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Re-thinking on land degradation and its impacts on livelihoods of the farmers in Kanungu District, Uganda

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ABSTRACT

Background: Worldwide, land degradation reduces the productivity of agricultural land by roughly 75%. Land degradation has made it difficult for people to make a living in Uganda, one of the world's poorest nations. Land degradation in Uganda poses a severe danger to rural populations' ability to support themselves and little effort has been done. The primary natural resource used by humans for economic, social, infrastructure, and other human endeavors is land. Land resources are so crucial in determining rural livelihoods, and the absence of sustainable land management techniques results in land degradation.

Results: The study findings proved that there was a significant positive relationship between the effects of land degradation and the livelihoods of farmers ($p < 0.01$, $r = .530^{**}$) in Kanungu District, which suggests that adoption of new seed varieties which can withstand harsh climatic conditions, strengthening agricultural reforms, and agroforestry would improve the livelihoods of local farmers to improve their savings and production of quality crop products. Therefore, the alternative hypothesis was therefore accepted and it was concluded that "There is a significant relationship between land degradation and the livelihoods of farmers in Kanungu District."

Conclusion: These observations indicated that land degradation significantly affects the livelihoods of farmers as the majority of the participants agree that deforestation causes land degradation.

Keywords: land degradation, Kanungu District, Uganda, rural livelihoods, agricultural reforms, sustainable land management, socioeconomic systems.

Introduction

Globally, food production has been affected by land degradation (Kamau, 2018). Land degradation is the loss in productivity of land and its ability to provide services as a result of natural and anthropogenic factors. These factors affect soil quality and the ability of land to produce will have been affected and, hence, famine among smallholder farmers. Intentional and non-international human activity, as well as natural causes, all contribute to global soil degradation and land cover change (Xie *et al.*, 2020). However, it is now known that human activities are changing the natural world's environment (Ronald, 2020). According to Ayalneh (2003), differing relief, ecosystem, rainfall, land use, land cover, and soil types are the immediate and underlying causes of the scope and severity of the problem of land degradation. According to Nyol (2019), land degradation reduces the productivity of agricultural land by roughly 75% across the world. According to Israr *et al.* (2020), little is being done to lessen the impact of land degradation on agriculture, which results in low agricultural outputs.

In Africa, land degradation is not only one of the most significant environmental issues (Xie *et al.*, 2020), but it is also a significant social and economic burden (Cohen, 2007; Gisladdottir & Stocking, 2005; Mohamed *et al.*, 2019). This leads to the disappearance of biodiversity, the security of food and energy, land desertification, the development of sustainable socioeconomic systems, and human habitats (Carswell, 2002; Pani, 2020). Particularly in most developing nations, land degradation resulted in a sharp drop in agricultural productivity that exceeded a household's need for subsistence (Kirui and Mirzabaev, 2014).

Water and wind erosion also contribute to land degradation in East Africa (Xie *et al.*, 2020), which results in the loss of soil and long-term natural vegetation (Fenta *et al.*, 2020). Disasters like floods and droughts get worse as a result, significantly endangering humankind's ability to survive and advance (Quarantelli, 2003). In Uganda, about 75% of the land is relatively fertile and gets

enough rain to support pastures or rain-fed agriculture (Syagga, 2006). Only about 30% of the arable land is now being farmed (Akello, 2002).

According to KDLG (2022), little has been done to inform local farmers about better agricultural practices. Kanungu District was one of the counties of the former Kigezi in 1962, the year of independence (then called Kinkizi County), that were impacted by land degradation due to bad farming systems. When Rukungiri District was created in 1974, it was included in that district. The district was established in July 2001. The district is made up of 511 villages, 4 town councils, and 13 sub-counties. Kanungu, Kambuga, Butogota, and Kihhi are the town councils.

