with recovery challenges due to the non-commitment of stakeholders to landslide risk reduction measures. These findings agree with several studies (Fowze et al., 2012; National Academies Press, 2004; WHO, 2022). According to a report by National Academics Press (2004), landslide risks in the United States kill about 25 to 50 people and cost about $1 to $ 3 billion annually. In addition, it also causes a lot of damage to the environment and social problems. Whereas WHO (2022) recently reported that from 1998 to 2017, landslides caused more than 18,000 deaths and affected an estimated 4.8million people worldwide. Similarly, Karim, (1995) and Alcántara-Ayala, (2014) noted that Haiti, one of the most vulnerable nations globally, recorded approximately 230,675 deaths in a landslide event. However, Baum & Johnson (1996) observed that the damage associated with landslides has become increasingly costly as development in urban areas advances more and more on hillsides. In addition, the results of the research by Egboka et al., (2019) are consistent with these findings. Their findings demonstrated that gully and soil erosion, as well as landslides, are to blame for the widespread destruction of human life, plant (flora), and fauna (animal) life; industrial, commercial and residential property; communication facilities and transportation systems; arable lands degradation and destruction; pollution and contamination of all types of water supplies (surface and groundwater supplies); community migration; and isolation of settlements. The research also showed that natural (biological) activities and artificial processes contribute to the corrosion and erosion of gullies, with the latter being the more common of the two types of processes.

Economically, landslide occurrences have resulted in several economic woes in rural communities. These consequences include loss of income opportunities, loss of farmlands, low commercial activities and increased cost of repairing damaged structures, accounting for between 16% and 23% (Table 4). It was discovered that the impacts on farmlands and loss of NTFPs may have created food shortages and income problems. Altogether 834 hectares of farmlands were destroyed in Agwagune, Buanchor and Ukpe-Alege. There was also massive damage to properties, including bridges, roads, houses, and other infrastructures, which increased the cost of repairing these damaged properties. Generally, landslide hazards impose untold economic hardships on governments and the people of these affected areas.

4.3. Landslide Risk Reduction and Management Measures in the Areas

Landslide-based risk management is anchored on the risk reduction framework, which covers a broad range of intervention measures, activities, projects, and programs to reduce disaster risk, primarily designed at risk localities and based on urgent needs and capacities. The participatory study using group interview, scored landslide risk reduction measures based their level of performance in terms of ameliorating the challenges posed by landslide disaster in the study area. The result presented in Figure 4 shows that financial support scored 65% while provision of food/ household items attracted 64%, and provision of building materials had 60%. These measures were considered by the people as being frequent and commonly used by the stake holders across the sampled communities.

However, in Table 5, the study indicates that structural interventions, provision of building materials and supply of food/house items representing 20% and 15%, respectively were considered as landslide mitigation measures that have benefited the people across the sampled locations. It was discovered that the financial support from the various stakeholders was restricted to a few community individuals, especially leaders and elites, to the detriment of the affected people. At the same time, building materials and food/household items were widely distributed to people, including women. Building materials commonly distributed include cement, zinc, and nails. Also, food and housing items include rice, semovita, food seasoning, cooking utensils, accessories, plates, and cloths, among others. Most of these materials rarely compensate the affected victims due to the significant losses experienced during slides.

Although these findings are in tandem with the Asian Disaster Preparedness Centre (ADPC) in 2013, which recommended empowerment and capacity building as sustainable strategies, but are contrary to Rahman (2018) and Davies (2015), who noted that community engagement had been acknowledged as an additional component in disaster management which is necessary to reverse the global trend of the exponential rise and increase in catastrophe occurrence.

