ASSESMENT OF SMALL HOLDER FARMERS' TECHNIQUES OF LAND DEGRADATION MANAGEMENT IN KAITA LOCAL GOVERNMENT AREA, KATSINA STATE, NIGERIA

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DECLARATION

I hereby declare that this work is the product of my research efforts undertaken under the supervision of Dr. Muhammad Nuraddeen Danjuma and has not been presented elsewhere for the award of a degree or certificate.

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CERTIFICATION

This is to certify that research work for this dissertation and subsequent write upby(Aisha Kabir Barda, SPS/14/MGE/00014) were carried out under my supervision.

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APPROVAL PAGE

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DEDICATION

This Dissertation is dedicated to my beloved Parents, Husband, Children (Muhammad AlMustapha, Fadimatu and Abdur-Rahman) and the entire members of my family.

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ABSTRACT

The aim of this study is to assess the small holder farmers' techniques of land degradation management in Kaita Local Government Area, NorthWestern Nigeria, with a view to provide information for promoting sustainable land use in the area. The study area comprises a total of 10 wards namely Abdallawa, Ba'awa, Dan kaba, Dankama, Gafiya, Girka, Matsai, Kaita, Yandaki and Yanhoho out of which Dankama, Girka, Matsai and Kaita were systematically sampled. A total of 58 household heads were selected from 463 houses in the study villages using systematic sampling technique while seven participants were also drawn using snowball sampling technique for in-depth interview.The result shows that types of land degradation in the area are water and wind erosion, salinization and soil compaction.Itis indicated that decline in yield of crops is the core indicator of land degradation in the study area (mean 56.89%), followed by soil erosion (mean 31.03%). Poverty andConflict on the available land resources as well as hunger and starvation appeared to be the major effects of land degradation in the area. Result of the study indicated that application of synthetic fertilizer is the widely used method of handling land degradation in the study area (mean 48.27%). Moreover, livelihood sources have now become diverse across and within the study area owing to failure of the land, households often engage in many diversified activities including seasonal migration as a livelihood strategy to contribute in reducing vulnerability. Assisted natural generation (48.27%) which farmers believed is efficient, less costly and do not require much labour compared is practised by overwhelming majority in the study area as a technique of management of land degradation. This study recommended that more commitments should be made to encourage the use of assisted natural regeneration for combating land degradation in the study area through non-centralized means of resources sharing that unfairly allocate environment management funds to the central agencies thereby alienating the rural poor.

CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND TO THE STUDY

The world is facing multiple challenges in the 21st century. Of serious concern, is land degradation resulting from intensive forms of land use that exceed the ecological carrying capacity that have been widely reported (United Nations Convention to ConvertDegradation and Desertification, 2013). Land degradation negatively affects the quality of land as manifested in various forms that express the poor condition of the land resources such as soil erosion by water and wind, soil fertility decline, water logging, salinization, lowering of water table and deforestation, Food and Agricultural Organization(FAO, 2003). In most cases, changes in quality and quantity of land due to land degradation are site specific and tend to vary with variations in human activities that exert pressure on the land resources (Lawal, 2012).

Land degradation remains an important global agenda in the 21st century because of its adverse impact on agronomic productivity, the environment, and its effect on food security and the quality of life (Eswaren, 2001). It is acknowledged that land degradation has occurred and continues to occur, in both developed and developing countries (Barrow, 1991). Evidences of land degradation in Midwestern United States of America in 1930s as manifested by dustbowls are reported by Barrow (1991). The global nature of land degradation has also been reported in Germany (Moldenhauer, 1980). However, it is far worst in Africa than in other continents because as noted by McCann (1999) that African landscapes are anthropogenic and are subject to constant changes as a result of human interferences.

In Africa, land degradation and desertification processes result from both human activities and climatic variability (United Nations Environment Programme, 2008). An estimated 65% of

Africa's agricultural land is degraded due to erosion and/or chemical and physical damage. Thirty-one per cent of the continent's pasture lands and 19% of its forests and woodlands also are classified as degraded (FAO, 2005). World Commission for Environment and Development warned that unless mankind changes many of its present lifestyle, the world would face unprecedented environmental degradation that would affect the present and future generation (WCED, 1987).With the dangers of further deterioration before us, assessment of environmental degradation has therefore become a global issue for the long-term management of the earth bountiful natural resources and the sustenance of livelihood that depend on them (William, 1998).

In Nigeria, land degradation is a common problem to all ecological regions. However, due to ring population pressure, over grazing and continuous over-exploitation of marginal lands through human activities and urbanization (Federal Government of Nigeria, 1999), the country has lost most of its biological diversity (Federal Ministry of Environment, 2013). This has in turn aggravated the twin problems of degradation and desertification and has led to hardship among smallholders.Land degradation is a social-economic problem. The underlying causes are directly related to human activities that often produce and use natural resources in unsustainable ways (Imeson, 2012). The causes of land degradation in particular is an emergent result of the common global culture in which financial investment and marketing mean that we all want the same things as cheaply as possible (Imeson, 2012). According toUNCCD (2013) the immediate causes of land degradation are inappropriate land use that leads to degradation of soil, water and vegetative cover and loss of both soil and vegetative biological diversity, affecting ecosystem structure and functions.

Literature is replete with various studies on land degradation and its impact on livelihood of smallholders in Africa and northern Nigeria in particular.Since the 1970s, Africa has been heavily affected by land degradation. Land degradation has threatened the livelihoods and future of entire populations across the region. At the same time, 46% of African land is affected by land degradation jeopardizing the livelihoods of nearly 65% of the African population (Botoni and Subsol, 2013). In Sahelian countries, land degradation causes a decrease of almost 3% of agricultural production per year, further endangering food security in the sub-region (Warren, 2002).In recent years, more attention has been given by governments to an integrated approach to combat land degradation and against this backgroundindividuals within the affected communities in Katsina State vary greatly in their ability to bear the costs of land degradation. Thusthe smallholders who live in poverty and lack income and other resources needed to obtain the basic necessities of life, find it particularly difficult to cope especially in northern Katsina State (Abdurrashid, 2012) where overwhelming majority of the people rely heavily on agriculture to meet their daily needs. As has been mentioned, the rising loss of income from agricultural production declines due to land degradation can impact on poverty levels at national scale (Diao and Sarpong, 2007), hence, this study was conceived because smallholder farmers are seriously affected by increasing land degradation.

1.2 STATEMENT OF RESEARCH PROBLEM

In many parts of the world, land degradation is one of the phenomena that affect the smallholder farmers' livelihoods.The change in livelihoods is one of the consequences of land degradation upon people (Sah, 2002; Lestrelin and Giordano, 2007).Even though the importance of socio-economic conditions in the change in livelihoods is recognized, most studies have given emphasis to understanding of ecological aspects such as deforestation and loss of biodiversity,

drought, climate change, soil erosion, and resulting to desertification (International Crop Research for the Sahel and Tropics, (ICRSAT1995). This is due to long held view that ecological aspects are core indicators of land degradation (ICRSAT, 1995).

Despite increasing evidences of effects of land degradation on livelihoods of land users, most of the studies on land degradation put more emphasis on the physical processes and visible evidence of land resources depletion (Barrow, 199). Even though land degradation is a biophysical process, its spatial and temporal distribution is the product of human decisions and actions (Tegene, 2000). The nature of human activities and therefore, the extent of land degradation are determined by socio-economic factors such as land tenure, demographic trends, access to markets, institutional support and human health that influence the use and access to assets (Lal, 2005).

Northern Nigeria is known with land degradation. Several studies have been conducted on land degradation in the area as well as in Katsina State in particular since the 1977's call for greater attention to it by the United Nations. Recently, however, Lawal (2012) assessed local knowledge and management strategies of land degradation in Northern Katsina State and revealed that most woody plants in northern Katsina such as *Khayasenegalensis*and*Vitellariaparadoxa*have degraded significantly due to drought and agricultural activities. The strength of the study is its inclusion of primary stakeholders (local actors) such that their values are collected and tenably analysed. However, scientific validation of the data (in this context) has not been fully achieved because qualitative data alone which may be relative and depend on believes and experiences of the respondents cannot be used to measure degradation effectively. In 2012, Federal Government of Nigeria lamented that some villages and major access roads have been buried under sand dunes in the extreme northern parts of Katsina, Sokoto, Jigawa, Borno and Yobe states. Again,

this is a clear sign of the presence of land degradation in the study area. Gakkuk (2015) found that desertification has impact on crop yields in extreme Northern parts of Katsina State. The results showed that desertification is a menace which the people are aware of and have strategies to keep it under control.

Due to variations interms of strategies to combat land degradation, the need for this study is imperative. Several works including FGN (2012) and Lawal and Mashi (2014) have stressed the effects of land degradation on crop yields in Katsina State. However the indices and indigenous management practices were not considered in their study, yet it is very imperative to explore the land Degradation indices sand their indigenous management practices, thus the urgent need for up-to-date information on the management strategies of land degradation in the area because the degree of degradation varies with space and time. Understandinglocal techniques of land degradation management may improve the livelihood of smallholder farmers' in the study area as well as contribute to creation of preparedness measures among other benefits. This work will enable stakeholders to identify areas that are sensitive to land degradation on the basis of current understanding of the cultural drivers and the ecosystem processes.Such finding will also bring changes required for programmes and interventions in the natural resource management and establish links between macro policies devised by government and micro processes as manifested by smallholder farmers' activities

1.3 RESEARCH QUESTIONS

1. What are the types of land degradation in the study area?
2. What are the indicators of land degradation in the study area?
3. How does land degradation affect livelihood of smallholder farmers in the study area?
4. What arethe small holder farmers' responses toland degradation in Kaita LGA?

1.4 AIM AND OBJECTIVES OF THE STUDY

The aim of this study is to assesssmall holder farmers' techniques of land degradation management in Kaita Local Government Area, North-western Nigeria with a view to provide information for promoting sustainable land use in the area. The objectives of this study are to:

1. identifythe various types of land degradation in the area.
2. examine the indicators of land degradation in the study area,
3. identifythe effects of land degradation on livelihood of smallholder farmers' in the study area,
4. examinethesmallholder farmers response to land degradation in the study area.