The Kanungu district agroecosystem is similar to other highlands in Uganda (Olson & Berry, 2003). Kanungu is a highland area in the Southwest with steep slopes, intensely cropped hillsides, and high population densities (Olson & Berry, 2003). Erosion and consequent soil degradation have been assumed to be a major problem since before independence (Call and Gray, 2020). Kayonza Sub-county has experienced out-migration for many years due to the scarcity of land as a result of wars in the Democratic Republic of Congo (Benson & Ayiga, 2022). Several researchers have examined the extent and impact of human activities and land degradation that have led to soil erosion in the district (Olson & Berry, 2003; Abraham *et al.*, 2020), but little is known in the Kayonza sub-county. In Kanungu district, about 85% of the population depends on agriculture and continuously cultivating a single plot of land so as to meet their needs, especially in Kayonza sub-county, as a result of inadequate/small land and farming methods which lead to land degradation. Continuous use of a single plot of land due to anthropogenic activities leads to a disastrous loss of soil nutrients because of severe erosion. Thus, in order to sustain soil fertility, human activities should be reduced as one of the mandatory steps. Meanwhile some studies have been conducted on land degradation (Nyol, 2019), but there is no information study on the causes of land degradation and its impacts on the livelihoods of the farmers in Kayonza Sub-County, Kanungu district. Therefore, this study aims to assess the causes of land degradation and its impacts on the livelihoods of the farmers in Kayonza sub-county.

The objective of this paper, is to provide an in-depth understanding of the causes of land degradation and its impacts on livelihoods as well as the possible solutions to the impacts of land degradation in Kanungu district. Gumisiriza and Kugonza (2020) described the various causes and effects of land degradation. However, land degradation and its effects on the livelihoods of farmers were not fully addressed. This understanding may be important to education stakeholders such as

parents, religious bodies, teachers, school administrators, nongovernmental organizations, and the community to understand the effect of land use cover change on land degradation and design appropriate solutions. The study provided useful information on local land management practices like planting cover crops, and the results of this study helped in policy implementation on land degradation and its effects on farmers' livelihoods and mechanisms to improve degraded land in Kanungu district.

1. Study area

This study was conducted in Kayonza sub-county, Kanungu District (Fig.1; Tab.1). Kanungu District is located in south-western Uganda between 290 50'E and 0045'S of the Equator (<https://etd.cput.ac.za/>), bordering the Districts of Rukungiri in the north and east, Kabale in the southeast, Kisoro in the south, and the Democratic Republic of Congo in the west (Benson & Ayiga, 2022), 450 km from Kampala, which was curved out of Rukungiri District and started its operations on July 1st, 2001. The district is composed of 4 town councils, 14 sub-counties, 16 wards, 57 parishes and 520 villages. The district has 136 government primary schools, 19 secondary schools, one hospital, 2 HCIV's, 10 HC III's, and 14 HC II's (KDLG, 2022).

