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# RECENT CONSEQUENCES OF LAND DEGRADATION ON FARMLAND IN THE PERI-URBAN AREA OF KADUNA METROPOLIS, NIGERIA

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## ABSTRACT

This study identifies the recent consequences of land degradation in the peri-urban area of Kaduna metropolis with the aim to improve the environment and the socio-economic status of the inhabitant. Random sampling method was used to collect data from field observation and measurement while snow-ball sampling technique was adopted for the selection of farmers for semi-structured interviews, which are analysed using descriptive statistics. The result revealed that there are three new recent consequences of land degradation in the area; namely, one, socio-economic parameters which includes spending more time, energy and increase in cost of farming; two, the waste buried in the soil are non-biodegradable and contains poisonous chemicals while the third is the permanent resident of many non-degraded waste in the soil. Their implication has effect on the people's health, socio-economic pattern and quality and the environment which are all highly interrelated making the situation more complex. It is suggested that there should be proper and adequate waste management in place for the metropolis, improve conservation techniques to be employed by the farmers and where the land is assumed to be polluted beyond tolerance level the land use should be change from crop farming.

**Keywords**: Consequences, Conservation, Farmland, Degradation, Socio-economic, Sustainable development.

## INTRODUCTION

Land degradation is a long recognized environmental issue, which straddles both the physical and social sciences. Land degradation has been acknowledged in policy cycle through Agenda 21 and the signing of the United Nations Convention to Combat Desertification (UNCCD) in 1994. Land degradation is a contested term with various meanings, located as it is in various contexts. Historically, land degradation has been a contentious issue (Niemeijer & Mazzucato, 2002; Scoones & Toulmin, 1998; Warren, 2002). The causes and consequences vary from region to region, mainly in terms of localized intensity, as well as programs to solve problems of land degradation, which also vary regionally as a function of ecosystem characteristics, culture, economics, and political will. However, some cases of similarities in causes and consequences have being reported to exist (Reynolds, 2001).

The dual role of humanity in both contributing to the causes and experiencing the effects of global change processes emphasizes the need for better understanding of the interaction between human beings and the terrestrial environment. This need becomes more imperative as changes in land use become more rapid. As a result, understanding the driving forces behind land degradation in various ecological zones and developing models to stimulate these changes are essential to predicting the effects on global environment. Reynolds & Stafford Smith (2002) broadly classify into three groups, factors responsible for land degradation. These are: meteorological, ecological and human factors. The combination of the meteorological and ecological factors forms the biogeophysical factor while the human factors are the socio-economic factors.

Nicholson, 2002, reported that, climate and land surface are inextricable linked. Land degradation can therefore be evaluated within the context of the climate background. Climatic variables such as temperature and rainfall determine land surface character to a first approximation; the characteristics of the surface in turn, affect fluxes of energy, moisture, and particulates that modulate meteorological processes. Also, rainfall is the limiting factor in vegetation growth, the character of the rainfall, that is, its distribution in time and space has the ultimate influence on vegetation growth and the health status of the environment.

Humans are the dominant force in global environmental change. Socio-economic factors are clearly major drivers of land degradation (Abubakar, 2000; Olofin, 2000; Okin, 2002; UNEP, 1997). Milton & Dean (1995) listed the socio-economic factors to include, over estimation of carrying capacity, market forces, state subsidies and increasing land values. To Adewuyi (2008) and Okin (2002), land use is a major factor of soil erosion and land degradation. Crop cultivation and grazing are major land uses that have attracted a lot of condemnation for contributing to land degradation (Puigdefabregas & Mendizabel 1998). Studies like Albaladejo, Martinez-Mena, Roldan, & Castillo (1998) recorded significant decreases in both soil organic carbon content and stable aggregate and an increase in bulk density from areas subjected to heavy grazing.

Prince (2002) enumerated the following biogeophysical process as consequences of land degradation which was also corroborated by other studies (such as: Ali, 2003; de Sherbini, 2002; Idoko, 2004). They include the following: loss of soil structure and cohesion, soil crusting, soil compaction, soil erosion by ablation, gulling, sheet erosion, accumulation of soil at the base of perennial and permanent structures, local deposition in outwash farms, increased complexity of the landscape, dune formation, addition of sediment to water bodies, loss of productivity of crop lands, pasture and wood lands, dust storms, increased atmospheric aerosol loading, loss of surface roughness, increased albedo, decreased convection, reduced rainfall and changed atmospheric circulation.