This is because local communities are considered the primary emphasis of attention since they are the basic unit that is directly affected by landslide event. In contrast, Spiker & Gori (2000) noted that in order to attend to the goals of reducing

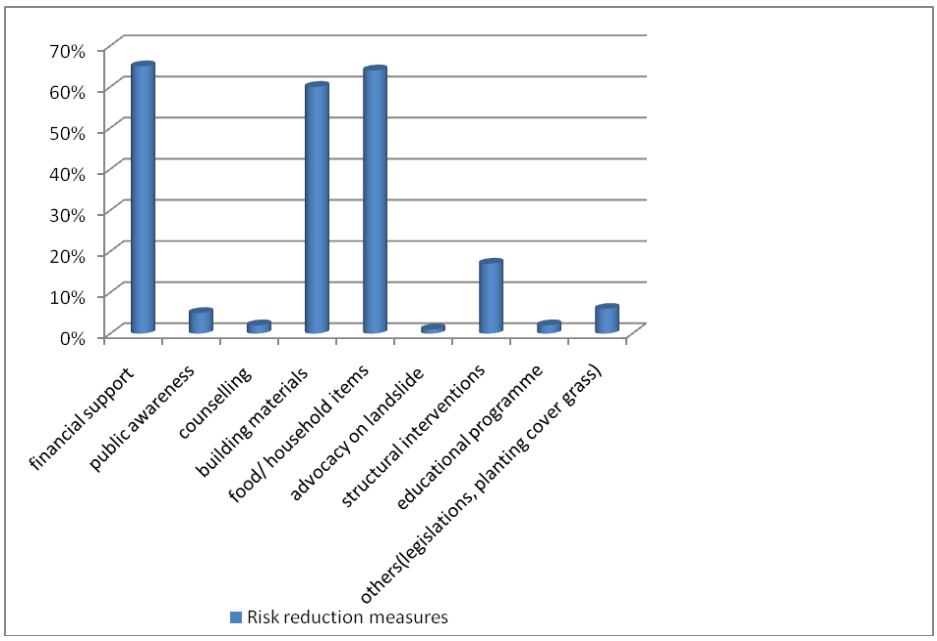

Figure 4. Participatory assessment scoring of landslide risk reduction measures in the area.

Table 5. Respondents' benefits from landslide risk reduction measures at the sampled locations

S/N	Benefits/measures	Agwagune	Buanchor	Ikwette/ Bendi	Ukpe-Alege	Ikot Ansa/ Edim Otop	Total
1	Financial support	30	15	00	10	25	80 (7%)
2	Public awareness	05	20	05	00	60	90(8%)
3	Counseling	20	40	00	10	70	140(12%)
4	Building materials	62	60	02	12	40	176(15%)
5	Food/house items	70	68	00	40	00	178(15%)
6	Advocacy on landslide	00	10	20	00	40	70(6%)
7	Structural intervention	20	68	20	18	115	241(20%)
8	Educational programs	15	0	05	12	60	102(9%)
9	Others (legislations, afforestation and planting of grasses, etc)	20	40	02	10	50	122(10%)
	Total	242 (20%)	331 (28%)	54 (5%)	112 (9%)	460 (38%)	1199 (100%)

Source: Fieldwork, 2021

the casualties from landslide risks, there is a need for a more thorough understanding of landslide occurrence and processes with a robust monitoring program.

It was also discovered that structural measures such as using rock blankets, gabions, concrete walls, and erosion control mechanisms that were not people-based but rather environment-based tend to be more sustainable than the piece-meal provision of building materials and food items, household items and financial supports to the people.

The other landslide risk reduction measures such as counselling, education programs and public awareness showed up clearly in the study area due to the activities of non-governmental organizations on environmental conservation. However, they were not significantly indicated by the study population (Figures 4 and 5) because of low level of education of the respondents. This study also indicated that landslide risk reduction benefits were significantly observed in Ikot Ansa/ Edim Otop in Calabar (38%), where the structural intervention measures were used primarily for erosion and flood control (Table 5), while in Buanchor (28%) and Agwagune (20%), food/house items and building materials were the principal approaches. Most people complained during the participatory study that these measures were not palliative.

4.3.1. Analysis of Peoples' Perception of Landslide Risk Reduction and Management Measures

The sample population was requested to rate the effectiveness of landslide disaster management and risk reduction measures to ascertain whether the

approaches are sustainable or not in the study area. The result indicates that 52% of the respondents across the study locations rated the risk reduction measures as poor or low inefficiency in meeting the challenges of landslide hazards in the study area (Table 6). In comparison, 31% ranked them as reasonable attempts and average performance. Therefore, it is evident that landslide risk reduction measures require commitment, funding, adequate education, and public awareness of landslide occurrence for sustainability in the area.