1.5 SCOPE AND LIMITATION

This work focused on identification of land degradation and management practices in the area adopted by smallholder farmers in the area only. It covered the period from 2015 to 2018 based on baseline information from the assessment of the land in the study area made by Gakkuk (2015). There was difficulty in accessing information concerning socio-economic variables of the instrument as well as accessing some participants. However, this was taken care of by engaging the key informants and community leaders before data collection.

1.6 SIGNIFICANCE OF THE STUDY

This study is significant for the development of functional management tool to be applied in the land management in north-western Nigeria. In particular, this work will benefit the following: policy makers to gather relevant information on land degradation management;forest extension officers by serving as a baseline in helping farmers to increase the productivity of their farms and improve their living standards; academics by serving as a

sample study in the management of land degradation; Non-governmental Organizations (NGO) and Community Based Organizations (CBO) to help smallholder farmers effectively manage their lands through overseeing and supervising the activities on the land to ensure that natural, cultural, and historic resources are sustainably maintained.

1.7 STUDY AREA

1.7.1 Location and Size

Kaita Local Government Area (LGA) is one of the 34 Local Government Areas of Katsina State. It is located between latitude $13^{o}.04'50''N$ and $13^{o}08'56''N$ and longitude $7^{o}45'14''E$ and $7^{o}75'38''E$ (Abdul Rashid, 2011).

Kaita has an area of $925km^2$and the LGA shares a boundary with Niger Republic to the north, Rimi, Mani and Katsina LGAs to the south and southeast respectively, Jibia LGA to the West and Mashi LGA to the EastIt comprises 10 wards namely Abdallawa, Ba'awa, Dan kaba, Dankama, Gafiya, Girka, Matsai, Kaita, Yandaki and Yanhoho(Abdul Rashid, 2011).

Kaita LGA is bounded by Niger Republic to the North, by Katsina, Batagarawa, Rimi and Mani Local Government Areas to the south, by Jibia LGA to the west and by Mashi LGA to the east (FIG 1).

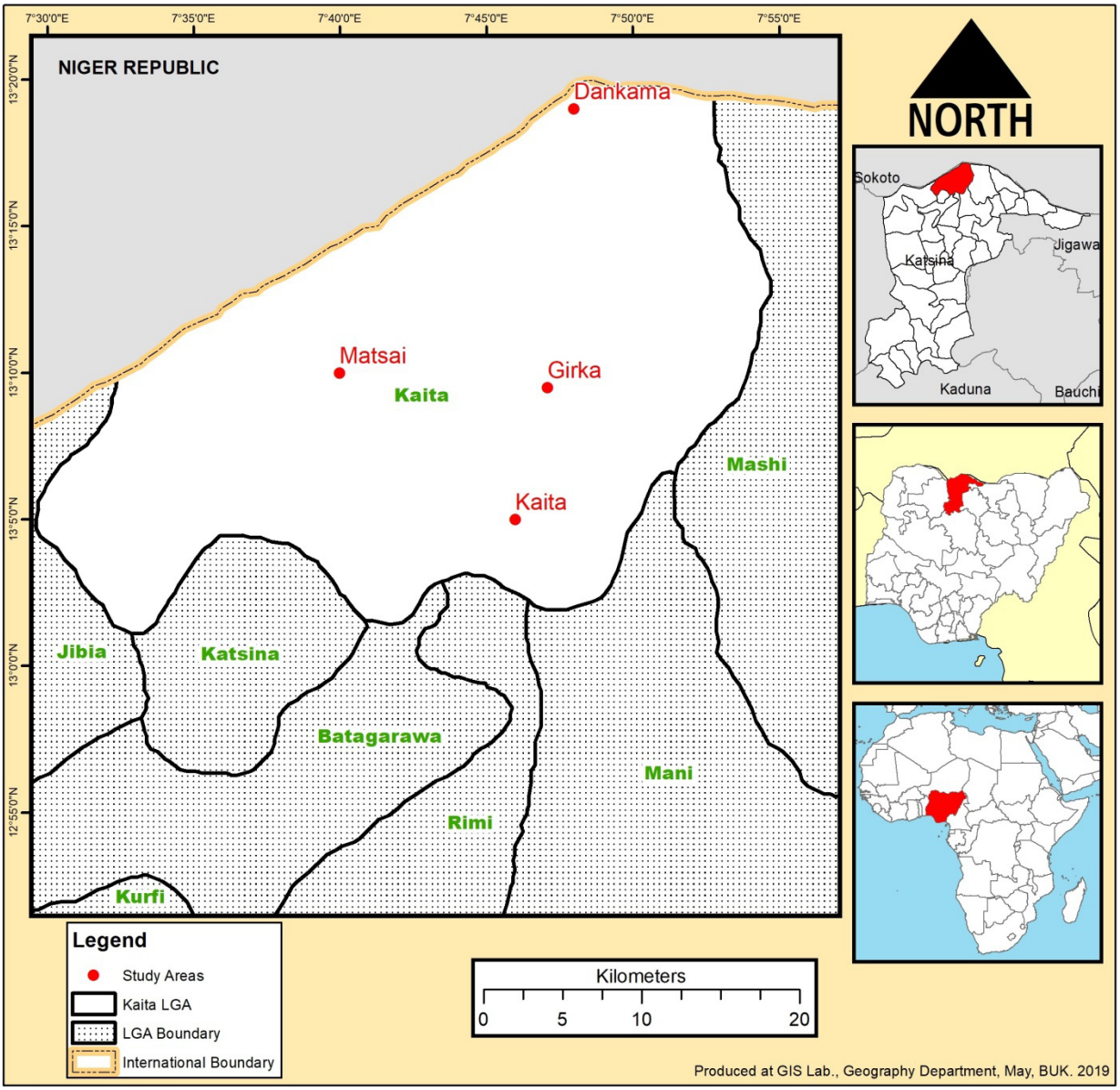

Figure 1: Kaita Local Government Area showing study points.

Source: GIS and Remote Sensing Lab, Geo, Dept. BUK.

1.7.2 Climate

Climate of the study area is the 'Aw' type as determined by Koppen in which distinctive wet and dry seasons are caused by the fluctuations of the ITCZ (Intertropical convergence zone) or the ITD south to north(rainy season), vice versa(dry season) and meeting at a front. The ITCZ separates humid maritime air mass originating from the Atlantic Ocean and dry desert air mass.

The ITCZ follows the apparent movement of the sun, (northwards in April – July and southwards in September – October). Four seasons are recognized based on the weather and agricultural activities tied to them in the Hausa land literally referred to as Bazara, Damina, Kaka and Rani (Lawal, 2012 in Olofin, 1987).

The area generally receive low rainfall coupled with low vegetation cover and dryness, this result to low crop yield which makes it necessary for irrigation activities to take place in the area paving way for salinization. Thus, the land become continuously degraded.

1.7.3 Soil

Soils of the area have been described aspredominantly ferruginous tropical red and brown soils underlain by the basement complex rocks the soil forming parent materials were weathered rocks and sand drifts composed of unconsolidated sands susceptible to erosion on the interfluves and upper slopes. The lateritic drift soil of the area is coarse and tends to be of low to medium fertility. Its fine consistence makes it ideal for growing crops like millet and groundnut.(Ibrahim, Nuraddeen and Abubakar, 2014).Soils in the Sahel are inherently fragile, low in carbon and poor in plants nutrients.They are predominantly sandy with low water holding capacity and usually less than 150cm deep (Harris, 2000). Many of these soils have a relatively short history of cultivation cycles (principally supports millet) and fallows. However as land becomes scarcer, fallowing tends to breakdown (Mortimore*et al*., 2006). The whole of Katsina area is covered by Lithosols and the soils of lateritic formation formed under alternating dry and wet seasons. Over cultivation of the soils associated with various farming activities such as harrow and tillage leads to soil erosion (both wind and water) resulting to land degradation in the area.

1.7.4 Vegetation

The vegetation of the area is secondary or degraded woodland comprising of widely spaced trees, lots of shrubs and continuous cover of herbs. With the exception of some exotic species planted as ex-situ conservation trees, the vegetation in the area and further north is composed of indigenous species which grow spontaneously. Some of the trees found in the study area include *Parkiabiglobosa, Adansoniadigitata, Khayasenegalensis, Fadherbiaalbida, Tamarindusindica*, and *Borassusaethiopum,* and exotic species *Azadirachtaindica,Eucalyptus camaldulensis*. Few fruit trees are grown on farms such as *Magniferaindica* and *Anacardiumaccidantale*. Man and his animals play a great role in modifying the vegetation cover in the border region and as a result continuous cover of shrubs overtakes the once woody landscape. Bush clearing, extensive agriculture and deforestation due to high demand of fuel wood are some common practices of the people of the region especially around the densely populated settled parts of Katsina.This led to soil erosion in the area and eventually land degradation.

1.7.5 Geology and Relief

Kaita is underlain by basement complex rocks which are old and hard. The area is made up of fairly rolling plains without any significant topographic features complicating the terrain, The characteristic landforms consist of high plains with broad shallow valleys dotted with numerous hills or inselbergs (residual rocks with steep sides).

1.7.6 Drainage and Hydrology

Katsina State has very few rivers and lakes, many of those present are either intermittent/seasonal or reduced drastically in volume during the prolonged dry season (Babsal, 1998). However, rivers and smaller catchments drain water to larger ones and move southwards as the volume of water in them rises at the peak of rainy season when run-off excesses collects. Majority of the rivers are seasonal in a character attributed to most African rivers. The volume of water carried by rivers and streams fluctuates with season and therefore catchments reaches bank full at the peak of

rainy season. Extensive flood occurs as a result especially during thelater part of the rainy season there by wearing away the top soil giving more room for land degradation.

