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Response to Land Degradation in Muduuma Sub-County, Mpigi District-Uganda

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Abstract: This study dealt with response to land degradation in Muduuma Sub-County, Mpigi District-Uganda. The study employed the cross sectional design due to its ability to collect data on more than one case from different respondents and at a single point in order to receive a body of quantitative data in connection with two or more variables. The target population was all the 9121 farmers of Muduuma Sub- County. However, only 114 of the total population was purposively sampled basing on the researcher's judgment that only arable farmers were fit for the study. Data was collected through a questionnaire, an interview guide and a Focus Group Discussion Guide and it was analyzed through the descriptive statistics and the thematic approach. The study concludes that the majority of farmers had knowledge of land degradation. This was shown through the various actions taken to address the phenomenon despite having limited formal education. Methods used include organic manure, mulching, trenching, afforestation and fertilizers. Therefore, knowledge about causes and impact of land degradation to households is required. Once the population is more informed about the dangers of land degradation, it is easier to develop suitable soil management practices which in turn promote appropriate resource management practices for sustainable economic growth and development.

Keywords: Land degradation; People's perception; Muduuma; Mpigi district.

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Introduction

Land degradation and desertification are among the world's greatest environmental challenges (ELD Initiative & UNEP, 2015). Land degradation refers to the loss of the productive capacity of soils characterized by loss of soil fertility, biodiversity and overall deterioration of natural resources (Chinzila, 2018). The Global Land Outlook, published by the United Nations Convention to Combat Desertification (UNCCD) reveals that pressures on global land resources are greater than at any other time in human history (UNDP, 2019). Orr et al. (2017) reported the estimates of Food and Agricultural Organization (FAO) which indicate that up to 25% of all land worldwide is currently highly degraded, 36% is slightly or moderately degraded but in stable condition and only 10% is improving.

Land degradation has reduced the productivity of nearly one-quarter of the global land surface which has impacted the well-being of about 3.2 billion people and costed about 10% of annual global gross domestic product in lost ecosystem services (Global Mechanism of the UNCCD and CBD, 2019). Soil erosion is regarded as the most serious form of land degradation around the world, especially in developing countries like Uganda, as well as some developed countries like Spain (Jiang et al., 2014). Agricultural productivity in most of the Easten Africa region is stagnant or declining because of land degradation.

Generally, it is estimated that between 4% and 12% of GNP in Uganda is lost from environmental degradation where 85% of this comes from soil erosion, nutrient loss and changes in crops. In Mpigi District, it is reported that there is declining trends in land cover with deforestation, soil erosion, un-restored quarry sites and other forms which pose dangers to human settlement (District, 2011). There are many studies about land degradation (Abdelrahman et al., 2022; Prăvălie et al., 2021) but little attention is put to the perceptions of the local people.

A healthy land is vital for the existence and persistence of human societies (Global Mechanism of the UNCCD and CBD, 2019). Land degradation is usually described as the natural resource that is being depleted (e.g., soil, Vegetation, environmental degradation) or the biophysical process by which it operates (e.g., soil erosion by wind or water, salinization, deforestation) (Nachtergaele et al., 2016). Available estimates show that land degradation affects 46% of Africa's land area with many people being affected. Additional estimates show that 75 to 80% of the continent's cultivated area is reportedly degraded with a loss of 30 to 60 kg of nutrients per hectare per year (Chinzila, 2018; ELD Initiative & UNEP, 2015). These figures are so alarming given the position Africa lies on the world map as the least developed continent.

Land degradation processes can have both natural and human (anthropogenic) origins (Kertész, 2009). Scientists recognize that the magnitude of change at which land is degraded is large and is leading to a future of uncertainty in land productivity. One estimate, for example, holds that the global expansion of croplands since 1850 has converted some 6 million km^2 of forests/woodlands and 4.7 million km^2 of savannas/grasslands/steppes (Lambin et al., 2001). According to the expert-based Global Assessment of Human-induced Soil Degradation (GLASOD) survey, about 15 percent of land is degraded (Thomasson, 1992). The highest proportions were reported for Europe (25 percent); Asia (18 percent) and Africa (16 percent) while the least was in North America (5 percent). As already pointed out, soil erosion is the most important form, causing more than 83 percent of the area degraded worldwide.

