JOURNAL OF NATURAL RESOURCES AND DEVELOPMENT

Land Degradation Management in the Lawra District of Ghana: Present Practices and Opportunities for Rural Farmers in Semi-Arid Areas

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Article history

Received 02/10/2016
Accepted 07/12/2016
Published 28/12/2016

Keywords

Livelihoods
Over cultivation
Productivity
Restoration
Sustainable agriculture

Abstract

This study contends that land degradation is depriving rural farmers and other agriculture-dependent poor people in semi-arid areas of sub-Saharan Africa of their traditional means of sustainable livelihood. The study sought to assess present trends in land degradation and management practices and examine the potential for redress based on the perspective of rural farmers in the Lawra District of the Upper West Region of Ghana. Using a mixed-method approach, the study revealed that inappropriate land use practices, such as bush burning, over cultivation and tree cutting, are taking over the resources of the ecosystems of the community, thereby affecting sustainable means of crop production. The study points out that interventions targeted at improving land productivity for livelihood improvement in the study area are producing positive results and recommends scaling up interventions by refocusing attention on inappropriate land use practices that frequently lead to land degradation.

1. Introduction

Land degradation has become an acute problem in Africa, especially sub-Saharan Africa, where soil erosion, deforestation, overgrazing and mismanagement of land resources have rendered over 320 million hectares of land unsuitable for agricultural production **[1]**. Land degradation processes, such as water erosion, wind erosion and sedimentation, cause long-term destruction of vegetation. Land degradation tends to be accelerated by rapid urbanization, deforestation, poor agricultural practices, pollution and overgrazing, leaving arable lands bare, degraded and unproductive **[1], [2]**. Universally, about 80 percent of agricultural land is degraded by either water or wind erosion, though water erosion is the most prominent **[2]**. Land degradation is a major driver of poverty, preventing smallholder farmers from making agriculture viable and profitable. In sub-Saharan Africa, land degradation affects 67 percent of agricultural lands, with about 490 million hectares showing signs of erosion and declining fertility **[3]**. In Ghana, like most countries in sub-Saharan Africa, the most vulnerable agro-ecological zone to land degradation is the interior savanna, which covers about 50% of the total land area of the country **[4]**. In this environment, traditional systems of soil fertility restoration, such as shifting cultivation and nomadic grazing, have broken down because the carrying capacity of the land has been exceeded **[1], [4]**. This has resulted in the cultivation of minimal and marginal lands with serious degradation problems **[5]**.

The agricultural sector, which plays a fundamental role in Ghana despite the recent transition to an industry and service sector-led economy, is threatened by land degradation **[4]**. According to the FAO **[6]**, land degradation leads to deterioration in the quality and productive capacity of land, resulting in reduction of land-based livelihood opportunities, such as farming. Land degradation therefore deprives farming communities of the active youth needed for self-sufficient sustainable development founded on land resources, which helps agriculture, the core of rural economies. Ghana's agricultural sector comprises approximately 30 percent of the country's Gross Domestic Product to date and employs approximately 50 percent of the population **[7]**. Growing demand for land for agriculture due to increasing population, coupled with climate change, has led to several land use changes. This has resulted in land degradation and threatened progress in the long run, given that the agricultural sector is particularly vulnerable to demographic and environmental changes. The agricultural sector, which is believed to grow at a rate of 6 percent **[8]**, can be retarded by natural and human-induced factors. Land degradation, for example, decreases crop yields, thereby threatening food security.

In the past decade, food insecurity and hunger among rural households in the northern regions of Ghana have been on the rise due to general climatic changes and the resultant land degradation **[9]**. It has generally been observed that natural forces, such as relief, temporal distribution of rainfall and drought, coupled with human activities, such as population pressure, annual bushfires, over-harvesting of wood and unsustainable cultivation practices, are responsible for accelerated land degradation in Ghana **[10]**. According to the FAO **[11]**, 1 in every 8 people in sub-Saharan Africa suffers from chronic hunger, 2 billion suffer from micronutrient deficiencies and a quarter of children are stunted in growth. Increasing agriculture production and, therefore, food availability is essential in tackling these problems. The high incidence of poverty and food insecurity in the northern regions of Ghana is partly due to the semi-arid conditions which make the lands prone to degradation **[12]**.