1.7.7 Population

The population of Kaita LGA is 184,401 persons at the 2006 census and population projection of 2016 indicates 246,200 persons with a population density of 266.2/km^2(National Population Commission of Nigeria-WEB). There is continuous growth of the population which is leading to high demand of food and causing more pressure on land as permanent cultivation become predominant in the area, it is associated with several farming practices such as land clearing through bush burning and the like which greatly affect the soil thus making it more prone to erosionand consequently degraded.

1.7.8 Land use

Agriculture is the major landuse activity of the area, accounting for a high proportion of the income of the economically active population. Food crop farming is the dominant economic activity, using diverse cropping systems. Major food crops grown are millet, sorghum, and vegetable along flood plains. These are produced principally for subsistence and occasionally for the local and urban markets. Most crop production on the aeolian soils is rain-fed.Sedentary farming, forestry and pastoralism are the major land use activities.These activities are highly associated with practices that greatly affect the land, continuous cropping always exhausts soil nutrients thereby reducing its quality and application of both organic manure and inorganic fertilizer become necessary. Overgrazing by animals exposes the soil and makes it more prone to erosion and eventually land degradation.

To mitigate the negative effects of theseland use practices and enhance efficient use of the land resources, farmers in the areacommonly use synthetic fertilizers to increase crop output and practice assisted natural regeneration and reforestation to replace the trees removed.

CHAPTER TWO

LITERATURE REVIEW AND CONCEPTUAL FRAMEWORK

2.1 REVIEW OF CONCEPT

To review various concepts under this study, existing literature related to the research topic are consulted. These include published and unpublished materials such as journal articles, Thesis and Dissertations, as well as other relevant materials.

2.1.1Land Degradation

Land degradation is the reduction in the physical, chemical or biological status of land which may affect its productive capacity (Eswaran et al., 2001). UNCCDD (1994) defines land degradation as the reduction or loss of the biological or economic productivity and complexity of rainfed cropland, irrigated cropland, or range, pasture, forest and woodlands resulting from land uses or from a process or combination of processes, including processes arising from human activities and habitation patterns, such as: (i) soil erosion caused by wind and/or water; (ii) deterioration of the physical, chemical and biological or economic properties of soil; and (iii) long-term loss of natural vegetation. Land degradation encompasses the whole environment but includes individual factors concerning soils, water resources (surface, ground), forests (woodlands), grasslands (rangelands), croplands (rainfed, irrigated) and biodiversity (animals, vegetative cover, soil) (FAO, 2005).

2.1.2 Sustainable Land Management

Sustainability is maintaining natural systems over the indefinite future, such as living, working, and managing in ways which are environmentally “sustainable,” promoting biodiversity, and so on. The concept of sustainability arose with the environmental movement. The 1972 United Nations (UN) Conference on the Human Environment, held in Stockholm, Sweden,

acknowledged widespread evidence of pollution, disturbances of ecological processes in forests and other biomes, and natural resource depletion (The World Commission on Environment and Development, 1987).

Since publication of the Brandt land report in 1987, the concept of sustainability has received increasing attention among scientists, yet researchers have struggled to operationalise the concept. Smyth and Dumanski (1993) subdivided the general concept of sustainability into four main pillars: (a) productivity, (b) stability of production, (c) soil and water quality, and (d) socioeconomic feasibility.

Sustainable land managementis a knowledge-based procedure that helps integrate land, water, biodiversity, and environmental management (including input and output externalities) to meet rising food and fiber demands while sustaining ecosystem services and livelihoods. Sustainable Land Management as defined by TerrAfrica is: 'the adoption of land use systems that, through appropriate management practices, enables land users to maximize the economic and social benefits from the land while maintaining or enhancing the ecological support functions of the land resources'. SLM includes management of soil, water, vegetation and animal resources. Hence it is a knowledge-based procedure that helps integrate land, water, biodiversity, and environmental management (including input and output externalities) to meet rising food and fiber demands while sustaining ecosystem services and livelihoods. SLM includes actions to stop and reverse degradation—or at least to mitigate the adverse effects of earlier misuse (World Bank, 2006). SLM involves these activities:

1. Preserving and enhancing the productive capabilities of cropland, forestland, and grazing land (such as upland areas, down-slope areas, flatlands, and bottomlands)

2. Sustaining productive forest areas and potentially commercial and noncommercial forest reserves.
3. Maintaining the integrity of watersheds for water supply and hydropower-generation needs and water conservation zones

2.1.3 Livelihood

A livelihood is a means of making a living. It encompasses people's capabilities, assets, income and activities required to secure the necessities of life (Chambers and Gordon, 1992). Livelihood refers also to a set of activities performed to live for a given life span, involving securing water, food, fodder, medicine, shelter, clothing, and the capability to acquire above necessities working either individually or as a groupby using endowments (both human and material) for meeting the requirements of the self and his/her household on sustainable basis with diginity (Frank, 2000).

2.1.4 Smallholder Farmers

Smallholders are small-scale farmers, pastoralists, forest keepers, fishers who manage areas varying from less than one hectare to 10 hectares. Smallholders are characterized by family-focused motives such as favoring the stability of the farm household system, using mainly family labour for production and using part of the produce for family consumption. Smallholders provide up to 80 percent of the food supply in Asian and sub-Saharan Africa (FAO, 2012).

2.2 HISTORICAL OVERVIEW ON LAND DEGRADATION RESEARCH

Land degradation plagues almost all arid, semi-arid and sub-humid areas and presents a global challenge that requires urgent attention. It is interesting to note that the concept of degradation/desertification was discussed earlier by European and American scientists in terms of increased sand movements, desiccation, desert and Sahara encroachment and man-made

deserts (Stebbing 1935 and 1938, Lowdermilk 1935and Jones 1938 in Helldén, 2003). However, the word "desertification" was introduced by the French forester Aubreville in 1949 when he suggests that desertification meant the spreading of deserts or desert-like conditions. Aubreville (1949) also stated that there are real deserts being born today, under our very eyes, in the 700-1500 mm annual rainfall areas. Since then, different concepts of desertification have developed and been discussed over and over again by scientists, politicians and the international community.

Problem of desertification has also been approached by the international community. The Plan of action to Combat Desertification has been accepted by the Conference on Desertification in Nairobi in 1977. The Rio Earth Summit of 1992 led to the UN Convention to Combat Desertification (UN, 1997) and was ratified by more than 150 countries. However, research on desertification in the African Sahel has been in the scope of the scientific community since the second half of 19th century. In the later periods of colonization, western colonizers discussed the questions of degradation, desertification and the role of human activities in these processes (Mainguet and Da Silva, 1997).

Meanwhile the past 20 yearswitnessed tremendous efforts to combat desertification covering a worldwide scope. For example, the United Nations has periodically focused on desertification and drylands, notably adopting the Convention to Combat Desertification (CCD) in 1992 (UNCCD, 1994) and designating 2006 as the International Year of the Desert and Desertification. The immediate goals of the UNCCD (1994) are (i) prevention and/or reduction of land degradation; (ii) rehabilitation of partly degraded land; and (iii) reclamation of desertified land.

2.3 LAND DEGRADATION IN NIGERIA

The extent and severity of desertification in Nigeria has not been fully established neither the rate of its progression properly documented. Nevertheless there is a general consensus that desertification is by far the most pressing environmental problem in the northern parts of the country. The visible sign of this phenomenon is the gradual shift in vegetation from grasses, bushes and occasional tress, to grass and bushes and in the final stages, expansive areas of desert-like sand.

It has been estimated that between 50% and 75% of Bauchi, Borno, Gombe, Jigawa, Kano, Katsina, Kebbi, Sokoto, Yobe, and Zamfara States in Nigeria are being affected by desertification. It is estimated that the country is currently losing about 351,000 hectares of its landmass to desert conditions annually, and such conditions are estimated to be advancing southwards at the rate of about 0.6 km per year (FGN, 1999).

2.4 INDICATORS OF LAND DEGRADATION

The degree of degradation is estimated using various measurable quantities, called indicators. An *indicator* is formally defined as a measurable variable representing an operational attribute of a given system (Gallopin, 1997).

2.4.1 Declining Farm Yields

Recent evidence suggests that land degradation is a serious threat to productivity in more humid environments as well (Bai, et al., 2008). This suggests that it's a global phenomenon that affects all. Based on available studies, land degradation over the next 25 years may reduce global food production from what it otherwise would be by as much as 12 percent (Pender, 2009). Estimates suggest that land degradation may reduce global agricultural production by 0.1 to 0.5 % per year, resulting in an aggregate production loss of 2.5 to 12 percent after 25 years (Pender, 2009).

Studies in particular African countries have estimated annual productivity losses due to land degradation ranging from as little as 0.04% per year in South Africa (McKenzie, 1994) to as much as 3% per year in the Ethiopian highlands (FAO, 1986), 10% per year in Mali (Bishop and Allen 1989) and 11% per year in Malawi (World Bank, 1992). Several studies have estimated impacts of land degradation on food production in particular regions or countries. A review of these studies by Wiebe (2003) concluded that estimated impacts typically are less than 1% per year loss in yields on average, although larger impacts have been estimated for areas particularly vulnerable to land degradation, such as on steeply sloping lands in Kenya (2.2% losses per year on a 15 percent slope) (Pagiola, 1996). Evidence from long term trials in Kenya shows that maize yields on continuously cropped plots fell nearly 50 percent over 17 years even with recommended inorganic fertilizer rates; while the decline was much less where both organic and inorganic fertilizers were applied (Pender, 2009).