Other scholars reported that land degradation also causes for example alteration of ecosystem services locally and globally, deforestation, loss of biodiversity, habitat loss and species endangerment (FAO, 2000; Olofin, 1997; WRI, 1997); changes in hydrological and climatic cycle (Olofin, 1997; Shonekan, 2004) reduced agricultural yield (Anderson, 1990; Mallo, 1998; Ramankutty & Foley,1999; Sisk, 1998; Thebaud, 1995); socio-economic welfare (Mariko, 1991; Mortimore, 2000; Singh , Shi, Zhu, & Foresman 2000). Lastly, security and infrastructural supply (Mazzucato & Niemeijer, 2000). The causes of land

degradation are as diverse as its consequences to man. Although they appear unlimited, in effect however they are basically grouped into environmental (ecosystem), economic, political, security, health, trade, education and the general well being of the people.

From the review of relevant literature, the most suitable conceptual framework for this study is the sustainability model. This model is arrived at because the essence of studies in land degradation is to determine the causes of land degradation, its rate and subsequently to use the findings for conservation of the land in particular and the environment in general for sustainable development for both current and future users. Therefore efforts are not just on what the current land users can get from the land but to ensure that future users even get better output. To this end, this study is designed on the model of sustainability, and as a result the methodology and discussion focus greatly on it with particular emphasis on conservation.

Peri – urban areas are transition zone between urban and rural areas. Consequently these areas are under intense pressure for change in their land use and land cover (Adewuyi, 2008). However, of recent these areas also begin to bear the burden of inadequate or lack of proper management of the resources of the city. A case in focus is Kaduna Metropolis, a city that is daily expanding due to several factors, among which are immigration from rural areas, proximity to Abuja, the federal capital territory and better job opportunity and standard of living. But, the available infrastructures are not increasing at the same rate. Thus, this expansion has its own consequences on the city and it peri-urban area.

The consequences emanate from the city centre first before creating both environmental and socio-economic problems at the peri-urban areas. Of concern to this study is the lack of adequate waste management in the metropolis which has led to dumping of refuse in drainages and streams (Nyeh, 2009). This leads to blockage of the channels and subsequently flooding takes place (Abdullahi, 2009). The effect of the flooding differs between the metropolis and the out-skirt strictly because of differences in land use and cover. While it is easy to tackle it in the city because affected areas are usually the roads and adjacent buildings, where basic cleaning and application of disinfectants will easily solve the problems.

When this phenomenon occurs in the peri-urban area, it causes wide spread flooding of farmlands and dumping of waste materials on farms. Unlike in the metropolis, it is very difficult to handle the effects in the peri-urban area where land use is for crop farming mostly (Adewuyi, 2010) and surface soil is exposed and required tilling the soil before it is used. The main land degradation problem for such land use before now use to be erosion (Adewuyi, 2008), however, because of the dumping of waste on farmland during flooding and the mixing of waste such as nylon, polythene, rubber, plastic materials and light metal with the top soil which are not easily degraded, thereby introducing new problems. Since this is a new challenge to the farmers of this area, the research problem was to find out what the farmers goes through or experienced in order to put these lands to use for crop farming and more importantly to proposed conservation techniques for the area for sustainable development.

The general assumption for this study was that the earlier this problem is understand in detail and characterized, the quicker the conservation will be developed and the better the output from the farm which will subsequently bring higher yield to the land user and better socio-economic conditions for improved standard of living and more importantly creating sustainable development. Therefore the aim of this study is to identify the new consequences of land degradation in order to improve the

environment and the socio-economic status of the inhabitant. To achieve this goal the following objectives are set: to map the river course, land use and cover adjacent to the river, examined the types of land degradation and their consequences and proposed ways of handling these new environmental problems for sustainable developments.