In the Lawra District of the Upper West Region of Ghana, productivity of farm lands is generally low and variable due to reliance on, and over-cultivation of, limited land. Most people (70 percent) in the Lawra District live in rural areas and depend on subsistence farming for their livelihoods. Most farmers who live in the rural areas practice small-scale rain-fed agriculture and/or agro-pastoralism. They depend on the land for agricultural production or for animal rearing. A large area of the district, equivalent to 70% or more, is semi-arid, while part of it is completely arid **[13]**. The soil in the area is of low fertility, low organic matter content, and low water retention **[13]**. The soils are vulnerable to water and wind erosion, leaching and salinization (due to high temperatures) if put under irrigation. The process of land degradation in the district is attributed to water and wind erosion, sedimentation, long-term destruction of vegetation and decreased bio-resources. This also includes soil salinization due to poor farming methods (i.e. the inability of the farmers to employ appropriate/improved farming techniques). Government as well as private organizations (including NGOs operating in the district), some communities and individuals (including researchers and academics) have identified the need to conserve land and reverse degradation to restore its productivity and improve the quality of life for those who depend on it for their livelihoods. A notable intervention is the Ghana Environmental Resource Management Project (GERMP) designed to support the implementation of the country's Environmental Action Plan (EAP) **[13]**. In the Lawra District, the GERMP aims to strengthen communities to enable them to reverse land degradation trends by adopting sustainable land management practices. The question which this study seeks to answer is; how effective are current land degradation management practices in the Lawra District? Thus the aim of the study is to examine current land degradation management practices and prospects for redress among small-holder farmers in the Lawra District.

1.1 Land Degradation and Management Practices

Land degradation is an environmental phenomenon affecting dry lands and resulting in a long-term decline in ecosystem function and productivity **[4]**. It is the loss of utility or potential utility of land through the reduction of or damage to physical, social, cultural or economic features, and/or reduction of ecosystem diversity **[8]**. There may be a single cause or a complex combination of causes, some may be bio-geophysical ('natural'), and some socio-economic ('human') and it is quite possible that a cause will be indirect, perhaps cumulative and difficult to identify **[14]**.

Land degradation in dry lands is a multi-faceted problem. Consequently, current management approaches that attempt to mitigate such land degradation often fail to produce significant improvements. A major challenge is to learn how interactions between natural and human causes can be better managed to increase prospects for ecologically and socially sustainable improvements to agricultural production **[15]**.

Land degradation threatens fertile land throughout the world. It is estimated that 1 to 1.5 billion people in all parts of the world are already directly and negatively affected by land degradation **[14]**. Between 10 and 20 percent of dry lands are degraded and 24 percent of globally usable land on earth is degraded at an estimated economic loss of USD 40 billion per year, including a startling loss of grain worth US$1.2 billion yearly. If agricultural land productivity remains at its current levels, an estimated 6 million hectares of land would need to be converted to agricultural production every year until at least 2030 to satisfy growing demand **[14], [15]**. Land degradation most directly impacts one of the most vulnerable human populations – the rural poor. More than 1.2 billion people live on fragile lands in developing nations, where they are clustered in fragile environments, remote areas, and/or on marginal lands, and depend directly upon the most degraded land for their sustenance and income **[16], [17]**.

Land degradation in semi-arid and arid areas is one of the major environmental issues of the 21st century, particularly due to its impact on world food security and environmental quality **[15]**. Recent studies indicate that the factors that trigger land degradation, such as global climate change, have resulted in drier conditions in semi-arid and arid regions **[18], [19], [20]**. Degradation of soil and vegetation can lead to substantial reductions in ecosystem functions and services, perhaps in as much as 70 percent of dry lands **[21]**. Soil erosion is the most widespread form of land degradation in these landscapes, while other forms include chemical degradation (loss of nutrients, depletion of organic matter and acidification) and biological depletion. Landscapes devoid of vegetative cover deeply incised by gullies that are difficult to reclaim, characterize large land expanses in the regions of the world classified as dry lands **[15]**. Land degradation and sustainable agriculture in semi-arid and arid areas have a mixed relationship (**Figure 1**). Land degradation results in declining food production but, with effective management practices, the situation can be reversed to ensure sustainable food production.