2.4.2 Desertification

Desertification has always been understood to refer to two resources: *soil and vegetation.* Desertification was first defined in 1949 by Aubreville as the process of transformation of productive land anywhere, into an ecological desert due to the ruinous act of erosion, often impelled by manmade deforestation (Aubreville, 1949). Desertification has aroused much emotive and scientific interest, and there are many different definitions of the term (Verstraete, 1986).Desertification is the process of ecological degradation by which economically productive land becomes less productive and, in extreme cases, develops a desert-like landscape incapable of sustaining the communities that once depended on it (Westing, 1994). According to Article 1 of the United Nations Convention to Combat Desertification (UNCCD, Paris, 1994), means "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors,

including climatic variations and human activities" (UN, 1994). This equates desertification with land degradation, and confines it geographically to dry areas. Desertification arises both from human abuse of the land and from adverse climatic conditions such as extended drought (UNEP, 1992) which may trigger, maintain, or even accelerate the process of dryland degradation. The case histories of four different regions- the Sahel, the Euphrates-Tigris basin, the Aral Sea region and the Dustbowl of the USA which are undergoing or have undergone desertification show a common structure underlies the desertification process (Darkoh, 1995).Desertification occurs most frequently in ecosystems that have low rainfall, long dry seasons, recurrent droughts, mobile surface deposits, skeletal soils, and sparse vegetation cover (Le Houérou, 1968; Dregne, 1983).

Desertification is one of the most serious of all global environmental change problems. It results from society's inability to develop sustainably, because decisions are taken to use natural resources in ways that ultimately impinge adversely on human environmental welfare (Grainger, 1990). In the 1980s, the area of drylands at least moderately affected by desertification was estimated at between 600 million ha (Middleton and Thomas, 1992) and 2,000 million ha (Mabbutt, 1984).

2.4.3 Soil Erosion

Soil erosion is another common type of land degradation in the world. Soil erosionrefers to a loss in soil productivity due to: “physical loss of topsoil, reduction in rooting depth, removal of plant nutrients, and loss of water. Soil erosion is a quick process (Lal, 1990).Soil erosion is a major factor in land degradation and has severe effects on soil functions such as soil's ability to act as a buffer and filter for pollutants, its role in the hydrological and nitrogen cycle, and its ability to provide habitat and support biodiversity.Water and wind erosion, respectively, account for 46%

and 38% of all the degradation (GLASOD 1988). Bielders*et al*. (1985) noted that wind erosion can remove up to 80 tons of soil on one hectare in a single year.

Whereas soil erosion is a natural geomorphic process, human activities such as cultivation, overgrazing and deforestation accelerate the process beyond the acceptable levels. With an increasing human population, farming and livestock keeping is being expanded into remote, steep and hilly slopes thus increasing the potential for accelerated rates of erosion.Eswaran et al. (2001) estimated that the total annual cost of soil erosion from agriculture in the USA is about US$ 44 billion per year, about US$ 247 per ha of cropland and pasture. Lal (1990) suggests that Africa may face greater problems of soil erosion than other regions. Although many parts of Africa do not yet face a situation of land scarcity, erosion-induced land degradation leads to the cultivation of ever steeper and more marginal land. This land is less productive and more susceptible to erosion, particularly when farmers transfer cultivation techniques better suited to land of higher productivity.

2.4.4 Flood

This phenomenon occurs when water covers previously dry areas, i.e. when large amounts of water flow from a source such as a river or a broken pipe onto a previously dry area, or when water overflows banks or barriers. Floods can be environmentally important to local ecosystems. For example, some river floods bring nutrients to soil such as in Egypt where the annual flooding of the Nile River carries nutrients to otherwise dry land. Floods can also have an economic and emotional impact on people, particularly if their property is directly affected.

2.4.5 Natural Hazards

Hazard is the potential for a natural or human-caused event to occur with negative consequences.

A hazard can become an emergency; when the emergency moves beyond the control of the population, it becomes a disaster. Cyclones develop when a warm ocean gives rise to hot air, which in turn creates convectional air currents. Cyclones occur when these conventional air currents are being displaced. The term hurricane/typhoon is a regionally specific name for a "tropical cyclone". In Asia they are called 'typhoons'; in the Indian and Pacific Oceans they are called 'cyclones'; and over the North Atlantic and Caribbean Basin, they are called 'hurricanes'.An earthquake is a trembling or shaking movement of the earth's surface, resulting from plate movements along a fault-plane or as a result of volcanic activity. Earthquakes can strike suddenly, violently, and without warning at any time of the day or night.A tsunami is an ocean wave generated by a submarine earthquake, volcano or landslide.The term landslide refers to the downward movement of masses of rock and soil. Landslides are caused by one or a combination of the following factors: change in slope gradient, increasing the load the land must bear shocks and vibrations, change in water content, ground water movement, frost action, weathering of shocks, removal or changing the type of vegetation covering slopes. Landslide hazard areas occur where the land has certain characteristics which contribute to the risk of the downhill movement of material.

2.5 CAUSES AND CONSEQUENCES OF LAND DEGRADATION

The causes and consequences of degradation cannot be generalized on a global, continental, regional or even national level (Helldén, 2003). They are site specific. Every site and case needs its own diagnosis, based on an integrated and systemic research approach, before the right cure, often complex and integrated in nature, can be identified and implemented. The causes of dryland degradation, also referred to as desertification, remain controversial (Geist and Lambin, 2001). Recent analysis by Geist and Lambin (2004) suggests that claims that desertification is

either a human-made or a purely natural (i.e. climate-driven) process should be more nuanced. Indeed, case studies indicate that desertification is a coupled biophysical and socioeconomic process (Reynolds and Stafford-Smith, 2002), the details of which need to be specified for the various regions affected by desertification.

2.5.1 Causes

According to Geist and Lambin (2004) carried out a worldwide review of the causes of land degradation are: (1) increased aridity; (2) agricultural impacts, including livestock production and crop production; (3) wood extraction, and other economic plant removal; and (4) infrastructure extension, which could be separated into irrigation, roads, settlements, and extractive industry (e.g., mining, oil, gas).

a. Climatic Variations

Drought is a naturally occurring phenomenon that exists when precipitation has been significantly below normal recorded levels, causing serious hydrological imbalances that adversely affect land resource production systems (UNCCD, 2011). Drought is one of the main causes of desertification. It can be attributed to inadequate seasonal precipitation, a prolonged dry season or a series of sub-average rainy seasons (Sheikh and Soomro, 2006). Continued land abuse during droughts, however, increases land degradation.

b. Extensive Cultivation

Rapid population growth and need to satisfy the capitalist consumer economy has brought an increase in the cultivation of lands to meet up with the food requirements of the populace as well as industrial raw materials. This has led to land over-utilization for land which thus cause land degradation. In the dryland Africa, harmful agricultural practices, such as over cultivation, overgrazing, bush fires, cultivation of marginal and easily eroded land, mechanization and the

widespread use of chemicals and pesticides, have intensified land degradation (Darkoh, 2003). Unsustainable practices in irrigation and production may lead to increased salinization of soil, nutrient depletion and erosion. An estimated 950 million hectares of salt-affected lands occur in arid and semi-arid regions, nearly 33 percent of the potentially arable land area of the world.

c. Deforestation

Deforestation is illegal cutting down of trees resulting to non-forest areas for urbanization, agriculture and for some other reasons such as logging. Report put it that the world current rate of deforestation is 160,000 square kilometres per year which equates to a loss of approximately 1% of the original forest habitat each year. Deforestation, however, destroys the trees that bind the soil to the land (Wardell, Reenberg, and Tettrup, 2003).

d. Overgrazing

Overgrazing is common in the areas that depend mostly on rearing of animals for their upkeep and living. However, overgrazing removes the vegetation cover that protects soil from erosion (UNCCD, 2011). Apart from the degradation of natural vegetation cover, over-grazing results in a decrease in the quality of rangelands (Sheikh and Soomro, 2006).

e. Urbanisation

Due to the rapid economic growth, there is an increasing trend in the rate of urbanization especially in the developing countries. There is no problem with urbanization, but most of them are always observed without proper environmental impact assessment of the proposed developmental project. The problem of superimposing developmental projects without preliminary impact assessment on environment is more severe and complicated in developing world.

2.5.2 Effects

Effects of land degradation include diminished food production, soil infertility and a decrease in the land's natural resilience; increased downstream flooding, reduced water quality, sedimentation in rivers and lakes, and silting of reservoirs and navigation channels; aggravated health problems due to wind-blown dust, including eye infections, respiratory illnesses, allergies, and mental stress; loss of livelihoods forcing affected people to migrate. Desertification threatens the livelihoods of one billion people and has already made 135 million people homeless (UNEP, 2008).One quarter of the earth's surface is threatened by desertification-an area of over 3.6 billion hectares (Sheikh and Soomro, 2006). Since 1990, 6 million hectares of productive land are lost every year due to land degradation and the world's drinking water supplies have fallen by almost two thirds since 1950 (Sheikh and Soomro, 2006).

Desertification currently affects about one-sixth of the world's population and one-quarter of the world's land: 6 to 7 million hectares (Mha) are lost annually due to soil erosion, and up to 20 Mha of irrigated land are affected by salinization (World Resources Institute, 1992). Between 1981 and 2003, 24 per cent of the land has been degraded globally. About 1500 million people depend directly on these degrading areas. Nearly20 per cent of the degraded land is cropland, and 20 to 25 per cent is rangeland. Desertification causes soil to lose its ability to support rain-fed crops. It inevitably results in emigration as the land cannot sustain the original inhabitants (Westing, 1994).

Two thirds of the world's degraded lands are found in Asia and Africa, but human-induced degradation is most severe in Africa, where 30% of the agricultural land, pastures, forests, and woodlands are degraded, followed by Asia (27%) and Latin America (18%) (Per and Rajul, 1995).

2.6 ASSESSMENT OF LAND DEGRADATION

Land degradation is an increasing problem in the World. The key issues associated with land degradation today are: degradation of ecosystems, desertification; loss of productivity ,loss of biodiversity and decline of soil and water quality (FAO, 2005). Assessment and monitoring have been carried out to ascertain the causes and impact of land degradation at national, local and farm levels, even though there is still much more to gain an understanding of these threats globally.

Fortunately, scientists around the world started long ago to look at the problem of land degradation and have developed assessment and monitoring methods. Therefore assessment methods has been developed to determine the status of the land, extent and impact of land degradation and to help designing possible conservation activities. Accurate and relevant assessment methods of land degradation in drylands with a flexible scale combining socio-economic, institutional, and biophysical aspects and driving forces are needed to plan actions and investments to reverse land degradation, improve socio-economic livelihoods, and conserve dryland ecosystems and its unique biological diversity (Snel and Bot, 2003).