## MATERIALS AND METHODS

### Study Area

The study area is a portion of the peri-urban area of Kaduna metropolis, Kaduna state, Nigeria (Figure 1). The main river in focus is River Mashi a tributary of River Kaduna. It flows roughly from the north to the south and has large portion of the metropolis as its catchment area. The river forms the natural boundary between Igabi, Kaduna north and south local Government areas. These areas lie within a 500m corridor from the outskirts of the city in some places while in other places development has envelope the surrounding (Figure 2). These zones are transition areas from rural to urban and they lack adequate infrastructure in comparison to the main city. It falls within latitudes $10^{\circ}\ 22^{I}\ 00^{II}$ – $10^{\circ}\ 26^{I}\ 00^{II}$ N and longitudes $7^{\circ}\ 29^{I}\ 00^{II}$ – $7^{\circ}\ 35^{I}\ 00^{II}$ E with the elevation ranging from 600 to 650m above mean sea level. The approximate size of the study area is 8,000$m^2$ (8$km^2$). It falls within Igabi and Kaduna north local government areas of Kaduna State, Nigeria (Figure 2).

Kaduna experiences a tropical continental climate. This type of climate is characterized by two distinct seasons of dry and wet. The dry season sets in October and last till April of the following year while the wet season starts around late April and last till October. Kaduna temperature is high throughout the year with mean minimum temperature at 23$^{o}$C and mean maximum at about 34$^{o}$C.The diurnal range of temperature is sometimes as high as 12$^{o}$C which is good for crop growth throughout the year (Adeleke & Leong, 1981). The annual average rainfall is 1250mm with maximum rainfall between July and August (Kowal & Knabe, 1972).

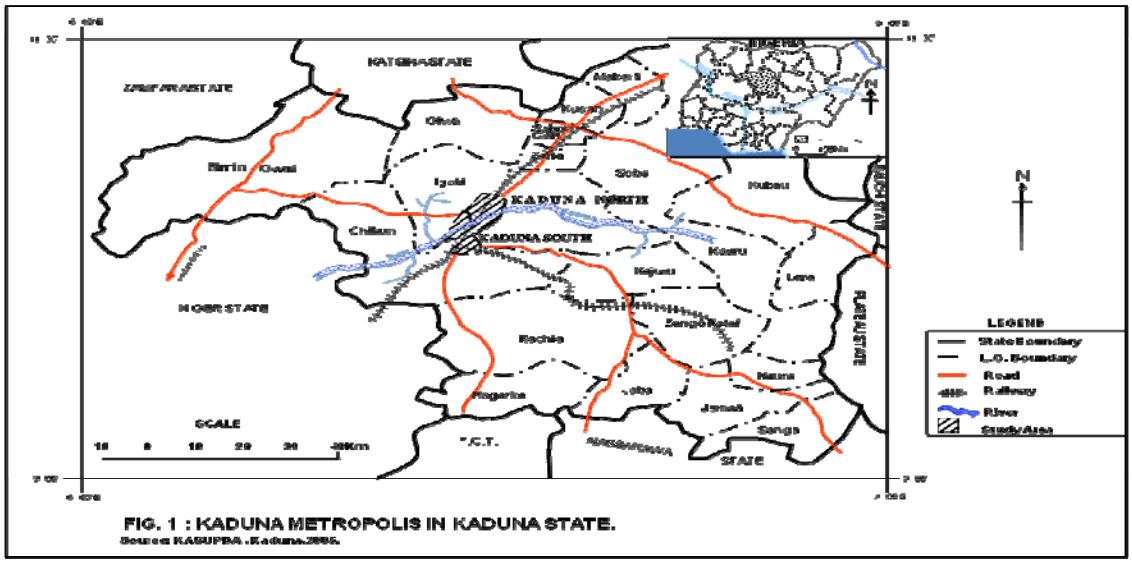


FIG. 1 : KADUNA METROPOLIS IN KADUNA STATE.

The land uses of the adjacent land to the river are mostly for agriculture while housing is also encroaching into the flood plain. The trees are generally moderate in size, ranging from 5 to 15m in height and 15 to 100cm in trunk diameter. The crops

grown are mainly cereal (maize, guinea corn and millet) and vegetables (spinach, tomatoes, cabbage, onions etc). Cattle, goat and sheep grazed the vegetation from time to time.