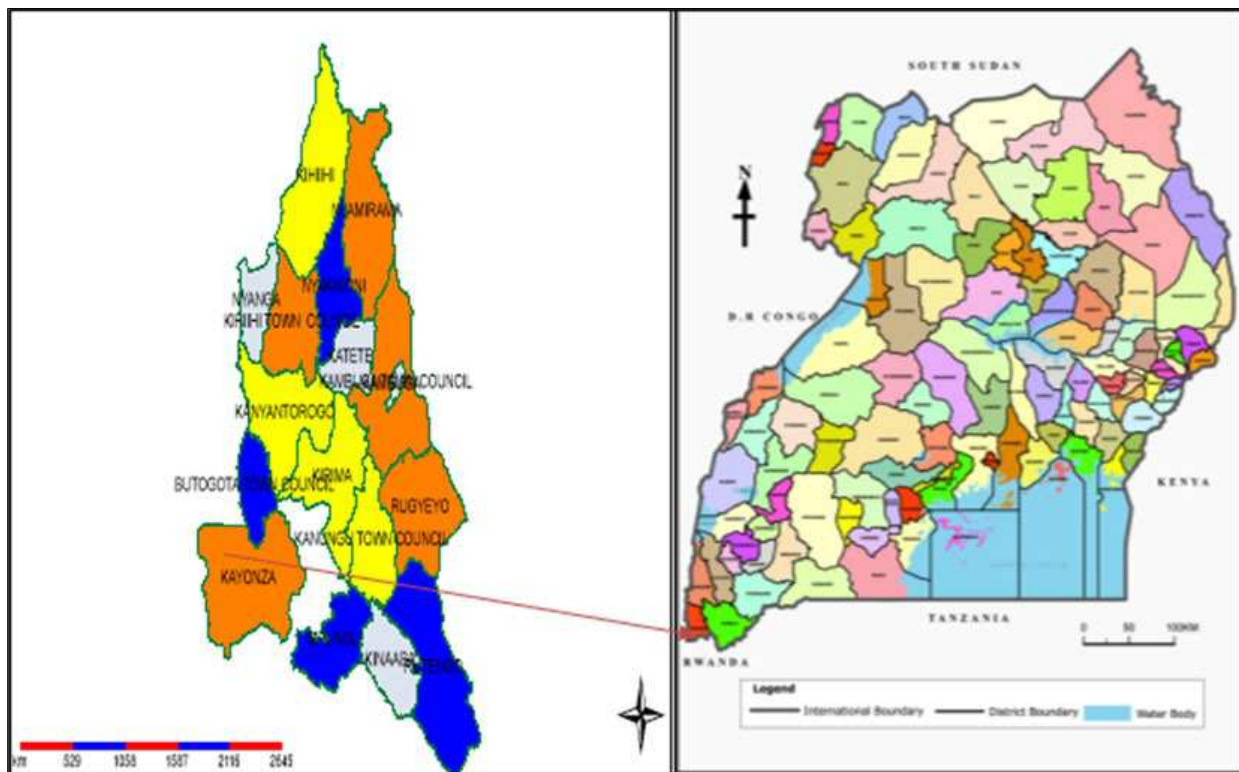


Figure 1: Location map of Kayonza sub-county, Kanungu District.

Climate and landscape

The district has a tropical type of climate receiving moderate and fairly well distributed annual rainfall of about 1200mm. The district receives a bimodal type of rainfall between the months of March – May and September – December every year. The rest of the months are dry with temperatures ranging from 15°C to 20°C on average.

Kanungu district lies in the fringes of the western rift valley with the Northern part forms part of the Rift valley with undulating plains with the middle part (sub-counties of Rugeyo, Kirima and parts of Kanyantoro) comprising of flat topped hills with gentle sloping sides and broad valleys. These hills gradually increase in height to the highlands of Rutenga with Burimbi peak of Mafuga being the highest at 2,503m above sea level with some parts of Kihhi Subcounty lying in the fringes of the western Eastern African rift valley. Total area of the district is 1,228.28 km², comprising 60percent small-scale farmland, 15 % high tropical forest, 11 % woodland, 9 % grassland, 2 % bush land, 1% open water and 2 % miscellaneous mosaics. The vegetation ranges from the high tropical forests of Bwindi impenetrable national park to the grasslands of Queen National Heritage.

Table 1: Information from Uganda.

Uganda	
Latitude	: 29 degrees 50'E
Longitude	: 0 Degrees 45'S
Max ASL	: 2503m
Total surface area	: 129.1 Km ²
Area under land	: 1251.8 Km ²
Area under water and swamps	: 40.3 km ²
Temperature	: 15 Degrees C–20 Degrees C
Rainfall	: 600mm–1200mm

2. Conceptual Framework

The conceptual frame work provides a diagrammatic insight of the proposed study (Fig.2). On the right-hand side is the independent variable (land degradation) and on the right is the dependent variable (livelihoods of farmers).