The most common methods used to assess land degradation are: expert opinions, land users' opinions, field monitoring, observations and measurement, modelling, estmates of productivity changes and remote sensing. The methods have been applied to different approaches which use either qualitative or quantitative measures or both.

2.7 FRAMEWORKS FOR THE ASSESSMENT OF LAND DEGRADATION

Several conceptual frameworks for land degradation assessment have been developed over the years by various scholars and research agencies. The commonly used frameworks are;

2.7.1 Stress-Response Framework

This frameworkwas developed by the United Nations Statistical Office in the mid-1970s through a joint initiative with Canada. The framework considers the stress on the natural environment beyond its carrying capacity and its effects on human beings. The focus of the stress-response framework is on the effects of human activities on the natural environment. The stress-response approach has had a major impact on environmental reporting around the world (Hodge, 1991). The exclusion of the major causes of the stress on the natural environment is, but, one of several serious limitations to current expressions of the stress-response concept, one that reduces significantly its usefulness for assessing environmental degradation holistically.

2.7.2 Pressure-State-Response Framework

The Pressure-State-Response (PSR) assessment framework was developed by the Organisation for Economic Cooperation and Development (OECD) in 1994as a step further of the stress-response framework. The assessment framework takes into consideration, the “pressures” which describe the intensity and extent of human activities acting directly on the environment beyond its carrying capacity. The “state” refers to the baseline state of the environment as judged from areas relatively unaffected by direct human activities. Examples include air pollution, water contamination, land degradation, depletion of renewable and non-renewable natural resources, and expansion of human settlement (Pinter et al., 1999). The “responses” deal with the impacts of stresses on the environment and assess human actions, such as legislation, new technology, economic instrument, economic expenditures, changing consumer preferences and international conventions, undertaken to protect the environment (Gallopin, 1997). The PSR framework is the most widely accepted of the many frameworks advocated, having been adopted by the OECD for its analysis of the degradation and pollution of the natural environment. The PSR was used in the

methodology of the World Bank's Land Quality Indicator programmes (World Bank, 2001). In most developing countries, one cannot examine critically environmental degradation without considering the indirect causes of degradation, hence the limitation of PSR in this study.

2.7.3 Driving Force-State-Response Framework

The Driving force-State-Response (DSR) framework was first initiated by United Nations Commission for Sustainable Development in 1997 to consider the shortcomings of both the stress-response and the PSR framework. The framework, instead, considered the driving forces of environmental problems that did not feature in both the stress-response and PSR frameworks. The replacement of the term "pressure" in the PSR framework by the term "driving force" was motivated by the desire to include economic, social and institutional aspects of environmental problems (European Environmental Agency, 1999). The World Bank adopted the DSR framework in its work on indicators of environmentally sustainable development (World Bank, 1997). A major advantage of the DSR framework is that it organizes information on sustainable development systematically in a way that guides the user of the framework through all aspects of sustainability. In distinguishing between the social, economic and environmental aspects of sustainable development, the framework ensures that no aspects of sustainability indicators are automatically excluded. The inclusion of the economic and social aspects is particularly important for developing countries with economies in transition, for which an equal balance between the developmental and environmental aspects of sustainability is important in order to ensure future sustainable growth patterns (United Nations Commission for Sustainable Development, 1997). The DSR works perfectly when an environmental stress has been identified and linked to a causative set of human activities as perceived in most developing countries.

2.7.4 Driving Force-Pressure-State-Impact-Response Framework

The European Environmental Agency (EEA), within the legal basis of the European Union Environmental Policy Acts 95, 174, 175 and 176 of the consolidated version of the Treaty on European Union and under the auspices of the European Commission, in their effort to introduce environmental issues in their developmental agenda, further improved the existing assessment frameworks into a five indicator framework (which includes PSR and DSR as special cases) dubbed as the "DPSIR assessment framework" (EEA, 1999). Each indicator conveys its own distinctive meaning and application.The framework is seen as giving a structure within which to present the indicators needed to enable feedback to policy makers on environmental quality and the resulting impact of the political choices made, or to be made in the future (Kristensen, 2004).

According to the DPSIR framework there is a chain of causal links starting with '*driving forces*' (economic sectors, human activities) through '*pressures*' (emissions, waste) to '*states*' (physical, chemical and biological) and '*impacts*' on ecosystems, human health and functions, eventually leading to political '*responses*' (prioritisation, target setting, indicators).

The components of the DPSIR framework are explained by Kristensen (2004) as: a 'driving force' is a need. Examples of primary driving forces for an individual are the need for shelter, food and water, while examples of secondary driving forces are the need for mobility, entertainment and culture. Pressures on the environment, according to Geist and Lambin (2002) are human activities or actions, usually at the spatial level, that originate from intended land-use and directly impact negatively on the natural environment. As the driving forces, the pressures of degradation are usually multivariate.

Driving forces lead to human activities such as transportation or food production, i.e. result in meeting a need. As a result of pressures, the 'state' of the environment is affected; that is, the

quality of the various environmental compartments (air, water, soil, etc.) in relation to the functions that these compartments fulfil. The 'state of the environment' is thus the combination of the physical (air, soil and water quality), chemical and biological conditions (ecosystems-biodiversity, vegetation, soil organisms, water organisms etc.

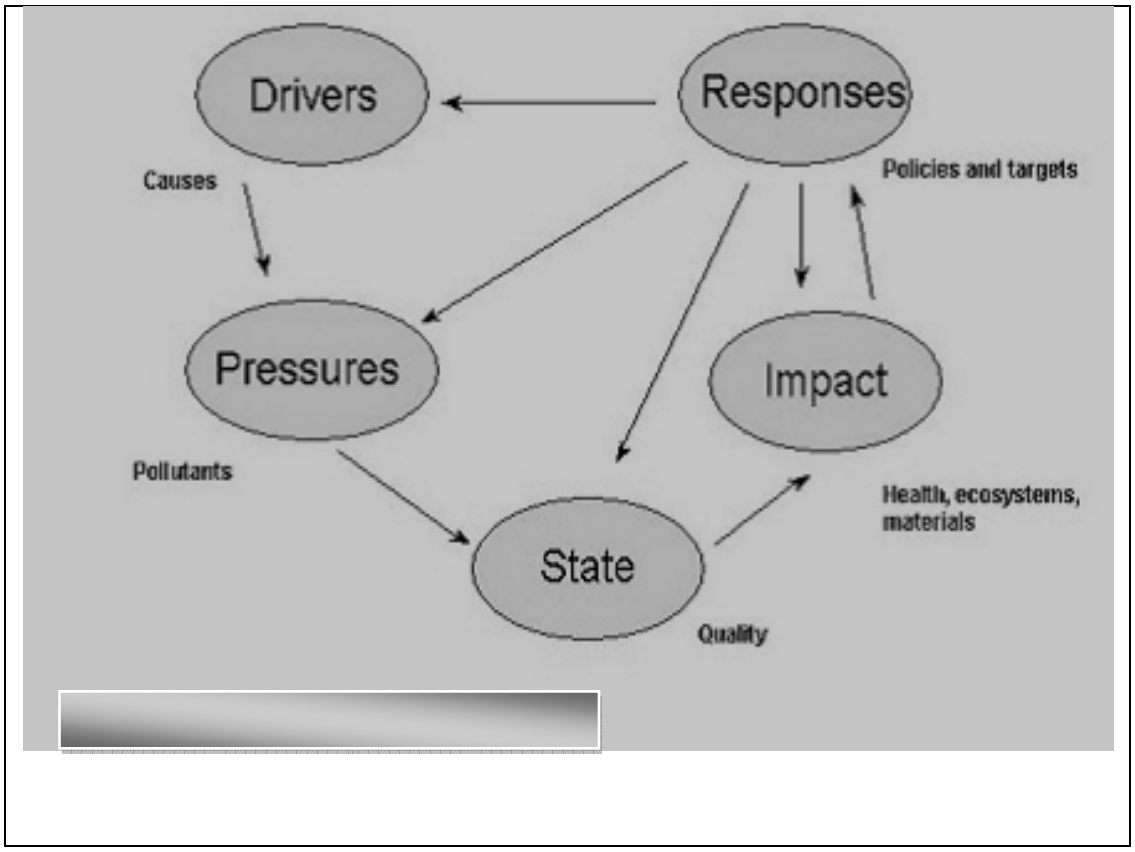

Figure 2: The DPSIR assessment Framework

Source: Adopted from Kristensen (2004).

Wathern (1988) described environmental impacts as the change in environmental parameters, over a specific period of time and within a defined area, resulting from a particular activity compared with the situation which would have occurred had the activity not been initialised.In

other words changes in the state may have environmental or economic 'impacts' on the functioning of ecosystems, their lifesupporting abilities, and ultimately on human health and on the economic and social performance of society.A 'response' by society or policy makers is the result of an undesired impact and can affect any part of the chain between driving forces and impacts

2.7.5 Sustainable Livelihood Approach

The Sustainable Livelihood framework is used for understanding how household livelihood systems interact with the natural, socio-economic and policy environment (Chambers and Conway, 1992). Impacts can be in both directions i.e. many pressures leading to land degradation arise from the activities of land-users and LD/SLM causes impacts on land-users' livelihoods. In this assessment the SL approach is used to help understand both: the drivers and pressures leading to LD/SLM and the impacts of LD/SLM on people (Chambers and Conway, 1992).

The platform or core of a household's livelihood is its assets, classified into five classes and denoted by a pentagon. Both the vulnerability context (on the left hand section of Figure 2.2 and policies, institutions and processes (or "institutional context", in the central box) affect the access people have to key assets and what they can do with them. The livelihood strategies of different individuals and categories of households are shaped by their asset base and by the vulnerability and institutional context in which they live. When tracking back from LD/SLM pressures to driving forces it is often in these two contextual areas (vulnerability and institutional) that the driving forces are found. Five concepts that are crucial for understanding the linkages within the framework are: i) The vulnerability context, ii) Livelihood assets, iii) Institutions, iv) Livelihood strategies, v) Livelihood outcomes (Ellis and Allison, 2004).