The main causes of land degradation in Africa include demographic growth, conflicts and wars with expanded refugees settlements, inappropriate soil management, deforestation, shifting cultivation, insecurity in land tenure, variation of climatic conditions and intrinsic characteristics of fragile soils in diverse agro- ecological zones (Chinzila, 2018; Hannam, 2022). Different forms of land degradation can affect the quality and productivity of soils and limit various soil ecosystem services in a given environmental system (Seifollahi-Aghmiuni et al., 2022).

Biophysical causes and unsustainable land management practices are reported to be the immediate causes of land degradation (Nkonya et al., 2012)The biophysical causes include topography, which determines the soil erosion hazard and climatic conditions, such as rainfall, wind and temperature. Poverty can be both a result and a cause of land degradation (Pender et al., 2004). Under intense stress to meet subsistence needs, poor farm households may react in ways that are deleterious to soil fertility because they cannot afford to make land improvement investment such as application of adequate soil nutrients. It should be noted that the failure to make land improvement investments leads to further reduction in crop yields and returns from agriculture, contributing to greater poverty.

In Uganda, Steep Slopes, deforestation, use of marginal lands and Land fragmentation are direct causes of land degradation while population pressure, reduced fallows and climate change effect key out as indirect causes (Republic, 2018). The expansion of area under cultivation has been primarily due to short and medium-distance migration and conversion of wetlands, grasslands and forests to crops (Olson, 2003). Bernard et al. (2022) suggest that deforestation driven by anthropogenic activities can have multiple negative impacts on the environment including loss of wildlife habitat, soil erosion and desertification, water cycle disruption, loss of traditional livelihoods, and increased ecological risks from forest fragmentation.

Study Area

This study was carried out in Muduuma Sub-county which is located in Mpigi District in Central South Uganda. It lies between latitudes 0^0 15' North and 0^0 25' North and longitudes 32^0 16' East and 32^0 25' East. The sub county is bordered by the sub-counties of Namayumba and Kakiri to the North; Wakiso and Nsangi to the East; Kiringente and Kalamba to the South and Malangala and Ssekanyonyi to the West as seen in Figure 1.