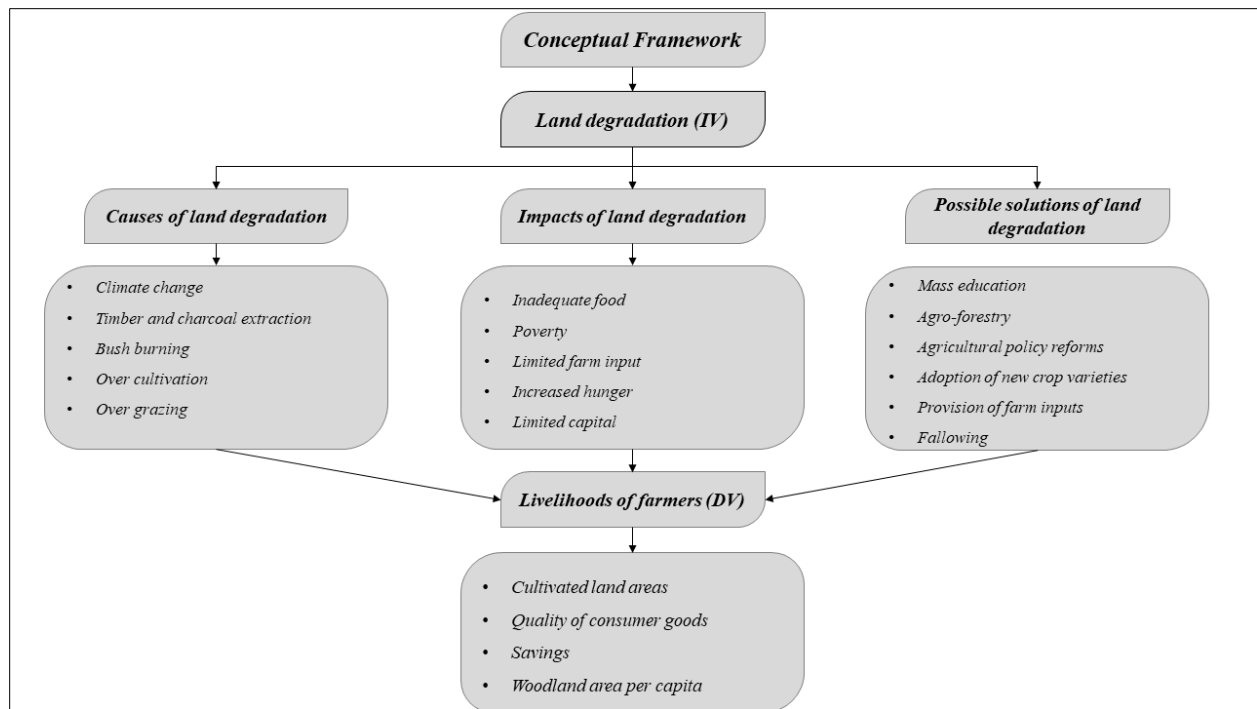


Figure 2: The relationship between land degradation and livelihoods of farmers.

According to Fig. 2, anthropogenic activities and natural phenomena have exacerbated hunger, famine-related resource constraints, and insufficient food. This is a result of overpopulation, which has had an impact on the livelihoods of the locals in the Kanungu District in terms of savings, decreased cultivated land area, and subpar goods due to unproductive soils that cannot support crop production. Mass education among local farmers on better farming techniques, such as agroforestry and the planting of cover crops, fallowing, and the provision of agricultural inputs to farmers during climate change seasons, is necessary to address this issue. In Kanungu District, this may result in less poverty and higher agricultural productivity.

3. Materials and Methods

The study used a cross-sectional research approach, where the information gathered reflects the state of affairs at a specific time, making it possible to gather insightful information quickly. Since a cross-sectional survey allows for the gathering of data using a range of techniques, a mixed method was used in this study, combining quantitative and qualitative techniques (22). According to Creswell (2017), the quantitative approach helped in testing hypotheses to draw statistical inferences, while the qualitative approach supplemented the quantitative one by providing detailed information. For this study, the units of analysis were local people involved in the causes of land degradation and its impacts on the livelihoods of the farmers (24). The only open-ended questions

in the tool were on a 5-point Likert scale, where 5 was for strongly agreeing and 1 was for strongly disagreeing. The respondents self-administered the printed surveys. In order to gather qualitative data, I created an interview guide based on the study's goal and then spoke with the respondent in person.

3.1. characteristic of the study area

In terms of terrain, Rugeyo, Kirima, and some of Kanyantorogo subcounties make up the Kanungu district, which is situated on the margins of the western rift valley (25). Every year, the district experiences bimodal rainfall between the months of March–May and September–December (26). The other months are dry and typically between 150 and 200 degrees Celsius. According to KDLG (2022), the district has a total area of 1,228.28 square kilometers of vegetation, of which 60% is small-scale agricultural, 15% is high tropical forest (27), 11% is woodland, 9% is grassland, 2% is bush land, 1% is open water, and 2% is various mosaics. Greyish-brown sandy loams and reddish-brown sand are the two most prevalent soil types. The study population of 31,577 households will be selected for this study (28). To get the sample size, the Yamane formula (1967) was used. According to Benson and Ayiga (2022), the sample size of the population is determined using a formula when the population is big to come up with accurate respondents/sample size as;

$$n = \frac{N}{1+N(e)^2} \quad (\text{Eq.1})$$

Where:

n = Sample size; N = Population size; 1 = constant; e = Level of precession 12 %.