Population pressure and human activities have a profound influence on the degradation trends and patterns in dry lands **[22]**. Anthropogenic pressures, which are the main underlying causes of land degradation in these areas, include the overgrazing of rangelands, which comprise around 70 percent of dry lands, and conversions to cropland. Grazing pressure, loss of vegetation cover, and the lack of adequate soil conservation practices render soils in these regions more susceptible to processes of soil erosion, which in turn can have important impacts on regional climate and desertification **[23]**. Other human activities contributing to land degradation in semi-arid and arid areas include overcultivation which exhausts the soil, deforestation which removes trees and vegetation which binds the soil to the land, inappropriate land use practices that turn cropland saline, unsustainable agricultural land use, poor soil and water management practices and improper crop rotation and poor irrigation practices. Type of land use as well as surface physical configuration also affects land degradation. These pressures are exacerbated by climate changes, urbanization and management factors. Natural disasters, including drought, floods and landslides also contribute. Climatic vagaries such as droughts alternating with floods have led to the loss of rich topsoil through soil erosion and sedimentation, rendering large tracts of land worthless

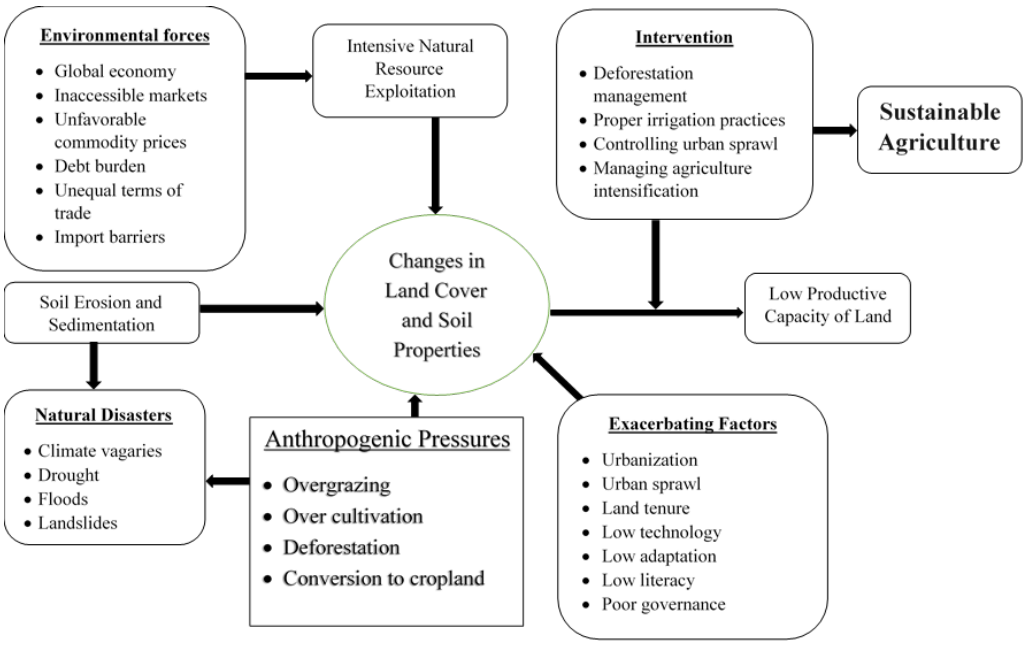

Figure 1: Land Degradation Management and Sustainable Agriculture Linkages

to those dependent on exploiting an area's bio-resources **[17]**. Human-induced causes of land degradation processes can either be direct or indirect. The indirect causes are largely determined by land use and land-use change; economic factors relating to the possibility of investing in the land and access to markets; social factors that assure the availability of infrastructure; and farmers' accessibility to land that allows them to produce at maximum capacity. A number of direct causes may seem natural but are wholly or partly comprised of human causes. Indirect factors such as bush invasion, forest fires, floods, landslides and droughts can have human involvement, while deforestation, overcutting of vegetation, shifting cultivation without adequate fallow periods, and overgrazing are classified as direct human induced factors **[24]**.

Traditional land tenure systems combined with high poverty and low literacy levels common among the rural population complicate land management processes. Low technological capacity, poor governance, poorly conceived management policies and their implementation further complicate land management issues. Technology development, technology transfer and low adoption rates further exacerbate the situation. Land ownership and land tenure determine the success rate of technology adoption as well as willingness to invest in land management initiatives **[20]**. External forces including the state of the global economy, inaccessible markets and unfavorable commodity prices, the debt burden, unequal terms of trade and protectionism plus import barriers in developed countries may increase rates of natural resource exploitation by preventing diversification **[23]**.