**Data and Methods**

Studies on land degradation are both biophysical and socio-economic in nature. As a result the methodology of data collection was designed to reflect these two factors. Since the aim of the study is to examine the recent consequences of land degradation and its effects on crop farming in the area, first hand information was collected through observation, measurements and interviews after a thorough reconnaissance survey. The reconnaissance survey was carried out to determine the size of the peri- urban area of Kaduna and the average size of the farm land in order to determine an adequate representative study size. This was used to determine the number of transects required and their dimensions. Satellite imagery was very useful during the survey.

During the field work, field observation was carried out between 8.00am and 4.00pm daily. Under this section, one basic set of data is targeted. This was to observe as seen on the field and document the type of land use, land cover, farming system, type of degradation and local conservation techniques, type of erosion and major crops produced in each transect. The observation was carried out by a thorough examination of each transect for each variable, and the result was documented on a recording sheet designed for the study transect. Each transect has a form and as a result at the end, 3 recording sheets was produced. The compilation was presented as Tables 1 and 2. The snow-ball sampling method was adopted to select 48 farmers out of an approximate 200. The summary of the result is presented in the appendix.

**RESULT AND DISCUSSION**

The peri-urban area of Kaduna metropolis has a distinct type of cover because the land use differs from that of the heart of the metropolis. Consequently, the major covers reflect the type of use and as a result, the covers for the area are houses, trees, crops, grasses, litters, shrubs and refuse (Plate I). This implies the area is not a complete built up area. The size and percentage of the area degraded, the character of the vegetation and the tree are documented in Table 1. On Table 2 are summary results from field observation which catalogue land use, land cover, soil type, texture and colour, type of degradation, erosion type and numbers, farming system, crop planted and existing conservation techniques.