Therefore:

$N = 31577$; 1 =constant; $e = 12$ %;

$$n = \frac{31577}{1 + 31577 (0.12)^2} = 69$$

$n = 69$ respondents were selected for this study.

Validity is the extent to which a test measures what it is supposed to be measured (29). The research study ensured validity of the instruments for efficiency and effectiveness of the tools to arrive at the dependable findings, conclusions, and recommendations demanded by the study

objectives and topic (27). The instruments were designed and discussed to ascertain whether they were comprehensive, clear, simple, and relevant to the study objectives.

The degree to which an instrument consistently measures whatever it is intended to measure is considered its reliability (30). When evaluating the internal consistency or average correlation of items in a survey instrument, Cronbach alpha reliability coefficients of 0.7 or above (Cronbach, 1951) are utilized. The created scale is more dependable the higher the score. For instance, Arifin and Malaysia (2018) contend that a reliability coefficient of 0.7 alpha is appropriate (Tab.2). This study places a high value on instrument reliability since it allowed for reliability because the same instruments were used again on the same relevant respondents to see whether they produced the same results (Arifin *et al.*, 2018). In the Kanungu district, I carried out a pilot study on the factors that contribute to land degradation and how they affect farmers' lives. The goal was to assess how consistently different research participants responded (17). The association between land degradation and farmer livelihoods was then calculated using Cronbach's Alpha Coefficient (1951), as shown below (Tab.2).

Table 2: Reliability Statistics of questionnaires.

Variable List	Cronbach's Alpha	N of Items
Land degradation	.713	7
Livelihoods of the farmers	.701	7
Relationship	.767	7
Overall	0.727	21

Since the reliability test was 0.7 and above, the instrument was reliable as the basis to decide on the relationship between land degradation and the livelihoods of the farmers. The field data collected was processed and analyzed both quantitatively and qualitatively. During processing, the data was edited, coded, and the tabulation of data proof read. This ensured a clear and easy presentation of the research findings. According to (32), after carefully sifting the data, it was edited, coded, and input into a computer using the Statistical Program for Social Sciences (SPSS) software. From this information, frequencies, percentages, means, correlations, and regression analysis tests were produced.

4. Results

4.1. Demographics

The demographic characteristics evaluated in this study were age of respondents, sex, marital status, and educational level. These characteristics were selected because they influence the causes of land degradation and its impacts on livelihoods of the farmers in Kanungu District. The findings are presented and discussed in the (Tab.3) blow.

From the field survey conducted in Kanungu District, out of 69 respondents that were selected to participate in the study, 58% were male respondents and 42% were female respondents (Tab.3). The study findings indicated that the number of males was bigger than that of their female counterparts. This is because men in Kanungu District are more involved in land degradation. The majority, 36% of respondents, were in the age bracket of 21–30, and 7% were aged 50 years and above. The researcher considered the age of respondents in order to acquire their knowledge based on their life-time experience with the impacts of land degradation on the livelihoods of the farmers in Kanungu District, 62% of the respondents were married, whereas 36% were single. Lastly, 58% of the respondents had completed their secondary level of education, followed by 29% who attended university, and only 13% of the respondents attained an institution level of education.

Table 3: Demographic Characteristics of Respondents.

Gender	Frequency (N=69)	Percentage %
Sex		
Male	40	58
Female	29	42
Age		
<20	10	15
21-30	25	36
31-40	14	20
41-50	15	22
50>	5	7
Marital Status of Famers		
Married	43	62
Single	26	38
Level of Education		
Secondary	40	58
Institutions	20	29
University	9	13

Field survey findings in the (Tab.4) above shows that majority of the respondents in Kayonza sub-county, Kanungu District strongly agreed that deforestation causes land degradation with a (Mean = 4.49 and SD = 0.947), on population increase, participants greed (Mean = 3.46, SD =

0.500), on increased rainfall, some of the participants agreed with (Mean = 3.14, SD = 0.804), and when asked if their poverty causes land degradation, majority agreed (Mean = 3.63, SD = 0.492).