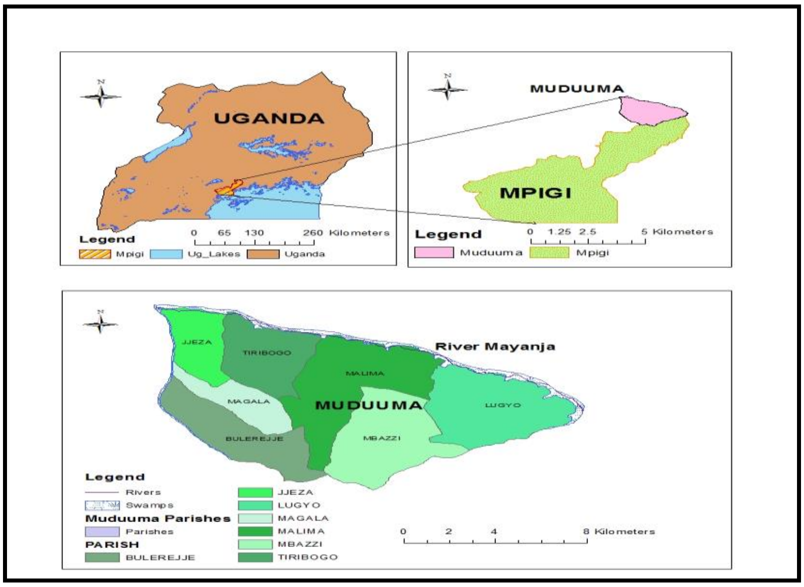

Figure 1: The location map of Muduuma Sub-county, Mpigi District

The sub-county covers a total land area of $161km^2$ (UBOS 2004) of which Malima parish covers approximately $35km^2$, Lugyo $32Km^2$, Mbazzi $28Km^2$, Bulerejje $22Km^2$, Tiribogo $20Km^2$, Jeza$13Km^2$ and Magala $11Km^2$. The Sub County area accounts for 10.5% of the total land area of Mpigi District which is $1524Km^2$ and 0.06% of the total land area of Uganda which is 241,000 km^2. Being centrally located in the great African plateau within Southern-Central Uganda, Muduuma Sub-County's landscape forms a visibly impressive scenery consisting of flat-topped and rounded hills which rise very nearly to the same height. These hills are separated by gentle slopes with broad valleys often containing thick papyrus swamps. The elevation ranges between 1,140 and 1,311 meters above sea level with the highest point being Mairye hill in Mbazzi Parish (1,311m while the lowest point is 1,1140m, near river Mayanja in the northern part of the Sub County (EAST AFRICA 1:50,000 (UGANDA) KAKIRI; Sheet 70/2 Series: Y732 Edition 3-U.S.D).

Topography

A keen observation aided by the topographic survey map extract EAST AFRICA 1:50,000; UGANDA; KAKIRI; Sheet 70/2 Series; Y732 Edition 3-U.S.D indicates that the landscape of this study area can be divided into three distinct categories: raised, low and gently sloping landscapes. About forty eight hills can be identified on the map forming the first category of raised landscape across the seven parishes of the sub county. These hills are typical of Buganda land system (Figure 4) characterized by a combination of steep slopes forming conical shapes while others are gently sloping with flat tops. The pediment slopes have been eroded due to extensive agricultural practices Figure 2 as well as the geomorphic processes that have been taking place in the area for a long period of time.

The gentle slopes form the third category of landscape that covers a large proportion of the total land area in Muduuma sub-County. These gentle slopes are located between hilly and the gentle areas respectively. In general, this landscape can be described as undulating across the whole sub-county. Agriculture as a backbone is the most dominant land use in the third category of landscape.

The lowlands form the second category and are located amidst the hills, which are likewise colonized by swampy vegetation forming buffer zones of several tens to hundreds of meters along river banks (Figure 3). Beyond these buffer zones, other vegetation types can be identified, including tall grass and trees. The most outstanding of all the lowlands is located in the South-East of the Sub-County stretching all the way through the eastern boundary and stretching along the northern boundary of the Sub-County. This lowland is occupied by River Mayanja which is fringed by a long stretch of a papyrus swamp. In the western periphery of the sub-county, there is River Muyobozi lowland which occupies a smaller proportion in terms of size compared to the former. It is also covered by a thick papyrus swamp enclosing the whole river channel.

Figure 2: One of the hills representing both the raised and the gentle slopes where crop growing is visibly seen dominating the gentle slopes. The photograph was taken in Mbazzi parish, Muduuma sub-county

Figure 3: Mayanja swamp, one of the lowland areas in the study area located in the northern part of Muduuma Sub-County