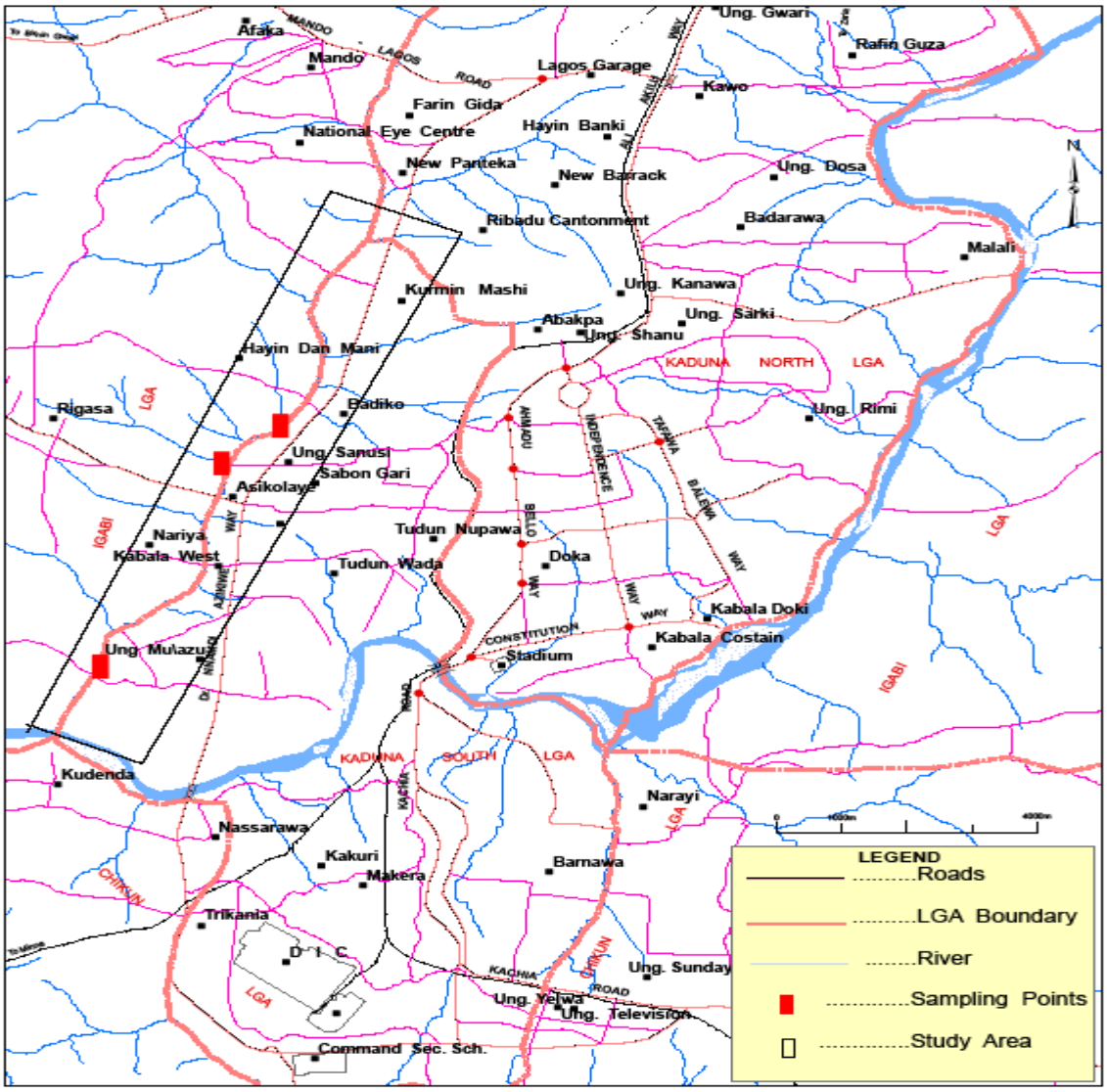


**FIG. 2 : KADUNA METROPOLIS SHOWING THE STUDY AREA**

Source: Fieldwork, 2011.

**Table 1: Summary of Land Use and Land Cover Characteristics**

| Transect | Area Degraded ($m^2$) | Percent of Area Degraded | SCI (%) | Tree Crown Fullness (%) | Area Cover By Litter (%) | Tree Density Per Transect | LCI (%) | Ratio of Indigenous to Exotic Trees | Types of Exotic Trees |
|---|---|---|---|---|---|---|---|---|---|
| TP 1 | 0 | 0 | 20.00 | 25 | 42 | 1 | < 1 | 1 Palm | Palm |
| TP 2 | 195.70 | 0.78 | 52.60 | 75 | 4 | 121 | 10 | 1:12 | Mango, Guava, Kola |
| TP 3 | 132.65 | 0.53 | 1.83 | 80 | 25 | 77 | 6.2 | 1:10 | Mango |

**Table 2: Summary of Results from Field Observation**

| Transect | Land use | Land cover | Soil Type | Soil texture | Soil colour | Type of degradation | Erosion type and number | Farming system | Major crop planted | Conservation techniques |
|---|---|---|---|---|---|---|---|---|---|---|
| TP 1 | Crop farming | Trees and grasses | Silty clay | Fine | Fine brown | Deforestation | NIL | Crop and animal -rain fed | Maize and millet | Use of fertilizer |
| TP 2 | Crop farming | Trees and crops | clay | Fine | Dark brown | Flooding, Gully, pollution and refuse dumping | One gully | Intensive crop farming-Irrigation | Maize, rice, cabbage, tomatoes and lectus | Use of fertilizer, manure, raised beds and construction of water channels |
| TP 3 | Crop farming | Trees, crop and litters | silty | Fine | Brown | Gully, refuse dumping and excavation Pits | Two gully | Crop-rain fed | Maize | Use of fertilizer |

Refuse dumping is a common land degradation in the area (Plate I and Table 2) and it occurs in two forms. First, human beings deliberately dump refuse on parcels of land due to proximity or availability of empty space. Second, refuse is dumped

or scattered as a result of actions of wind and water. They are commonly found along drainage channels. However, refuse dumped by the action of water is by far the most important and they occur randomly. The refuse content range from domestic waste such as paper, polythene, food, animal carcass, cloths, saw dust, plastics and light weight objects that are not biodegradable. Year after year, these wastes are partially either cleared or are left to expand to swallow surrounding farmlands. The major type of waste creating problem in the area are non-biodegradable in the likes of nylon, polythene and plastic.

Three new discoveries were made during the study. One, that farmers spend enormous energy and time to clear their farmland of waste such as cellophane, polythene and other light weight waste deposited by floods. This singular problem not only degraded the environment but also, much more, increase the hardship farmers along the river banks go through. As a result, more time and energy are spent on the farmland which was not the case in the past.