Table 4: Community response on causes of land degradation

Causes of land degradation	N	Min.	Max.	Mean	Std. Dev.
Deforestation	69	2	4	4.49	0.947
Population increase	69	1	4	3.46	0.500
Increased rainfall	69	0	4	3.41	0.804
Poverty	69	4	4	3.63	0.492
Valid N (listwise)	69				

Note that a score of 5 indicates strong agreement, a score of 4 indicates agreement, a score of 3 indicates uncertainty, a score of 2 indicates disagreement, and a score of 1 indicates significant disagreement. The mean was used to make conclusions of the findings and was interpreted as follows: 1 to 1.8 = strongly disagree; 1.81 to 2.60 = disagree; 2.61 to 3.40 = not sure; 3.41 to 4.20 = agree; 4.21 to 5 strongly agree.

4.2. Correlation results on the effects of land degradation on livelihoods of farmers.

Based on (Tab.5) above, the study found out that a significant positive relationship existed between effects of land degradation and livelihoods of farmers ($p < 0.01$, $r = .530^{**}$) in Kanungu District which suggests that adoption of new seed varieties which can withstand harsh climatic conditions, strengthening agricultural reforms, and agroforestry would improve livelihoods of local farmers to improve on their savings and production of quality crop produces. Therefore, the alternative hypothesis is therefore accepted and concluded that “There is a significant relationship between land degradation and livelihoods of farmers in Kanungu District.” Hence, it can be concluded that land degradation significantly affects livelihoods of farmers.

Table 5: Shows correlational results for the effects of land degradation on livelihoods of farmers

<i>Correlations</i>				
			Effects of Land degradation	Livelihoods of farmers
Spearman's rho	Effects of Land degradation	Correlation Coefficient	1.000	0.530^{**}
		Sig. (2-tailed)	0.000	0.000
		N	130	130
	Livelihoods of farmers	Correlation Coefficient	0.530^{**}	1.000
		Sig. (2-tailed)	0.000	0.00
		N	130	130

****.** Correlation is significant at the 0.01 level (2-tailed).

4.3. Regression results on the effects of land degradation on livelihoods of farmers

Results presented (Tab.6) include R as 0.533, R² as 0.282, adjusted R² as 0.270 and standard error of the estimate as 0.86105 using the predictor; effects of land degradation. The R² value of 0.282 suggests a 28.2% variance that land degradation had on livelihoods of farmers in Kanungu District while the remaining percentage of 71.8% could be attributed to other factors not studied. Lastly, land degradation was found to have a significant positive effect of on livelihoods of farmers, it can be said that land degradation significantly affects livelihoods of farmers.

Table 6: Regression results for the effects of land degradation on livelihoods of farmers.

Model	R	R ²	Adjusted R ²	Std. Error of the Estimate
1	0.533	0.282	0.270	0.86105

a. Predictors: (Constant), effects of land degradation

Findings in Table 7 shows $\beta = 0.732$, implying that a 1 unit increase in climate change effects will lead to a 0.732 increase in the livelihoods of farmers. This is statistically significant at 95% confidence levels since $P = 0.00 < 0.05$. By implication, any improvements in farming practices will improve farmers' livelihoods in terms of reduced bush burning, reduced over cultivation and bush fallowing, adoption of new crop varieties, and agroforestry.

The results revealed that bush burning has a positive and significant influence on the livelihoods of farmers ($\beta = .578$, P-value = .000), which indicates that emphasis on reducing bush burning will improve farmers' livelihoods in Kanungu District in terms of mass education to farmers on how to maintain soil fertility, use of mulches as a mechanism to keep soil warmth, soil texture, and protection of soil micro-organisms to increase crop productivity.

Lastly, the results revealed that over cultivation, as one of the causes of land degradation, has a positive and statistically significant influence on farmers' livelihoods ($\beta = .523$, $p = .003$), which indicates that emphasis on reducing over cultivation through crop rotation will improve farmers' livelihoods in terms of increased soil fertility that facilitates crop growth, thus reducing poverty, hunger, and pressure on the available plots of land in Kanungu District.