Land degradation leads to a significant reduction of the productive capacity of land. Changes in land cover and soil properties affect the productivity of the landscape **[25]**, with important environmental, socioeconomic, and political implications. Land degradations can be controlled through deforestation management, managing irrigation, managing urban sprawl, agricultural intensification and land reclamation. Solutions largely depend on the willingness to change and sharing information that will guide appropriate action. Semi-arid and arid areas face an enormous challenge, part of which is to come up with viable solutions that will reverse the degradation of land and manage it sustainably **[22]**.

2. Study Area and Methodology

The Lawra District is one of the 11 districts in the Upper West Region and it lies in the north-western corner of the Upper West Region of Ghana between latitudes 2° 25′ W and 2°45′ W and longitudes 10°20′ N and 11°00′ N (**Figure 2**), covering an area of approximately 975.5 km^2 **[26]**. The district has its administrative capital at Lawra and shares boundaries with the Nandom District to the north, Jirapa District to the south, Ivory Coast to the west and to the east with the Lambussie-Karni District. The district has a population of approximately 100,929 (48,641 males and 52,288 females) living in 157 communities **[27]** with a growth rate of about 1.7%, which is below the national growth rate of 2.7%. The low population growth rate in the district is attributable to out-migration. According to the 2010 Population and Housing Census Report **[27]**, the Upper West Region recorded the highest negative net-migration rate of 302.50 per 1,000, losing 209,414 people during the 2000-2010 inter-census period. Subsistence agriculture is the main livelihood activity in the district but this is hindered by the poor nature of the soil and unfavorable weather conditions coupled with poor farming practices which lead to transitory food insecurity. Land degradation causing emigration has become a challenge in the district.

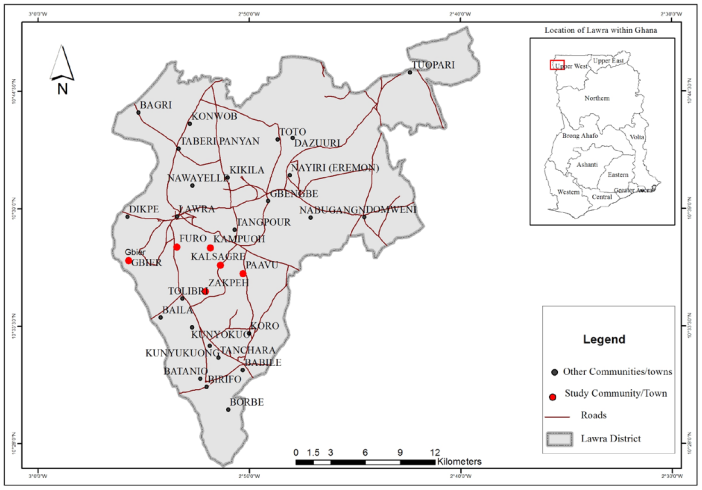

Figure 2: Map of the Lawra District showing the study communities

This study made use of first-hand information generated from the field. A mixed-method approach was used, taking into consideration the data demands of the study. Considering the nature and causes of land degradation in the district, preliminary visits to selected farms within the study communities were undertaken to obtain prior knowledge and understanding of the nature of land degradation in the area. A two-stage sampling method, involving cluster and systematic sampling, was used to select farmers from two groups of communities – GERMP and non-GERMP communities. The GERMP communities are Kaanpuoh, Zakpeh and Kalsagre, with the non-GERMP communities being Paavu, Furo and Gbier (**Figure 2**). The total sample size of 228 farmers was distributed among the six communities using the proportional sampling distribution technique taking into consideration the number of farming households in each community. Questionnaires were administered to collect information on measures adopted to make degraded land suitable for cultivation of crops and general land management practices from the selected farmers. This was followed by field observations on their farms to ascertain land degradation management practices. In addition, in-depth interviews were held with the head of the Department of Food and Agriculture and the GERMP Consultant from the Regional Environmental Protection Agency. The interviews covered nature and causes of land degradation and the practices adopted by farmers to reduce its impacts. Satellite images, the medium resolution landsat thematic images, bands 2, 3, 4 and 5, were acquired from USGS. gov

[31] for the years 1991 and 2014 respectively and merged using Erdas Imagine 9.2 software to form single multiband images for the respective years and ground truthing data helped in the various land cover classifications which included water bodies, bare lands, open savanna, closed savanna and settlement.