The first recent consequences is socio-economic in nature being that farmers now need to exalt more energy to produce less than what they use to get in the past. One of the farmers interviewed revealed that he spent at least two weeks of hard labour in the last five years at the beginning of every farming season just to gather and sort out waste from his farm of about 1000$m^2$ (Plate II). This further reduced the time available to 25% of the farmers who have other economic activities for their survival and for socialization of all the farmers (Appendix 1). Therefore by implication, in the long run it could also create poor health conditions and other social problems for the farmers. Grazing animals for both private and commercial consumption can also consume poisoned vegetation which in turn can create safety and health problems in the food chain.

**Plate I: Refuse Dumping in Artificial Pond**

The second dimension to it is time. Following the popular adage that “time is money”, the time spent to clear the waste and sort it before preparing the land for farming is indirectly adding to the time spent for farming. Increase in the time spent on the farm invariable leads to the third dimension of the first new recent consequences of land degradation in the peri-urban area of Kaduna metropolis which is high cost of farming. Also, part of the cost implication is from the money spent on their health and for hiring of additional hands and the conservation that is employed which Adewuyi (2010) already found to be inadequate in many areas. From this study, the three socio-economic characters of the first new consequences are inter-related and one leads to the other making the whole situation more complicated.

The second new consequence is that the kinds of waste emanating from the metropolis have changed and is now introducing new problems at the peri-urban areas. Before farmers are used to easily decompose waste materials such as dead animals, human faeces, bad fruits and food which many of the farmers even used as manure to enrich the soil. But recent discovery revealed that the type of waste now include chemicals from battery, electronics and household equipments which invariably pollute the soil. This demand for a better waste management system within the metropolis because once the soil is polluted it is more difficult and costly to eradicate and which in this case it is even beyond the ability of the farmers. The biggest fear and concern is the problem it can introduce in the food chain and the health consequences since most of the produce are consumed by the larger population of the metropolis.

The third new consequence is that based on the available conservation techniques that the farmers are using, they are only able to reduce the amount of waste, and many are still left in the soil. This is so because they employed physical removal of big sized waste from the surface soil while the smaller size and the ones buried in the soil are left untouched (Plate III). At the long run, the soil will suffer from the effects of this waste. This is likely the reason for the trend experienced in crop yield and the years since when it as being observed particularly in areas with declining productivity. Also this likely explains why 90% of the changes in crop yield and changes in vegetation occurred in the last 15 years and 50% of it occurs in the last 5 years (Appendix 1).

**Plate II: Sorted Waste on farmland**

**Plate III: Farmland Dotted with Waste After Sorting**.

Most of the farmers in the area are below 50 years of age, with fairly large family to look after, further implying that the impact of the new consequences of land degradation in the area is enormous and should not be waved aside but rather the policy maker should begin to find lasting solution to it as it has health, socio-economic and environmental implications. It also requires urgent attention because the area is underdeveloped with a lot of projects chasing little revenue.

## CONCLUSION AND RECOMMENDATION

In conclusion, our investigation identifies three new recent consequences of land degradation in the peri-urban area of Kaduna metropolis. All of these are traced directly and indirectly to lack of adequate waste management within the metropolis, meaning the current approach is grossly unsustainable. In our opinion, this is a time bomb that can go on anytime; therefore the earlier there are alleviation steps the better for the environment sustainability and the socio-economic well being of the people at large, since crops grow there are sold in open market for all. The steps on one hand should focus on better waste management for the metropolis while on the other hand areas already polluted should be conserved and the people affected be given support both in the short and long run. Therefore, in order to improve the environment and the well being of the inhabitants, these three discoveries are recommended research areas for further studies.

This study will also like to advise the various tiers of government to have a comprehensive review of the types of waste generated, the quantity of waste generated, the methods of disposal, collection and management and their effect on sustainable development. Doing this will characterized the existing waste management methods and provides an avenue to improve on them and finally create a sustainable environment. There is also the need to continue with enlightenment of the citizens on how to disposed there waste and where necessary to put in place reward and punishment which implies the re-introduction of sanitary waste inspectors in various communities.