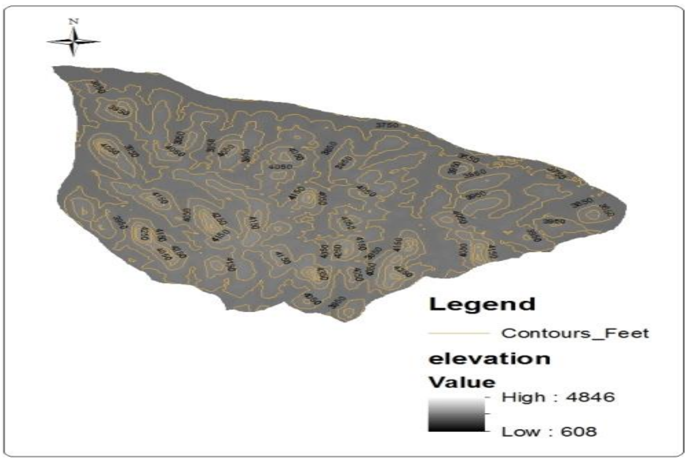

Figure 4: Elevation map of Muduuma Sub-County, Mpigi District

Climate and Land Cover

Like the rest of Mpigi District, Muduuma sub-county experiences a bi-modal rainfall pattern annually with the first rains received between the months of March and May. The second rains are received between the months of August and November. The average annual rainfall amount in the area is about 1320mm (NEMA-Mpigi 2011). Although the annual rainfall is high, its distribution is not even and it is sometimes unreliable.

The average annual maximum temperature of the district ranges between 22.5°C and 27°C while the average minimum temperatures vary from about 18°C to 23°C. The area is characterized by two main vegetation types, that is, natural vegetation cover and planted vegetation cover. Being located within Lake Victoria crescent, tropical rain forest used to dominate as the natural vegetation. However, due to high population increase, forest vegetation is almost completely gone. Other vegetation types found in the area include tall grass such as Elephant grass, Spear, Guinn grass and short grasses such as Lemon, Thatch grass and Couch grass with scattered trees such as *Cacia Hokii* which have gradually taken over. Planted forests have recently been introduced especially in severely destroyed government forest reserves with individual private owners jumping the queue (Figure 5).

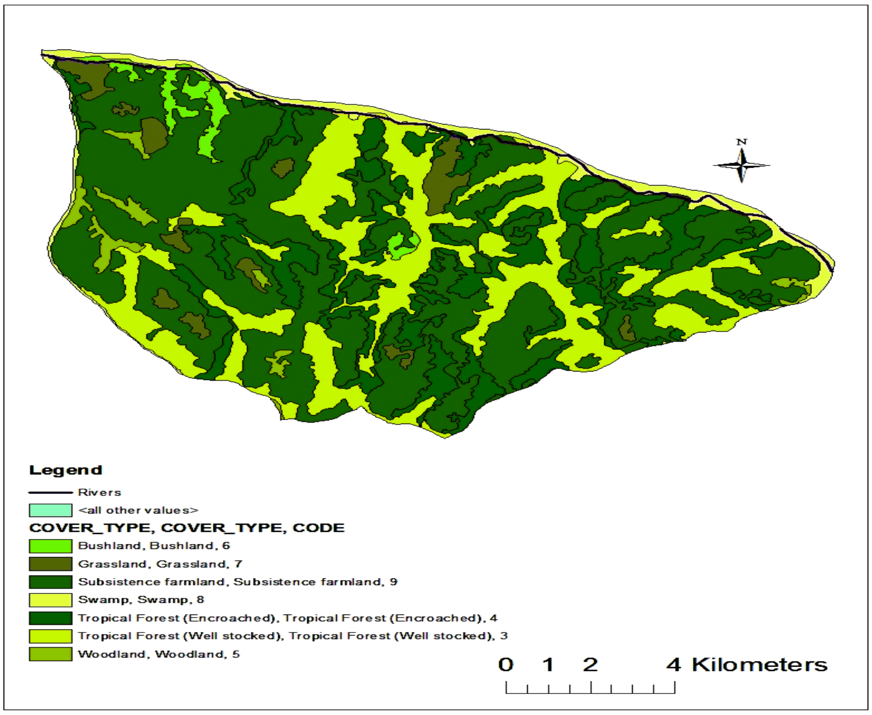

Figure 5: Land cover map for Muduuma sub-county, Mpigi District

Soils

The soils of the area can be categorized as typically the Buganda catena, consisting of shallow brown loam soils on broad crests with deep residual soil on the side slopes (Fungo et al., 2011). This has a great impact on the concentration of land use in the area where majority of the population have been attracted to the gentle and lower slopes leaving the upper slopes unoccupied. With this, land degradation has been eminent on the lower and gentle slopes due to the fact that they are the potentially productive areas.