3. Results and Discussion

Rural farmers demonstrate adequate knowledge of the occurrence of land degradation and its causes (**Table 1**). The main signs of land degradation mentioned by respondents were increased bare lands, presence of erosion gullies and declining soil fertility, and these were believed to be caused by soil erosion, bush burning, over cultivation, cutting of trees, illegal mining and sand winning. From these responses, it can be said that land degradation is tantamount to its effects and confirms the findings of Dejene *et al.* **[28]** in that farmers are aware that soil degradation is taking place on their farms at various levels as well as in the surrounding areas. Observations made on farms, and confirmed by the GERMP Consultant in the district, indicate that land degradation has been a problem for the past few decades and has worsened annually through inappropriate human activities which have led to development of sheet erosion in muddy areas and gullies in the valleys. The presence of bare lands and erosion gullies appear to be the most frequent signs of land degradation in both GERMP and non-GERMP communities, indicating that bare lands are more exposed to various causes of land degradation. Other evidence of land degradation observed by farmers include loss of tree cover and drought. Farmers were of the view that drought, soil nutrient loss and cutting of trees often deny the land of vegetation cover or protection and expose it to degradation.

Table 1: Nature and causes of land degradation (%)

Evidence of land degradation	Communities		Causes	Communities	
	GERMP	Non-GERMP		GERMP	Non-GERMP
Lands becoming bare	31.6	41.8	Soil erosion	11.4	15.6
Presence of erosion gullies	32.8	34.6	Bush burning	40.3	36.4
Declining soil fertility	27.5	27.3	Over cultivation	23.7	28.7
Others	8.1	6.3	Cutting of trees	10.0	12.3
			Illegal mining	7.1	9.5
			Sand wining	4.8	5.3
			Others	2.7	2.2
Total	100.0	100.0	Total	100.0	100.0

Data obtained in the study (**Figure 3**) indicates that land cover removal increased from 259.02 ha in 1991 to 999.36 ha in 2014, implying a percentage change of 5.66 (**Table 2**). This development is mainly due to the construction of 17 small dams in the district to help reduce water shortages for agriculture. The construction of these dams led to the clearing of vegetation which protected the lands from erosion. The land cover for the closed savannah in 1991 decreased from 19035.99 ha to 12496.32 ha in 2014, implying a 50.0 percent increase in land cover removal, which is also attributed to the human population growth within the study area. There was also an increase in bare lands from 2,621.25 ha in 1991 to 3,074.76 ha in 2014, indicating a 3.47% increase in land cover change. Settlements increased from 7,668.18 ha in 1991 to 8,950.23 ha in 2014, representing a 9.8% increase in land cover change (**Table 2**). The Open Savannah land cover destruction increased from 60927.66 ha in 1991 to 64,991.43 ha in 2014, implying a 31.07% increase in land cover destruction in the Lawra District. Boserup **[29]** and Turner *et al.* **[30]** identified population increase as a push factor which compels farmers to intensify the cultivation of crops to increase food production. In 1984, the population of the district was about 63,717 which increased to about 87,525 in 2000 and further increased to about 100,929 in 2010 **[27]**. The continual increase in population has increased the number of settlements and farm lands within the district. There are also attributions to inappropriate farming technologies and practices in addition to the expansion of farms.

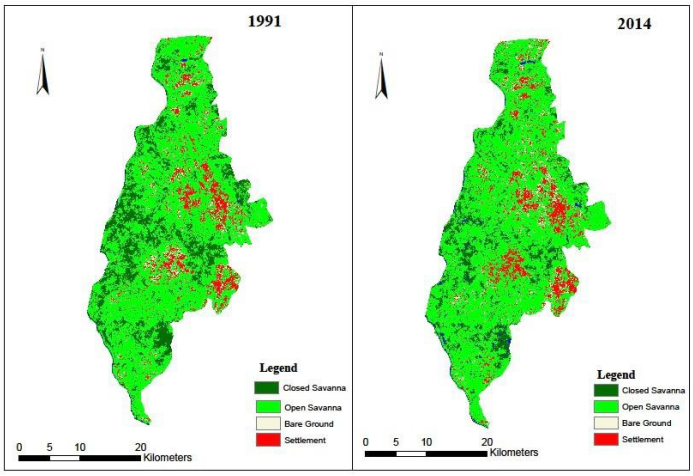

Figure 3: Land Use/Cover Map for Lawra District (1991 and 2014) (Source: Based on data from USGS.gov [31]).