Table 6. Respondents' perceptions of landslide risk reduction measures

S/N	Element rating	Number of people	Percentages
1	Excellent	15	4%
2	Good	28	7%
3	Average	51	13%
4	Fair attempt	68	18%
5	Poor	174	52%
	Total	387	100%

Source: Field work, 2016

Again, participants' observation of the mitigation suggested the existing measures are skeletal and unsustainable to ensure the prevention and preparedness for future landslides in our environment. Furthermore, the assessment also covered specific measures and settlements under consideration. The findings indicate that financial support, building materials, and food/house items with a mean score of 68, 67 and 55 were rated higher than other measures (Table 7).

Nevertheless, the people recognized these measures as unsustainable since most products were consumables quickly. Also, the financial support was limited to very few individuals, especially elites. The participatory study further confirmed that the benefits (measures) flow was sometimes diverted to political leaders' families and friends. Other measures such as public awareness, counselling and capacity building representing mean scores of 45, 36 and 35 (Table 7) are yet to receive attention from the people since it requires the understanding of landslide occurrence and necessary skills to reduce pressure from the landscapes. Capacity building and empowerment are sustainable measures to ensure the tenure, continuation and further dissemination of information about mitigation of landslides (Baum & Johnson, 1996). In order to determine the variation in the effectiveness of landslide risk reduction and management measures across the sampled settlements. The study formulated a null hypothesis H_0 and tested it as follows:

H_0: There is no significant variation in the effectiveness of landslide reduction measures across the sampled locations. ANOVA was used to test the stated null hypothesis using the data in Table 7. The result of the analysis is presented in Table 8. The analysis of the variance of the effectiveness of landslide risk reduction measures produced an F-ratio of 1.171, which is less than the tabulated value of 2.69 at 0.05 levels of significance. Therefore, the study accepts the null hypothesis (H_0) and confirms that the effectiveness of landslide risk reduction and management measures across the sampled areas does not significantly vary at a 0.05 level of significance. This finding implies that all landslide risk reduction measures were almost rated the same efficiency in the study area.

The study recommends improving these measures to ensure their sustainability in the area. This finding confirms that the effectiveness of landslide risk reduction measures across the sample areas does not

Table 7. Answers on the effectiveness of landslide risk reduction measures across the sample areas

S/N	Attributes	Agwagune	Buanchor	Ikwette/ Bendi	Ukpe-Alege	Ikot Ansa/ Edim Otop	Total Average
1	Financial support	78	66	50	64	80	68
2	Public awareness	42	52	10	30	92	45
3	Counseling	40	48	00	22	70	36
4	Building materials	69	42	70	64	90	67
5	Food/house items	78	67	00	72	60	55
6	Structural intervention	20	18	20	10	60	26
7	Capacity building	36	42	10	28	61	35
	Total Average	52	48	23	41	74	47

Source: Fieldwork, 2021

Table 8. Results of analysis of variance of the effectiveness of landslide risk reduction measures

Source of variation	Sum of squares	Degrees of freedom	Mean sum of square	F-ratio	Sig
Between Groups	71659.257	4	17914.814		
Within Groups	458784.286	30	15292.810	1.171	0.343
Total	530443.543	34			

Significant at 0.05 confidence level

vary significantly at a 0.05 level of significance. This finding implies that all landslide risk reduction measures were rated the same in their efficiency in the area. However, the study result indicated that the study population rated the effectiveness of landslide disaster management and risk reduction measures to ascertain whether the approaches are sustainable.