The area is predominantly a banana-coffee farming system where coffee and bananas are grown in considerable amounts the former being entirely cash crop for export. Other crops cultivated include maize, beans, potatoes, yams and cassava. A small fraction of farmers grow vegetables and fruits, which are mainly grown on homestead gardens. Indeed, many households' livelihoods are characterized by small-scale subsistence mixed farming-system, with livestock (e.g. cattle, sheep, goats, pigs and chicken) farming as an integrated part. In regard to crop production, farmers mainly depend on rain-feed farming system dominated by annual food crops.

Demography

The total human population of Muduuma Sub-county was estimated in 2004 to be approximately 21,271 and in 2014 to be 30403 (Table 1). This population was characterized as typically rural. While the population density of the Sub County was estimated at 134 persons per square kilometer (2004), with an annual growth rate of 3.5% (NEMA-Mpigi, 2011). This high growth rate is linked to the current high pressure exerted on land, hence accelerating land degradation.

Table 1: Human population of Muduuma Sub-county

Year	Males	Females	Total
2004	10,817	10,454	21,271
2014	14941	15462	30403

Table 2: **Demographic attributes of respondents (n-114)**

Variable		*Frequency*	*Percentage*
Sex	Male	53	46.49
	Female	61	53.50
Age (years)	20-34	29	25.43
	35-49	44	38.59
	50-64	27	23.68
	>65	14	12.28
Education level	Non formal	53	46.49
	Primary	39	34.21
	Secondary	17	14.91
	Certificate and above	5	4.38
Farming experience (years)	1-5	37	32.45
	5-10	31	27.19
	11-15	27	23.68
	>15	19	16.66
Land holding size (acreage)	<5	71	62.28
	6-10	26	22.80
	>10	17	14.19
Monoculture		59	51.75
Deforestation		77	67.54
Soil erosion vulnerability		56	49.12

Methodology

This section presents the methodology which guided the study.

Design

The study employed the cross sectional design due to its ability to collect data on more than one case from different respondents and at a single point in order to receive a body of quantitative data in connection with two or more variables (Baxter et al., 2008). The design was employed alongside both quantitative and qualitative approaches.

Population and Sampling

The target population was all the 9121 farmers of Muduuma Sub- County. However, only 114 of the total population was purposively sampled basing on the researcher's judgment that only arable farmers were fit for the study. This was intended to get quality data from the respondents given the limited resources that disenabled the researcher to reach all the farmers in the region. Data was collected through a questionnaire, an interview guide and a Focus Group Discussion Guide. Data was analyzed through descriptive statistics and the thematic approach.

Validity

The research instruments were validated through the application of content validity procedures. The researcher consulted supervisors who are experts in research to validate the instruments. The validity of instruments was further tested using the Content Validity Index (CVI) which yielded the construct validity index of 0.83. The researcher further established the validity of the instruments by using the expert judgment method. This involved judges scoring the relevance of the questions in the instruments in relation to the study variables and a consensus judgment was given on each variable.

Reliability
Reliability of the instruments was established through a test-retest technique. The researcher conducted a pre-test of the instruments to a group of subjects. Data was entered into the computer using SPSS to establish reliability of quantitative data provided by Cronbach's Alpha.

Ethical Considerations
The researcher took time to explain to respondents about the study purpose and the information given was to be treated with utmost confidentiality. The study sought for the willingness of respondents to participate without pay. The researcher further sought for permission from relevant authorities before data collection. Information was gathered from the respondents after consenting to participate in the study.

Results and Discussion
The study sought to establish people's response to land degradation in Muduuma Sub-county, Mpigi District.