Table 2: Land use/cover change.

Class Name	1991 (ha)	2014 (ha)	Change (ha)	% change	Type of Change
Water bodies	259.02	999.36	740.34	5.66	Increase
Closed savannah	19035.99	12496.32	-6539.67	50.00	Decrease
Open savannah	60927.66	64991.43	4063.77	31.07	Increase
Bare lands	2621.25	3074.76	453.51	3.47	Increase
Settlements	7668.18	8950.23	1282.05	9.80	Increase
Total	90512.1	90512.1		100.00	

Source: based on data from USGS.

The expansion of settlements has led to increases in sand winning for construction activities, which also causes destruction to the land. To be able to meet the basic needs of households, especially in terms of

food and shelter, farmers clear more virgin lands for crop cultivation and construction of houses for the increasing population. Observations from the study show that most of the farms of the respondents are situated far away from where they live and the reason given by an elderly woman of Kalsegra (a GERMP community) is that:

"*… some years back we used to farm around our houses and we got enough food to feed our family members. But now we have to move far away from our homes to look for fertile lands to farm*".

Other farmers claimed that they farm on virgin lands in order to protect their share of lands from being encroached on. The influence of sand winning can also be attributed to rapid urbanization. Vast lands that were hitherto agricultural producing areas are rapidly being used for residential purposes. The direct effects of fast expanding urban areas in the district is the issue of sand winning activities, most of them illegal, either within the towns or close to them. This is in direct response to the many construction works that are taking place in these areas. Most illegal sand winning activities lead to land degradation, soil erosion, drainage obstruction and a general destabilization of the ecosystem **[32]**. The recent discovery of gold deposits in the Lawra District has resulted in increased activities of small scale mine which have imposed additional burdens on lands and environmental degradation due to the removal of vegetation covers, digging of pits and the discharge of mining by-products into water bodies. A number of respondents have therefore identified illegal mining as one of the causes of land degradation in the study area (**Table 1**).

The causes of land degradation, as revealed by the study, confirms Nachtergael *et al.'s* **[33]** claim that the slope of land, and soil vulnerability to water as well as wind erosion influence land degradation processes and that factors such as bush invasion, forest fires, floods, landslides and droughts, may represent human involvement, while deforestation, overcutting of vegetation, shifting cultivation without adequate fallow periods, and overgrazing are classified as direct human induced factors. From the study, most of the respondents were of the view that bush burning is the leading cause of land degradation (**Table 1**). They argued that fire is widely used in land preparation and in hunting, indiscriminately burning out game such as rats and rabbits, whilst others indicated that over-cultivation and soil erosion are the major causes of land degradation in the district. The farmers' knowledge of the nature and causes of land degradation, however, seems to be mixed as some respondents could not distinguish between them. For example, a focus group discussion participant in Furo (a non-GERMP community) observed that:

"*… what I see to be an evidence of land degradation is that roots of giant trees in the community are being exposed which shouldn't have been the case. The soil in my farm used to be black, but now it is reddish in color which, I believe, is the cause of loss of fertility every year*".

The annual burning of the bush has both socio-economic and environmental effects. In both GERMP and non-GERMP communities, indiscriminate bush burning has been one of the major factors causing a change of partial forest into savannah and shrub lands. Fire produces immediate effects on aerial vegetation, which becomes evident by the total plant destruction and death. High canopy trees in the district, however, escape ground fires because the vertical discontinuity of the fuel prevents fire from reaching the canopies. Plant composition and soil fertility is also affected by fire in an indirect manner. According to Nsiah-Gyabaah **[34]**, there is high incidence of bush fires in the Upper West Regions with 112 annual cases recorded. Specific environmental/climatic factors, especially the nature of the vegetation, and wind speed also play a role in the incidence and spread of bush fires. For instance, farmers believe that drought is a major cause of bush fires since it often leaves the vegetation dry for a long period and exposed to fires.