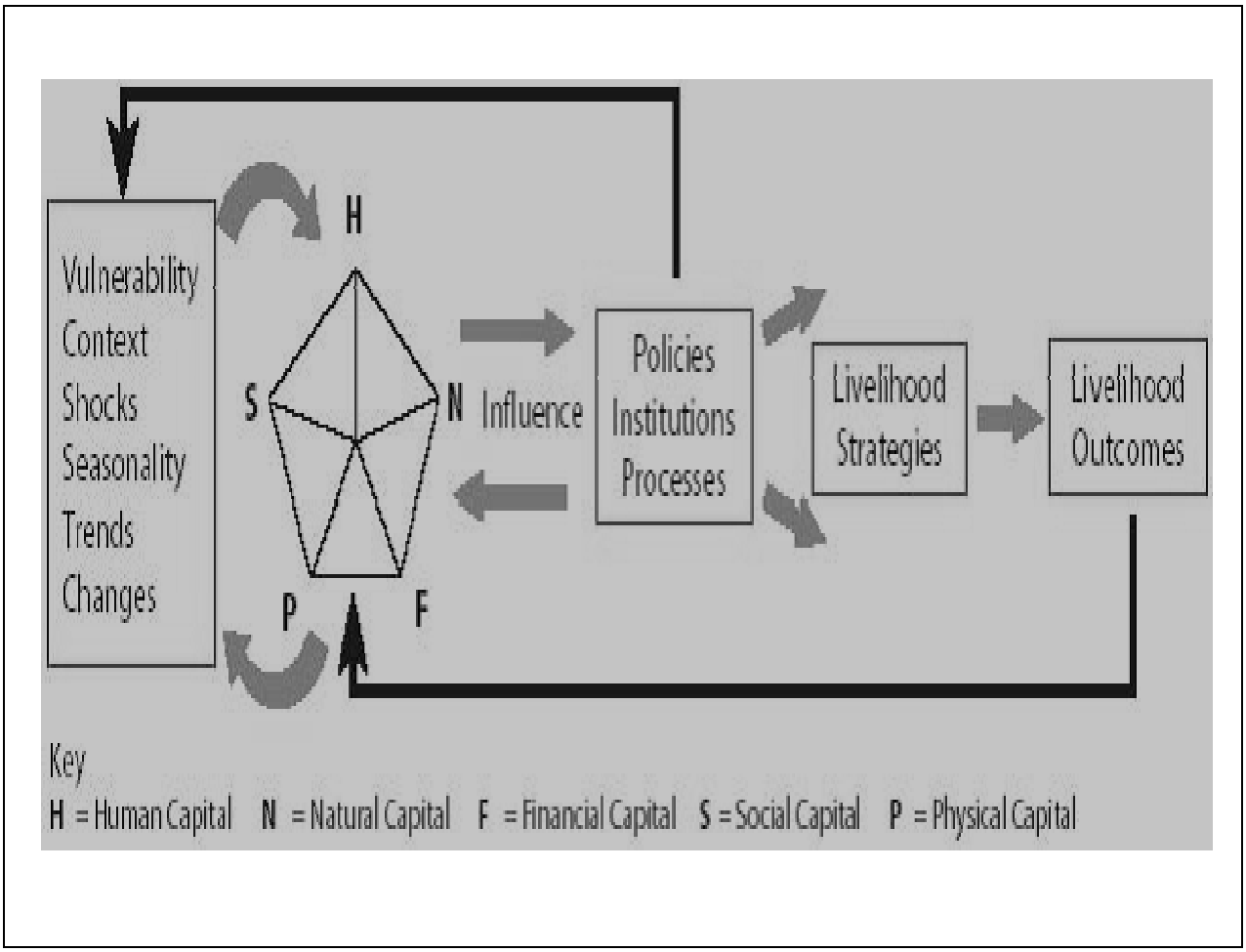

Figure 3: The Basic Livelihoods Framework

Source: Adopted from Ellis and Allison(2004).

The traditional practices that cause land degradation in the study area are: Soil excavation for construction; excessive cultivation; Overgrazing; Bush burning and Deforestation. Considering thePressure-State-Response (PSR) assessment framework, permanent cultivation and overgrazing are activities done in the area which directly influence the environment beyond its carrying capacity hence the "pressures".Theareas relatively unaffected by direct human activities

are the baseline of the environment refers to the “State”. Whereas the impacts of stresses on the environment that assess human actions are the “responses”.

2.8 MANAGEMENT OF LAND DEGRADATION

Land degradation is a widespread and growing problem that can be tackled through coordinated andcollaborative approaches and targeted programmes and action.

2.8.1 Indigenous Land DegradationManagement Practices

These are measures and practices that aim to integrate the management of land to meet human needs. Below are some of these practices according to (Eswaram 2001).

a.Planting of Cover crops: these are grown for the protection and enrichment of the soil, they are planted to manage soil erosion, soil fertility, soil quality, water, weeds, pests, diseases,biodiversity and wildlife in an agro-ecosystem.

b. Use of sandbags: sacks made from polypropylene or other materials are usually filled with sand / soil and use for flood control to check erosion as they act as a barrier to divert moving water around, instead of penetrating through. Sandy soil is most desirable for filling sandbags, coarse sand could leak out through as such double bags are sometimes used. However sandbags does not guarantee a water-tight seal but is satisfactory for use in most situations.

c. Tree planting: this is the process of transplanting tree seedlings for a number of purposes such as land reclamation, forestry and landscaping. The trees when planted serve as wind breaks to shelter crops, prevent soil erosion, protect, preserve and enhance agricultural yields.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter present the methodology adopted for this study which comprise of Data type and sources, Reconnaissance survey, Sampling and Methods of Data collection.

3.2 DATA TYPES

Data for this study is qualitative obtained from structured interview to provide answers to the first three research questions; and in-depth interview to provide answer particularly to the fourth which is the last research question. Both interviews served as subjective opinion of the interviewed participants generated to form part of primary data, where the archive data was collected from review of the relevant materials such as books, journals containing published and unpublished PhD, MSc and BSc Thesis, Dissertation

3.2 RECONNAISSANCE SURVEY

Reconnaissance survey was conducted in order to get familiar with the study area and to observe the immediate causes of the removal of vegetation in the study locations. The livelihood of the inhabitants was studied. Key informants werealso identified at this stage so as to have guide for sampling of interviewees.

3.3. SAMPLING TECHNIQUES

The study area comprises a total of 10 wards based on its political divisionnamely Abdallawa, Ba'awa, Dan kaba, Dankama, Gafiya, Girka, Matsai, Kaita, Yandaki and Yanhohoout of which four wards were selected using systematic sampling technique. In selecting the sample,locational

factor was considered thus the wardswere rearranged as1. Kaita. 2. Yandaki3. Yanhoho. 4. Matsai. 5. Dan kaba. 6. Gafia. 7. Girka. 8. Ba'awa. 9. Abdallawa. 10. Dankama.A random selection was done to choose the first sample, it appeared to be 1.Kaita, based on sampling interval of 3,every third ward is selected as a sample.Thus, the selected samples are 1.Kaita. 4.Matsai. 7.Girka 10.Dankama

Based on field survey the total number of houses in the selected villagesis 463,from which 58 were selected systematically using the equation:

K=n/m……eq. 1

Where K is the Sampling Interval, n is the total number of Population (sampled) and m is the expected sample to be drawn for the study.

K= 463/58=7.98 as calculated and presented (table 1)

Table 1: Sample of Participants

SN	Wards	No. of Streets	No. of houses	Sample of participants
1	Dankama	12	118	15
2	Girka	8	82	10
3	Matsai	9	91	11
4	Kaita	18	172	22
		47	**463**	**58**

Source: field survey 2018

To achieve the last research objective,a total of seven participants were drawn for in-depth interview using snowball sampling technique in order to identify the respondents with sound knowledge and experience of land degradation and its management in the area and they have interacted with development partners for over 10 years. This was done to provide answer for the last research question.

3.4 PROCEDURES FOR DATA COLLECTION

The method usedfor data collection was Focal Group Discussion; two check lists were designed and used by the researcher for structured and in-depth interviews. (a) Thestructured interview was conducted with a total 58 respondents with a view to generate information about land degradation in the study area. The interview method is a conversation with a purpose to engage the respondents with the issues concerning the indicators of land degradation and its effects on livelihoods in all the selected study locations using checklist. In each location the interview lasted for about 45 minutes at a scheduled time which was convenient to all participants. Usually market days were avoided as well as periods when there are ceremonies in the study villages.The interview was first conducted in Dankama with 12 participants from whom three were sampled using snowball sampling techniquefor in-depth interview. The interview was conducted in Girka with 8 participants, in Matsai with 9 participants and in Kaita with 18 participants from whom 4 were sampled for in-depth interview also by using snowball sampling technique.

(b) The in-depth interview was conducted by the researcherwith 7 respondents, 3 from Dankam and 4 from Kaita, to supplement and extend the structured interview by sourcing the knowledge, thoughts, and interpretations of strategies to combat land degradation in the area. Two in-depth interviews were conducted in Kaita and Dankama villages being wards with highest population density in the local government area.The in-depth interview took 1 hour 15 minutes in both locations.For Kaita and Dankama both interviews were conducted on the same day in order to synchronise issues being discussed.

3.5 PROCEDURES FOR DATA ANALYSIS

Quantitative data was subjected to analysis using percentage and mean with the use of Microsoft

Excel software while qualitative data was transcribed and presented in textual form in appropriate sections of the work.