The study showed that 46.49 of the 114 respondents were men while 53.50 were women which is in line with the national population status with majority being women (UBOS, 2020). Whereas the majority of respondents attained lower levels of education, some household heads were found having some knowledge about land degradation. This contends with Tesfahunegn (2018) who stressed that farmers are usually aware of land degradation problems though not always specific to the causes. This was revealed in good land management skills (figure 6) which some of these farmers exhibited. Some of respondents' gardens were well tilled. Crops were well maintained with good soil conservation skills. However, the ever shrinking land per household posed a serious challenge to respective farmers. According to the study findings, households identified having not more than 5 family members but most of them were found with less acreage of land. This aggravates the occurrence of land degradation in Muduuma Sub-County. FGDS showed that these households were staying with close family relationships. This implies land fragmentation amongst family members; a phenomenon which directly occur as a result of population increase (Lal, 2006). Population growth can induce responses in terms of agricultural intensification and technological and institutional innovation (Saguye, 2017) which act to reduce poverty and natural resource degradation (Nkonya et al., 2008).

Soil Conservation Methods
Results show that farmers engaged in various soil and water conservation methods used in their gardens, for example, the use of manure, mulching, digging of trenches to control surface run-off, afforestation and fertilizer application (Table 3). This is in line with Buyinza and Mugagga (2010) who stressed that farmers have increasingly employed different land conservation strategies to maintain the fertility of their land.

Table 3: Soil Conservation Methods

Conservation Method	*Frequency*	*Percent*
Organic Manure	31	27.0
Mulching	20	17.4
Trenches	16	13.9
Afforestation	11	9.6
Fertilizer	9	7.8
None of the above	27	23.6
Total	114	100

In table 3, the questionnaire revealed that organic manure was found to be the most commonly used method at 27.0%. The main type of organic manure used by farmers was from cow dung. Study findings by Mwaura et al. (2021) indicate that majority of farmers who used organic manure received high yields from their harvests.

In mulching, farmers used an assortment of plant materials that include dry grass, leaves and small twigs spread uniformly on the surface of soil in the gardens (Figure 6). However, very few farmers (17.4%) practiced it as it is tiresome and materials for mulches are not readily available. The major crops mulched were bananas, tomatoes and coffee. According to Tuure et al. (2021), covering the soil with mulch decreased the drying rate of the soil after precipitation events. However, some farmers were reluctant in the use of this soil conservation method which one of the residents in Senene village in Mbazi Parish described as being lazy. This method was said to be effective for crops especially during the dry season which according to the local farmers made their crops thrive better, particularly during the dry season. The organic mulch helps to protect the soil from evaporation thus keeping moisture within the soil. Grass, leaves and small twigs decompose and add nutrients within the soils.

Figure 6: Mulching at Kasabo in Malima parish, Muduuma, sub-County, Mpigi District

Figure 7: Trenches in the Garden

It was observed that people dig trenches as an approach to soil conservation. This method was third most used following manure and mulching with 16 (13.9%) respondents using it. One of the farmers in Nkambo Malima Parish noted that trenches (Figure 7) help to retain water within the garden which sustains nutrients and water in the soil.

The farmer further narrated that during the rainy season, water collects in trench dug in the garden for some hours. “It reduces water flow and loss as well as soil loss” he explained. This practice was common on raised slope areas where soil loss is highly likely to occur. In attempt to ameliorate challenges within the context, digging ditches was used even though records indicates that it neither put the context upright nor increased production (Ssali, 2002).

Conclusions and Recommendations

The study concludes that the majority of farmers had knowledge of land degradation. This was shown through the various actions taken to address the phenomenon despite having limited formal education. Methods used include organic manure, mulching, trenching, afforestation and fertilizers. Therefore, knowledge about causes and impact of land degradation to households is required. Once the population is more informed about the dangers of land degradation, it is easier to develop suitable soil management practices which in turn promote appropriate resource management practices for sustainable economic growth and development.

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