From the focus group discussions, poor environmental governance in relation to law enforcement, poverty and overgrazing were mentioned as causes of land degradation in the Lawra District. From this, the study acknowledges and upholds Lambin *et al.'s* **[32]** and Van der Geest's **[35]** postulations that apart from the general and well-known causes of land degradation, there are others that may be classified as deeply rooted drivers and they include population pressure, poverty, migration, lack of markets and infrastructure, poor environmental governance and weak institutional frameworks as well as inadequate education.

The physical environment of the Lawra District is affected by land degradation which often leads to excessive soil erosion usually accelerated by wind and rain water, and manifesting in loss of soil fertility, loss of wild edible fruits and low crop yields. The study reveals that 45 percent of the respondents observed "very severe" degradation of the land which is evident in excessive erosion, extinction of plant and animal species, loss of land cover and nutrients whilst 42 percent claimed that land degradation is "medium" which is attributable to the fact that wild fruits are becoming scarce (**Table 3**). The remaining 13 percent of the respondents asserted that there is "minimal" land degradation in the district, which they attributed to drought and loss of vegetative cover. From **Table 3**, 44.7 percent and 48.8 percent of the respondents from the GERMP and non-GERMP communities, respectively, were of the view that low crop yields through loss of soil fertility is the leading effect of land degradation in the district. According to these farmers, erosion removes the top soil continuously by creating several gullies on their farms. Another effect mentioned by farmers was loss of wild edible fruits, which often limit the availability of alternative food sources during the lean season. Observations made during focus group discussions revealed that low crop yields cause poverty and increase migration, corroborating the findings of Gyasi *et al.* **[36]** that low crop yields result in low incomes, and increase poverty, which, in turn, promotes migration from rural to urban centers. The study examined the influence of farm sizes and labor on crop yields (**Table 4**) in order to account for the role of land management practices. The amount or volume of output that is obtained from each farm is a key measure of farm size and labor. The farmers interviewed in the study cultivate on plots of land ranging

Table 3: Effects of land degradation (%)

Effects	Communities	
	GERMP	Non-GERMP
Low crop yields	44.7	48.8
Loss of soil fertility	27.2	28.8
Loss of edible fruits	19.4	14.4
Erosion	8.7	8.0
Total	100.0	100.0

between 1 and 14 acres. The data analysis indicates that farmers in the GERMP communities obtain more yields of all staple crops, mainly legumes, cereals and tubers (yam), than those in the non-GERMP communities (see **Table 5**). Similarly, the labor data shows higher yields in the GERMP communities for the use of both family and communal labor. However, a statistical t-test for all variables – farm size (p=0.10, family labor (p=0.08) and communal labor (p=0.07) – showed no significant differences at 5% confidence level. This suggests that the disparity in crop yields is attributable to the adoption of land management practices in the GERMP communities.

Table 4: Influence of farm size and labor on crop yields

Factor	Yields (Averages)					
	GERMP Communities			Non-GERMP Communities		
	Legumes (bags)	Cereals (bags)	Tubers (No.)	Legumes (bags)	Cereals (bags)	Tubers (No.)
Farm size (acres)						
1 – 4	3	4	30	2	2	22
5 – 9	5	7	65	3	4	54
10 – 14	6	6	130	5	3	82
Labor (No. of adults):						
Family						
1 – 4	2	3.5	15	1	2	10
5 – 9	3.5	5	55	2	3	26
10+	6	8	80	4	5	36
Communal						
5 – 10	7	12	115	5	8	35
11+	15	15	130	7	10	46

Table 5: t-test of yield for GERMP and Non-GERMP Communities

Parameter	N	Mean	SD	t	Df	p
Farm size	228	32.35	1.12	3.50	56.00	0.10
Family labor	228	28.45	1.02	2.70	51.00	0.08
Communal labor	228	30.56	1.04	3.24	53.00	0.07