Table 7: Coefficient

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.147	0.215	-	11.481	0.000
	Climate change	0.693	0.056	0.732	10.432	0.000
	Bush burning	0.615	0.083	0.578	9.802	0.000
	Over cultivation	0.821	0.082	0.523	5.367	0.000

a. Dependent Variable: Livelihoods of farmers

b. Predictors: (Constant), Climate change, bush burning, over cultivation

4.4. Impacts of Land Degradation on livelihoods of farmers

Table 6: Community response on impacts of land degradation.

Impacts of land degradation	N	Min.	Max.	Mean	Std. Dev.
Reduced agricultural productivity	69	0	4	3.42	0.765
Loss of biodiversity	69	1	3	3.44	1.443
Low crop harvest	69	0	4	4.20	1.194
Increased soil erosion	69	0	4	5.11	1.884
Valid N (listwise)	69				

Note that a score of 5 indicates strong agreement, a score of 4 indicates agreement, a score of 3 indicates uncertainty, a score of 2 indicates disagreement, and a score of 1 indicates significant disagreement. The mean was used to make conclusions of the findings and was interpreted as follows: 1 to 1.8 = strongly disagree; 1.81 to 2.60 = disagree; 2.61 to 3.40 = not sure; 3.41 to 4.20 = agree; 4.21 to 5 strongly agree.

From the field survey conducted, it was found out that most of the participants were agreed that land degradation reduces agricultural productivity with (Mean = 3.42, SD = 0.765), on loss of biodiversity, some of the participants also agreed with (Mean = 3.44, SD = 1.443), participants agreed that low crop harvest is as a result of land degradation (Mean = 4.20, SD = 1.104), participants also strongly agreed that the increased soil erosion result from land degradation (Mean = 5.11, SD = 1.884).

5. Discussion

5.1. Causes of land degradation

A majority of the participants agreed that deforestation causes land degradation in Kanungu District. This is in argument with Shoko and Naidu (2022); Assefa & Hans-Rudolf (2016), said that farmer perception is a factor in determining the level of acceptance and implementation of land management strategies. This is due to the fact that farmers have diverse viewpoints, but the majority of them in Kanungu District's rural areas concur that when trees are cut down, agricultural lands are left exposed to agents of soil erosion, which causes land degradation.

One of the key informants mentioned that: We have been practicing deforestation to get charcoal, school fees, and money to buy alcohol, not knowing that we are enhancing soil erosion, which is as a result of land degradation. With the skills gained from this research you are conducting; we are going to reduce deforestation and encourage most of the local communities to plant trees. (Key informant).

One of the farmers observed that: I have to keep a keen eye on the existing environmental programs, especially over the radio, to make sure that farming activities are improved and new farming methods are adopted like planting cover crops and early planting to reduce soil erosion in Kanungu District. It is a hard task since I am not an environmentalist by profession, but I follow the guidelines to ease conservation of biodiversity.

Relatedly, according to Ullah et al. (2021), the majority of deforestation activities are linked to rising demand for agricultural land, fuel charcoal, and timber cutting, as in the argument of Negassa et al. (2020). Uitto (2019) noted that this typically occurs in the context of inadequate institutional forest preservation measures and that it is advisable to build on existing knowledge, which will involve looking at interactions to lessen environmental changes and human-induced activities.

Furthermore, it was found out that most of the participants agreed that population increase causes land degradation. One of the participants revealed that: Due to war, in of Kanungu, there has been an increase in the population, and this has led to increased pressure on the available lands; hence, land degradation. (Chairperson LCI).

Additionally, it was shown that local farmers in Kanungu District concurred that rising rainfall contributes to the degradation of the land. Rainfall has an impact on agricultural fields, which reduces soil fertility and, as a result, crop yields. In accordance with Adenle *et al.* (2020), who claimed that decreased tree cover and increased grazing pressure continue to lower rangelands' productivity during rainy seasons, some respondents claimed that heavy rainfall kills their animals as they search for pastures and water, particularly from the rivers Munyaga and Ntengere in Kayonza sub-county.

The findings of the study survey support Yu and Rodrigo-Comino (2021), poverty contributes to land degradation and that this has an effect on agricultural productivity. This has an effect on agricultural output because it makes other necessary commodities and services less accessible to low-income households and because it makes labor more expensive to get these necessities.