3.6 ETHICAL CONSIDERATION

Here the research subjects were verbally informedabout the purpose of the study. They were also consentedon the research purpose and the potential benefit of the study. Their right to privacy was also be protected and insured at all stages.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 INTRODUCTION

This chapter present results and discussion which comprise of socio-demographic characteristics of the respondents, indicators of land degradation,effects of land degradation and the techniques for management of land degradation in the area.

High percentage of family size in the study locations may cause more pressure on land resources to cater with the number of the family which may have the propensity to degrade the land. This is contended by Abdulrashid L. (2011) that due to ever increase in population there is need to feed the population which may lead to various forms of degradation. Most rural households in the area depend on agriculture as the main source of their livelihoods and hence rely on the productive use of land. However, livelihood sources have now become diverse across and within the region owing to failure of the land. Table 2 showed the diversity of livelihood options in the study area despite limitations from land degradation.

4.2 DEMOGRAPHIC CHARACTERISTICS OF THE SMALLHOLDER FARMERS

The demographic characteristics of the respondents were evaluated and presented in table 2, which shows that the average family sizes are large and extended. This reveals that with such high population, the gravity of suffering in the area conditioned by low productivity of the land is serious. At present households in the study area engage in farming, agricultural wage labour, employment in rural non-farm economy and migration. In line with (Chambers 1997) who argued that poor people have to engage in diversifying their livelihood sources against risks and

uncertainties. Despite increasing diversification of livelihood sources, agriculture however, continues to play a vital role through its contribution to growth, employment and livelihoods in the area hence land degradation problems remain at stake.

Table 2: Householdls' information on source of livelihood

Options	**Dankama**		**Girka**		**Matsai**		**Kaita**	
				Average size of family				
	No. of resp.	**Percentage**	**No. of resp.**	**Percentage**	**No. of resp.**	**Percentage**	**No. of resp.**	**Percentage**
1 to 5	1	6.67	2	20	2	18.18	3	13.64
6 to 10	2	13.33	1	10	1	9.09	2	9.09
11 to 15	8	53.33	3	30	5	45.45	11	50
16 and above	4	26.67	4	40	3	27.27	6	27.27
Total	**15**	**100**	**10**	**100**	**11**	**100**	**22**	**100**
				Main sources of livelihood				
Farming	11	73.33	7	70	6	54.55	13	59.09
Marketing	2	13.33	0	0	2	18.18	5	22.73
Others such as herbal practitioner, barbing, blacksmithing, driving	3	20	3	30	3	27.27	4	18.18
Total	**15**	**100**	**10**		**11**	**100**	**22**	**100**
				Main crops grown				
Millet	7	46.67	5	50	4	36.36	9	40.91
Sorghum	2	13.33	2	20	2	18.18	5	22.73
Beans	0	0	0	0	1	9.09	1	4.55
Groundnut	0	0	1	10	2	18.18	3	13.64
More than one	6	40	2	20	2	1	4	18.18
Total	**15**	**100**	**10**	**100**	**11**	**100**	**22**	**100**
				Output since last 4 years				
Reducing	9	60	6	60	6	54.55	16	72.73
Increasing	0	0	0	0	0	0	0	0
Dwindling	4	26.67	4	40	2	18.18	4	18.18
The same	2	13.33	0	0	3	27.27	2	9.09
Total	**15**	**100**	**10**	**100**	**11**	**100**	**22**	**100**

Source: Filed Survey (2018)

The size of the family (Table 2) shows that Dankama, Matsai and Kaita recorded the highest family size among the respondents ranging from 11-15 which is 53.33%, 45.45% and 50.00% for Dankama, Matsai and Kaita respectively while Girka recorded over 16 as family size. This implies that respondents at Girka have the highest family size among the study locations however, the lowest.

Table 2shows that farming is the major source of livelihood in the area with 73.33%, 70%, 54.55% and 59.09% for Dankama, Girka, Matsai and Kaita respectively. This implies that the livelihood activities may lead to the land degradation if it is constant without proper management. This is supported by (Gallopin G.1997)that agricultural activity is the major activity that degrades the land.

Table 2 indicates that millet is the major crop grown in the area with 46.67%, 50%, 30.36 and 40.91% for Dankama, Girka, Matsai and Kaita respectively. This is probably attributed to the fact that land quality of the land is most suitable for milletcultivation than othercrops.The respondents show that there is reduction in their production within the last four years. This implies that the production capacity of the land is reduced which results from over use and inadequate management.

4.3 CLASSIFICATION OF LAND DEGRADATION IN THE STUDY AREA

In the study area Land degradation is classified on the basis of land productivity as:

(i) slightly degraded when crop yield is reduced by 10%.

(ii) moderately degraded whencrop yield potential is reduced by 10-50%.

(iii) severely degraded when land losesmore than 50% of its potential yield.

4.4 TYPES OF LAND DEGRADATION

The researcher discovered that, the major types of land degradation that are prominent among the study locations comprise ofwater and wind erosion, salinization and soil compaction.

4.4.1 Water and Wind Erosion

The respondents revealed that they cut trees for fuel wood and building material; clear the landfor cultivation; excavate mud for building which all cause erosion due to reduction in surface cover which expose the surface and make it more prone to both water and wind erosion as well as the formation of gullies.

4.4.2 Salinization

The salinity is formed naturally based on the respondents' views and some attributed it toimproper management such as high application of inorganic fertilizer and inadequate use of organic manure. This is contended by Brady and Wed (2009) who reported that use of inorganic fertilizer may lead to salinization of the soil. This is supported by Abdulraheed L. (2011) that the soil of the area has high / moderate salinity.

4.4.3 Soil compaction

This is the increase in bulk density and corresponding decrease in porosity of soil caused by loads applied to it. According to the respondents soil compaction in the area, reduces water holding capacity of the soil and restrict the growth of plant roots. (Table 3)

Table 3: Types of Land degradation in the area

Types	Study Locations							
	Dankama		Girka		Matsai		Kaita	
	No. of Resp.	%	No. of Resp.	%	No. of Resp.	%	No. of Resp.	%
Wind erosion	6	40	3	30	5	35.46	10	45.46
Water erosion	4	26.67	3	30	4	36.36	6	27.27
Salinization	3	20	2	20	1	9.1	3	13.63
Soil compaction	2	13.33	2	20	1	9.1	3	13.63
	15	**100**	**10**	**100**	**11**	**100**	**22**	**100**

Source: Field Survey (2018)

4.5 INDICATORS OF LAND DEGRADATION IN THE STUDY AREA

Table 4 below shows that the indicators and the level of their degradation by the respondents among the study locations. Result of the study indicated that decline in yield of crops as the major indicator of land degradation in all the study locations with 60.00%, 50.00%, 54.55% and 59.09% for Dankama, Girka, Matsai and Kaita respectively. This is in consistence with Warren (2002) which revealed that the phenomenon is a serious threat to productivity in more humid areas as well while the worse is in dry areas. This suggests that it is a global phenomenon that affects all locations but rather more severe in the dry areas.

Several studies such as Wiebe (2003) reported that typically are less than 1% per year loss in yields on average, although larger impacts have been estimated for areas particularly vulnerable to land degradation, less vegetative area and arid region (2.2% losses per year on a 15 percent slope) (Pagiola 1996). Estimates suggest that land degradation may reduce global agricultural production by 0.1 to 0.5 % per year, resulting in an aggregate production loss of 2.5 to 12 percent after 25 years (Pender, 2009).

Table 4: Indicators of Land Degradation

	Study Locations							
	Dankama		**Girka**		**Matsai**		**Kaita**	
Indicators	**No. of Resp.**	**%**	**No. of Resp.**	**%**	**No. of Resp.**	**%**	**No. of Resp.**	**%**
Declining crop yield	9	60	5	50	6	54.55	13	59.09
Decline in species diversity	0	0	2	20	1	9.09	3	13.64
Soil erosion	5	33.33	3	30	4	36.36	6	27.27
Emerging strain of insects	1	6.67	0	0	0	0	0	0
Total	**15**	**100**	**10**	**100**	**11**	**100**	**22**	**100**

Source: field survey (2018)

Soil erosion, asan indicator of land degradationhas a strong effect according to the smallholder farmers in the area (mean 31.74%). The farmers stated that the wearing away of the topsoil due to the action of wind and water is a major factor in the study area that has severe effects on soil functions such as nutrients cycling and water retention leading to loss of fertile land.This finding is in line with GLASOD (1988) that water and wind erosion account for 46% and 38% of all the degradation globally.This is further supported by Lal (1990) who reported that Africa may face greater problems of soil erosion than other regions and these could lead to cultivation of marginal land. This is also in correspondence with result reported by Abdulrashid (2011) in hisPh.D. Dissertation that the northern parts of Katsinahave identified soil erosion as the most biting indicator of land degradation in the area.

The farmers are vast in handling extreme situations concerning invasive plants in the study area. They were able to deal with some parasitic plants such as *gude-gude* and *harkiya*hence they reported this indicator very low. This is in line with Mortimore*et al*. (2006); Abdurrashid and

Mashi (2014) that farmers in the Sahel arehighy innovative and resilient to certain perturbations hence could deal with them using traditional methods.

4.6 EFFECT OF LAND DEGRADATION IN THE AREA

To identify the effect of land degradation on the livelihood of the respondents the three classes of land degradation in the area are considered, where indicators of land degradation are used as determinants (Table 5).

Table5: Degree of Losses due to Land Degradation

SN	Severity	No. of Respondents	Percentage
1	slightly degraded	5	8.62
2	moderately degraded	14	24.14
3	severely degraded	39	67.24
Total		**58**	**100.00**
Mean		**32**	**55.17**

Soutrce : field survey 2018

Findings of this study revealed that overwhelming majority of the participants (mean= 55 %) are severely affected by land degradation in Kaita Local government Area. This corroborates with finding reported byAbdurrashid and Mashi (2014) that the majority of the respondents in Kaita (72%), Jibia (65%), Baure (62%) and Mai'adua (54%) LGs of Katsina State believed that the level of soil degradation is very high in their villages, and predicted the severity of soil degradation is likely to increase overtime. Despite the various efforts to handle land degradation in the Kaita Local Government Area by the smallholder farmers, the phenomenon remains a major challenge to livelihood in the study area which continue to dwindle the livelihood base of

people and complicate efforts to improve living conditions in the area due to continuous increase of population as shown earlier in (table 2) and dependence on land resource in the area.