4.3.2 Analysis of Peoples' Perception of the Effectiveness of Stakeholders in Landslide Risk Reduction Measures in the Study Area

Results indicate that, on aggregate, different stakeholders have recorded fair performance in efficiency accounting for 42% of the respondents on the element rating. 29% indicated that these stakeholders had not achieved anything (Table 9). The efficiency of stakeholders requires improvement of sustainability measures such as capacity building, landslide education and awareness, and adequate financial support

Table 9. Respondents' perception of the effectiveness of stakeholders in landslide risk reduction measures
Source: Fieldwork, 2021

S/N	Element rating	Number of people	Percentages
1	Excellent	20	5%
2	Good	32	8%
3	Average	62	16%
4	Fair attempt	168	42%
5	Poor	114	29%
	Total	396	100%

An interview with some officials of the Cross River State Emergency Agency indicated that several donors, especially international donors such as WHO, United Nations, DFID, UNICEF, and Red Cross, were in partnership with the government to implement their risk reduction measures. Private companies such as UNICEM, Flour Mills etc., also constitute the donor institutions involved in landslide mitigations in the area.

Detailed analysis of specific stakeholders' contributions revealed that government, NGOs, and donor agencies were rated higher with a mean score of 64.49 and 38, respectively, while community self-help programmes and church donations were least in the rating by the people (Table 10).The study also observed that the public awareness programmes and counselling are still focusing on general issues of the environment rather than landslides which are gradually increasing due to population pressure on fragile slopes and loose soils. In order to determine the level of variation in the effectiveness of stakeholders in landslide risk reduction measures, the study also formulated a null hypothesis (H_0) and tested it as follows:

H_0: There is no significant difference in the effectiveness of stakeholders' involvement in landslide mitigation across the sampled villages. Improvement is required for sustainability. ANOVA was employed using the data in Table 10. The result is presented in Table 11. The analysis of variance produced on an F-ratio of 2.021 is less than the calculated value of 2.87 at 0.05 levels. Therefore, the study accepts the null hypothesis (H_0) that there is no significant difference in the effectiveness of stakeholders' involvement in landslide mitigations across the sampled villages. This implies that the performances of governments, donors, NGOs, churches as well as community self-help are almost the same.

This finding agrees with Anderson & Holcombe (2013) and World Bank Group (2013), who reported a considerable amount of funds appropriate and technical progress towards mitigation and livelihood activities. However, the impacts of landslide disasters on local communities remain an issue to be resolved. Also, Oyinsan (2012) in Nigeria noted that landslide occurrence and disaster issues are the same as in other parts of the world but not given adequate and direct attention, rather subsumed under general disaster management emergency dimensions grouped all forms of disaster.

4.4. Challenges of Landslide Risk Reduction Measures in the Study Area

On the side of the challenges of affecting landslide management measures, the study identified several hindrances militating against the government's

Table 10. Answers on the effectiveness of stakeholders involved in landslide risk reduction measures across the study locations

	Stakeholders	Agwagune	Buanchor	Ikwette/ Bendi	Ukpe-Alege	Ikot Ansa/ Edim Otop	Total Average
1	Government	58	60	70	50	80	64
2	NGOs	46	56	34	60	50	49
3	Donors	56	54	00	20	60	38
4	Community self-help	45	50	10	40	30	35
5	Churches	36	42	00	30	20	26
	Total Average	48	52	23	40	48	42

Source: Fieldwork, 2021

Table 11. Analysis of variance result of stakeholders' involvement in landslide risk reduction measures in the study area

Source of variation	Sum of squares	Degrees of freedom	Mean sum of square	F-ratio	Sig
Between Groups	2286.640	4	571.660		
Within Groups	5658.400	20	282.920	2.021	0.130
Total	7945.040	24			

Significant at 0.05 confidence level

Table 12. Perceived challenges of landslide risk reduction measures

S/N	Challenges	Agwagune	Buanchor	Ikwette/ Bendi	Ukpe-Alege	Ikot Ansa/ Edim Otop	Total Average
1	Lack of government commitment	51	55	50	38	66	260 (20%)
2	Poor sensitization to people	72	60	52	41	42	267(21%)
3	No adequate coordination	62	58	62	32	30	244(19%)
4	No education on landslide	74	64	65	43	41	287(22%)
5	Corrupt implementation of mitigation measure	58	42	38	31	81	240(18%)
	Total	317 (24%)	279 (21%)	267 (21%)	185 (14%)	260 (20%)	1.298 (100%)

Source: Fieldwork, 2021

successful implementation of risk reduction measures. The people perceived several challenges, including lack of education on landslides, poor sensitization of the people on landslides, lack of government commitment in implementing landslide risk reduction measures, and corruption in implementing the mitigations. The respondents considered all these as primary issues that needed to be tackled to succeed in landslide mitigation measures (Table 12).