One key informant mentioned that: People continue to use the little plots of land that they have due to poverty. He adds that most of the farmers in Kanungu District cannot manage crop rotation because they depend on the small pieces of land they have for survival. This has led to

increased land degradation in most parts of Kayonza sub-county like Kyeshero, Munyaga, Kyandago, Kanyabuhama, and Nyamiya. (Key informant).

5.2. Effects of land degradation

The majority of participants, it was discovered, agreed that land degradation lowers agricultural productivity. According to Thapa (2021), land degradation not only lowers the productive potential of agricultural land, rangelands, and forest resources but also has a substantial negative influence on biodiversity, which in turn causes farmers to produce less food. Additionally, after classifying these consequences as non-economic and economic, it was discovered that land degradation has already contributed to poverty in the Kanungu population, both rural and urban. Because land degradation occurs over such a long period of time, its effects on the community are difficult to measure.

One of the key informants mentioned that: The decline in land caused by human-induced activities has been a key task in Kanungu District and will remain a major issue. This may result in food insecurity and degradation. He added that effort has been made by the Uganda government through the National Resistance Movement (NRM), but local farmers are not putting into practice what the government is implementing and this needs an intervention because we get food from soils and they need much attention in terms of conservation.

It was discovered that some of the participants shared Salvati (2021) opinion that the lack of economic estimates of degradation is due to shortcomings in the gathering or dissemination of information about natural resources by the pertinent research institutions (17), which has resulted in biodiversity loss and alteration where little effort has been made. Some of the respondents stated that the poor water quality, crop loss, and animal deaths brought on by the excessive rainfall in Kanungu District were among the effects (19). Famine and starvation have resulted from these problems. Land degradation and food security, which require evaluation, were not examined in this study.

Additionally, several participants concurred that the low crop production in Kanungu District is due to land degradation, while other participants firmly agreed that the increased soil erosion is due to land degradation. High population densities, steep slopes, and densely cropped hillsides characterize the highland region of Kanungu. According to Desta *et al.* (2021), erosion and the ensuing soil deterioration have thus been considered to be a serious problem ever since before independence, and they still are in the study area with few solutions being implemented.

Although the findings of erosion measurements vary widely. Raimondo et al. (2021) noted that the erosion measurement results vary greatly, but it appears that the soils of Kanungu are stable and have high infiltration rates, leading to less than expected but still significant soil loss.

Conclusions

In conclusion, the study findings proved that there was a significant positive relationship between the effects of land degradation and livelihoods of farmers ($p = < 0.01$, $r = .530^{**}$) in Kanungu District which suggests that adoption of new seed varieties which can withstand harsh climatic conditions, strengthening agricultural reforms, and agroforestry would improve livelihoods of local farmers to improve on their savings and production of quality crop produces. Therefore, the alternative hypothesis was therefore accepted and concluded that “There is a significant relationship between land degradation and livelihoods of farmers in Kanungu District.” Hence, it can be concluded that land degradation significantly affects livelihoods of farmers (Fig.3).

It is also concluded that majority of the participants agreed that deforestation causes land degradation. This was because most of them in rural areas of Kanungu District agree that when trees are cut down, agricultural lands are left bare to agents of soil erosion and this results in land degradation and little effort has been taken to reduce this problem.



Figure 3: Some photos of land degradation in the in Kanungu District, Uganda.

Recommendations

To reduce land degradation in Kanungu District, strict laws and policies should be implemented. Environmental managers and policymakers are primarily responsible for preventing agricultural practices which leads to soil erosion like bush burning, deforestation. Hence, policymakers should enhance mass education over radios, community engagement and formation of local farmer village meetings on how to reduce land degradation there-off.

The management control role, which is critical to good soil resource governance, should be reformed and repositioned to ensure that monitoring, assessment, and reporting activities are logically linked to promote long-term soil conservation. This should unambiguously require focused governance improvements to minimize inefficiencies from land conservation control procedures to assure Kanungu soils are protected and managed for future use.

Abbreviations

HC	Health Center
HCIV	Health Center Five
KDLG	Kanungu District Local Government
NRM	National Resistance Movement
SD	Standard Deviation
SPSS	Statistical Program for Social Sciences

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Benson Turyasingura and Prof. Natal Ayiga, mainly collected the data and did the preliminary analysis and some interpretation. Prof. Brahim Benzougagh mainly designed this work and revised the paper totally. The authors read and approved the final manuscript.

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