4.6.1 Poverty

According to the respondents, their cultivable lands were reduced drastically in size and qualitydue to wind and water erosion, salinization and compaction.This made large part of the population to be vulnerable to poverty because high percentage of the respondentswas dependant on agricultural production as primary source of livelihood. This has been reported by FGN (2012) that it is not surprising that the 2010 poverty survey by the National Population Commission (Kale, 2012) showed that the Northwest and Northeast geo-political zones, which constitute the frontline states, had the highest poverty rates in the country with 77.7% and 76.3% respectively in 2010 relative to the national rate of 69.1%. This poverty condition is associated with failure of cropping system in the frontline states which could deteriorate if improved land management is not put in place (Olofin, 1998).

4.6.2 Conflict on the available land resources

According to the respondents demographic changes, increasing consumption and environmental degradation are placing significant and potentially unsustainable pressures on the availability and usability of land in the area. Increasing population creates competitive demands for the use of land causing a negative impact on other land uses nearby.

4.6.3 Hunger and Starvation

According to the respondents, the reduction in size and quality of the cultivable land leads to decline in crop yield which results to food crises that become a famine when there is so little food in the region. This eventually causes large scale starvation, malnutrition and death.(Table 6)

Table 6: Effect Land Degradation

SN	Effect	No. of Respondents	Percentage
1	Poverty	24	41.38
2	Conflict on the available land resource	17	29.31
3	Hunger and starvation	17	29.31
Total		**58**	**100.00**

Source: Field survey 2018

4.7 SMALLHOLDER FARMERS' RESPONSES TO LAND DEGRADATION

The farmers in the area identified their response strategies to land degradation on decline crop production and soil erosion. Smallholder farmers in the study area employed knowledge-based procedures and methods of maintaining and improving land systems over the indefinite future improved land productivity. They have planted some leguminous hedges on borders and in rows of their farms in order to control velocity of running water and reduce wash off, theyhave identified 4 ways of managing declining crop productivity and low yield over the years. This varies in their acceptability according to the choices of the participants in Table 7.

Table 7 shows that most farmers are involved in the application of synthetic fertilizer in handling the decline in crop productivity. It also revealed that households often engage in many diversified activities including seasonal migration as a livelihood strategy to derive some share for their tenuous livelihoods and thus, contribute in reducing vulnerability.They seasonally migrate to major cities such as Kano, Port Harcourt and Lagos to engage in non-agricultural wage casual work.

Table 7: Farmers' Method of Handling Declining Crop Productivity

Options	Dankama (N)	Percentage	Girka (N)	Percentage	Matsai (N)	Percentage	Kaita (N)	Percentage
1. Abandon farming and start other sources of livelihood	4	26.67	2	20.00	2	18.18	3	13.64
2. Apply more synthetic fertilizer	7	46.67	4	40.00	4	36.36	13	59.09
3. Apply more manure	2	13.33	2	20.00	4	36.36	4	18.18
4. Migration to cities for greener pasture	2	13.33	2	20.00	1	9.09	2	9.09
Total	**15**	**100.00**	**10**	**100.00**	**11**	**100.00**	**22**	**100.00**

Source: field survey 2018 (N) = Number of participants

Studies such as McDowell and de Haan (1997) pointed out that migration is widespread as a component of livelihood diversifications in countries such as Ethiopia, Bangladesh and Mali.In Africa and other developing parts of the world, the resultant effects of land deteriorating and shortage of opportunities in rural areas is forcing more people to desperate migration. Seasonal labour migration to other places such as urban areas and large scale commercial farms provide opportunities to households in supplementing their incomes, smoothing consumption and protecting their asset bases during lean seasons (World Bank, 2007).

4.7.1 Response to decline in Crop production

In response to the decline in crop production, in Table 7, result of the study indicated that application of synthetic fertilizer is the widely used method of handling land degradation in the study area (mean 48.27%). some apply more manure, a number of the farmers abandon farming and start other sources of livelihood while others migrate to cities for greener pasture.

4.7.2 Soil and Water Erosion

In handling soil and water erosion, farmers in the area use sand bags as a control measure, plant vegetation to cover and bind the soil with their roots. Herbs, wild flowers and small trees are usually planted.

4.7.3 Vegetation decline

Excessive removal of vegetation through bush burning, cutting of trees for fuel wood, land clearing for cultivation etc, in the area leads to decline in vegetation cover among the study locations, this contribute to land degradation in the area. As a control, Assisted natural regeneration is practiced by the majority (Table 8), and some farmers practice coppicing. Other practices are reforestation for replacement of the trees removed; and vegetation restoration in order to maintain vegetation health and provide resilient habitats.

The farmers apply certain techniques of land degradation management (table 8) which are, in fact, practices to stop and reverse degradation or at least mitigate the adverse effects of earlier misuse.

Most of the farmers were commonly using agronomic/biological conservation measures to handle land degradation in the study area (Table 8) indicates that Assisted natural regeneration (48.27%) which farmers believed is efficient, less costly and do not require much labour compared is practised by overwhelming majority in the study area. Some of the farmers also relied heavily on coppicing which have long been a tree management practised in the Sahel according to Danjuma (2017). Very few however employed seed banking in the study area because it is difficult to travel long distance in the forest and bush to collect seed and store them.

Table 8:Small Holder Farmers'Methods of Maintaining Land Systems

SN	Techniques	Study locations				Freq.	Percentage
		Dankama (N)	Girka (N)	Matsai (N)	Kaita (N)		
1	Assisted Natural Regeneration	8	6	5	9	28	48.27
2	Compost (made from pod of Acacia nilotica)	3	-	2	4	9	15.51
3	Planting of hedges	1	-	-	3	4	6.89
4	Coppicing	1	4	4	5	14	24.13
5	Seed banking	2	-	-	1	3	05.17
		Total				58	100

Source: field survey 2018(N) = Number of participant

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

SUMMARY

The study assessed the small holder farmers' techniques of land degradation management in Kaita Local Government Area, north-western Nigeria and provided information for promoting sustainable land use in the area. The study area comprised of 10 wards from which 58 household heads were selected from a total of 463 houses in the study villages. The result shows that, types of land degradation in the area are water and wind erosion, salinization and soil compaction. While the indicators are decline in crop yield,decline in species diversity, soil erosion and emerging strain of insects. Poverty,Conflict on the available land resources as well as hunger and starvation appeared to be the major effects of land degradation in the area. The results indicates that majority of farmers in the study area usually apply synthetic fertilizer to handle land degradation (mean 48.27%). Assisted natural regenerationis widely practiced by farmers in the areato improve the density and diversity of some candidate trees particularly *Faidherbiaalbida* and *Acacia nilotica* for soil fertility improvement. They also use compost made of a mixture of *Acacia nilotica* pods and synthetic fertilizer to manage their land believing that this is most resilient, cost effective and friendly but because they lack certain take up capital which they cannot fully realize in most cases. Additionally, These are land management with viable solutions for improving multiple outputs and services from the same unit of land in a sustainable and socially acceptable manner.

5.2 CONCLUSION

This study concluded that land degradation is prominent in the study area where about 90% of the land is affected (table 5). Crop yield decline and soil erosion in the study area where bulk of the populations live and whose livelihood depends on agriculture and related activities is no doubt that the damage to the land is no respecter of frontiers and this can affect future generation.

Various agronomic and biological techniques were however adopted by smallholder people in the area to improve land management through community participatory processes. Principally, the smallholders have jointly manage crop yield and soil erosion which are threatening the agricultural productive capacity of the land through assisted natural regeneration, planting on hedges and application of organic manure. These achievements were behind sustainability of farming practices to make their more development in the villages and in off-farm income generating activities in the area. For groups of poor and landless households with emphasis on those headed by women, coppicing is used to maintain their socio-economic levels through generations. Integrating local stakeholders will ensure the sustainability of land and its resources and redress the effects of degradation in the study area and Nigeria at large. This is because about 70% of the population of the study area are farmers and more than that are natural resource users, thus utilizing their potentials will restore the deterioration on land.

5.3 RECOMMENDATIONS

1. This study recommended that more commitments should be made to encourage the use of assisted natural regeneration for combating land degradation in the study area through non-centralized means of resources sharing that unfairly allocate environment management funds to

the central agencies thereby alienating the rural poor. This can boost smallholder farmers to achieve more inspite of economic crunch.

2.This study recommended that there should be concerted efforts in information dissemination and trainingto resource users, extension workers, researchers, policy-makersand decision-makersabout the causes, the context, and the impacts of land degradation. to achieve a break-through.

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APPENDIX

CHECKLIST FOR STRUCTURED INTERVIEW

SECTION A: Socio-Demographic and Economic Issues

1. What is the size of your family?

2. What is your main source of livelihood?

3. What type of farming system do you practice?

4. What are the reasons for undertaking a particular system?

5. What crops do you grow most?

6. How much do you invest in a farming season in the last 4 years?

7. How has been your output since last 4 years?

8. What was your response when you notice decline in output?

10. What are the other sources of income in your area?

11. Do you have livestock?

12. Give their number and type

13. Do you encounter any difficulty in keeping your livestock?

14. How has that affect your livelihood?

SECTION B: Indices of Land Degradation

1. What is your perception about land degradation in your area?

2. What shows you that the land is degrading in your area?

3. What form (s) of land degradation do you notice in your area?

3. How severe is land degradation in your study area?

CHECKLIST FOR INDEPTH INTERVIEW

SECTION A: Indigenous Techniques for Land Degradation Management

1. Do you have land degradation problem in your locality?

2. Do you have local laws on land resources management? Who is responsible for their enforcement?

3. What strategies do you employ for the management of land degradation in the study area?

4. Do you have any organizations/groups that deal with land degradation management in your village?