In attempting to reduce the effects of land degradation on their farms and yields, farmers in the study district have adopted various land management practices to sustain crop production increases and ensure sustainable agriculture. These practices aim to conserve soil nutrients and moisture. **Table 6** shows substantial differences in land management practices between GERMP and non-GERMP communities. Farmers in the GERMP communities adopted and practiced numerous land management measures to safeguard their lands in order to improve soil fertility and increase crop yields. Of the 103 respondents from the GERMP communities, 19.4 percent practice non-bush burning, 11.4 practice mulching, 7.1 percent plant cover crops, 4.8 percent use contour vegetative barriers, 32 practice composting, 14.6 percent and 4.9 percent practice Zai and half-moon and stone bunds respectively. The zai and half-moon and stone bund techniques were introduced by the GERMP in the communities while the other measures have been known by the farmers for decades. The zai and half-moon and stone bund methods are not widely used because of their labor intensiveness. Of the 125 respondents from the non-GERMP communities, 15.2 percent practice non-bush burning, 11.4 percent practice mulching, 7.1 percent plant cover crops, 44.7 percent apply manure, 16.9 percent employ zero tillage and 4.8% apply chemical fertilizer. Composting was not practiced by the respondents because much of the crop residue is used as fuel at home and for feeding livestock during dry season.

Table 6: Forms of land management practices (%)

Practices	Communities	
	GERMP	Non-GERMP
Non-bush burning	19.4	15.2
Mulching	11.4	11.4
Cover crops (mocunaplant)	7.1	7.1
Contour vegetative barriers	4.8	-
Composting	32	-
Zai and half moon	14.6	-
Stone bunds	4.9	-
Application of manure	-	44.7
Application of chemical fertilizers	5.8	4.8
Zero tillage	-	16.8
Total	100.0	100.0

The GERMP was introduced to guide rural farmers in sustainable land management practices, such as the use of legumes as cover crops to retain soil moisture and prevent soil erosion, rearing of drought resistant animals, such as goats, poultry, and the cultivation of drought resistant or early maturing crops. For example, after the GERMP was instituted, stone bunding was adopted and properly installed, resulting in a tremendous positive impact on soil properties and on crop production. The outcome of focus group discussions indicated that the implementation of the project has brought changes in the growing of crops in the communities. The farmers argued that their lands are regaining fertility since the introduction of the GERMP, adding that they have noticed a reduction in erosion cases. According to them, many tree species that were lost some years back have re-germinated because of favorable conditions, thus increasing the number of trees. A farmer in Kaanpuoh stated that:

"*... the loose nature of soils that existed before the introduction of the GERMP has become compact after the introduction of the program, preventing easy washing of the top soils and the destruction of crops by wind or rain water*".

4. Conclusion

This study has adopted a mixed method to assess land degradation and management practices in the Lawra District of the Upper West Region of Ghana. The study has provided a bearing for additional research because it has highlighted critical issues of concern among local governments and civil society organizations in northern Ghana. The findings of the study indicate that the process of land degradation will continue to repeat itself in a vicious circle with over-cultivation, bush burning and inappropriate land use practices causing land degradation. This will result in a search for new pasture and cropland, and as the human and animal population of the district increases continuously, this process will continue to repeat itself. Undoubtedly, over-cultivation leads to diminishing returns, where yields decreases seasonally, requiring an increase of the areas to be cultivated so as to maintain the same return on agricultural investments. In situations where population expansion outruns the amount of land available for cultivation, farmers are compelled to reduce the fallowing period thereby exerting more pressure on the available land causing depletion of soil nutrients. Land degradation management is therefore crucial to sustainable agriculture in the Lawra District. Gauging by the nature and magnitude of land degradation in the district, it is obvious that the effects are severe and the affected rural farmers lacked coordinated approaches to mitigate it. Stark variations in management practices among GERMP and Non-GERMP communities are clear indications of the role of institutional support in land degradation management and mitigation of its effects. The framers in the Non-GERMP communities lack institutional support that could aid recovery from these effects. Interventions targeted at improvement in land productivity and promoting sustainable agriculture in the GERMP communities has begun to yield positive results due acceptance by the rural farmers. The study recommends that actors engaged in agriculture and farmland development should consider scaling up interventions by focusing attention on inappropriate land use practices that frequently lead to land degradation. It is therefore important to draw policies on a more effective approach to agriculture and farmland management practices. A continuation of "people centered" interventions is recommended together with smart partnerships between the implementing institutions and farmer groups at the community level. Sustainable solutions will largely depend on willingness to change and the sharing of information that will guide appropriate local action.

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