The study rated lack of education on landslide hazards and sensitization as the most critical challenges accounting for 22% and 21%, respectively. It was discovered that no matter the amount of financial support, the people need to understand the processes of landslide occurrence through education and public awareness. These two measures are necessary for the local people affected by landslide disasters. This will enable them to get the essential information about landslide processes and establish early warning systems to aid technical authorities in advising, monitoring, and forecasting landslide hazards in prone areas more than ever before. Additionally, it will foster collaboration between governments, NGOs, and the general public through a round-table discussion to increase community understanding of specific components, such as risk, landslide hazard, and mitigation in the research region. The study also indicates that governments (state or local government areas) are not committed to risk reduction of landslide hazards. For instance, the budget appropriation for natural disaster mitigations for many years in Cross River State, South Eastern Nigeria, has rarely been implemented. Instead, the Federal Government and International Donors' Ecological Fund was minimally utilized for landslide risk reduction to tackle these challenges. Finally, the political class's coordination of the landslide risk reduction programme was discovered to settle their supporters instead of considering the area's affected victims of landslide hazards. This finding is in line with the works of Baum & Johnson (1996), who posits that many people have neglected landslide risk for several reasons, such as unawareness of the increasing danger of landslides. Gray & Sotir (1996), on the other hand, highlighted biotechnical slope protection, which includes biotechnical stabilisation and soil bio-engineering stability.

5. CONCLUSIONS AND RECOMMENDATIONS

The frequency of landslide occurrence has increased and gained momentum in the study area due to several causes. The participatory study identified many factors that made landscapes in these areas valuable to failure, predisposing the slopes to become unstable.

Also, the study indicated that climate change and human activities along hillslopes were considered the leading causes of landslides occurring in the area. In addition, rainfall, concentrated human activities such as farming, timber harvesting, and population pressure on vulnerable and fragile slopes were rated significantly among the people. Other factors for landslide hazards are soil erosion, land-use change and fragile slopes. The study also revealed the consequences of landslides across the sampled locations in threefold dimension, including the biophysical, social and economic effects based on the slide's nature and gravity and the people's perception. Apart from being a threat to man’s life, a landslide has been known to cause considerable damage and destruction to land, vegetation and water resources. It

destroys everything in its' path, including removing the topsoils, trees, herbs, shrubs, animals and blocking stream channels. It is the primary cause of erosion, pollution of water, vegetation loss, loss of wildlife, stream channel displacement and loss of non-timber forest products (NTFPs) and their associated consequences on their livelihood.

The dangers of landslide hazards are gradually increasing and widespread in the study area due to intense human activities, climate change and unsustainable landslide risk reduction measures. These measures are impositions rather than being people-oriented. Integrating the affected communities is necessary to understand landslide processes, vulnerable areas, and mitigation measures. For example, constructing structural interventions or land-use policies requires indigenous people's collaboration. Integrating indigenous alternative solutions is critical for monitoring and managing landslide hazards, particularly in susceptible environments. Additionally, it will encourage sustainability and improve the likelihood of replication by other communities since beneficiaries of landslide risk reduction measures will be able to claim ownership of their disaster risk reduction efforts. Thus, mitigations or risk reduction measures should recognize the primary factors of these landslides to ensure the sustainability of these programs and projects. Other necessary recommendations include the following:

(1) Incorporating landslide risk and efficient mitigation into the school curriculum in the state.

(2) Increasing environmental awareness focusing on landslide disasters through workshops, training and other programs in all the local government areas.

(3) To enable capacity-building procedures that result in individuals taking ownership of solutions they can implement independently.

(4) Willingness to tackle landslide risks by enacting adequate legislation by governments.

(5) Progressive evaluation of landslide vulnerable areas for emergency preparedness toward risk reduction in the affected communities.

(6) Promoting low-cost mitigation measures such as afforestation and planting cover plants, especially in vulnerable areas.

(7) Distribution of financial support, building materials provision, and food items should be the affected people-based instead of government representatives.

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