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**Appendix: Summary of the Result of the Interview**
**Personal Questions**

1. Age of respondent

| | No | % |
|---|---|---|
| 20 – 30 years | 10 | 20.8 |
| 31 – 40 | 12 | 25.0 |
| 41 - 50 | 11 | 22.9 |
| 51 – 60 | 07 | 14.6 |
| > 60 | 08 | 16.6 |

2. Years lived by the respondent in the area

| | No | % |
|---|---|---|
| 1 – 5 years | 1 | 2.1 |
| 6 – 10 | 7 | 14.6 |
| 11 – 15 | 6 | 12.5 |
| 16 – 20 | 8 | 16.6 |
| > 20 | 26 | 54.2 |

3. Occupation

| | No | % |
|---|---|---|
| Farming only | 36 | 75 |
| Farming and other jobs | 12 | 25 |

**Case History**

4. Whether there is changes in vegetation

| | No | % |
|---|---|---|
| Yes | 48 | 100 |
| No | nil | nil |

5. Years since when the changes in vegetation has being noticed?

| | No | % |
|---|---|---|
| 1 – 5 years | 14 | 29.2 |
| 6 – 10 | 17 | 35.4 |
| 10 – 15 | 3 | 6.3 |
| 16 – 20 | 5 | 10.4 |
| > 20 | 6 | 12.5 |
| Not sure | 3 | 6.3 |

6. Types of changes in vegetation

| | No | % |
|---|---|---|
| Increase in trees | 23 | 47.9 |
| Decrease in trees | 17 | 35.4 |
| Increase in grasses | 2 | 4.2 |
| Reduction in trees but increase in grasses | 4 | 8.3 |
| Lost of both trees and Grasses | 2 | 4.2 |

7. Trend of crop yield

| | No | % |
|---|---|---|
| Increase | 30 | 62.5 |
| Decrease | 18 | 37.5 |

8. Years since changes has been noticed in the crop yield

| | No | % |
|---|---|---|
| 1 – 5 years | 19 | 39.6 |
| 6 – 10 | 11 | 22.9 |
| 11 – 15 | 10 | 20.8 |
| 16 – 20 | 4 | 8.3 |
| > 20 | 2 | 4.2 |
| Not sure | 2 | 4.2 |

9. Whether there are changes in land use in the last 20 years

| | No | % |
|---|---|---|
| Yes | 30 | 62.5 |
| No | 16 | 33.3 |
| Not applicable | 2 | 4.2 |

10. Changes in land use

| | No | % |
|---|---|---|
| No changes | 18 | 37.5 |
| Forest to Agriculture | 24 | 50.0 |
| Rangeland to Agriculture | 6 | 12.5 |

11. Types of farm clearance before farming

| | No | % |
|---|---|---|
| Cutting grass only | 9 | 18.8 |
| Burning grass only | 1 | 2.1 |
| Cutting and taken away | 2 | 4.2 |
| Cutting and then burn | 36 | 75 |

12. Other types of land degradation beside erosion

| | No | % |
|---|---|---|
| Overgrazing | 1 | 2.1 |
| Loss of fertility | 17 | 35.4 |
| Invading species | 3 | 6.3 |
| Refuse | 1 | 2.1 |
| Flooding and all of the above | 20 | 41.7 |
| None | 6 | 12.5 |

13. The problems encountered by farmers due to land degradation
    a. Increased cost of farming (increased labour, time and finance)
    b. Increased use of fertilizer
    c. Reduction in crop yield
    d. Lost of fertility of the soil
    e. Lost of agricultural land

14. Measures introduced to reduced the effects of land degradation
    a. Application of manure and animal dung
    b. Application of fertilizer
    c. Bush burning
    d. Erosion control
    e. Leaving crop residual on the farms
    f. Re-forcing water channels
    g. Making ridges align perpendicular to the direction of slope
    h. Using raised beds
    i. Employing farming practices such as crop rotation and mixed farming.

15. Major farming systems in the area

| | No | % |
|---|---|---|
| Crop farming alone | 29 | 60.4 |
| Crop and animal husbandry | 17 | 35.4 |
| Crop and forestry | 1 | 2.1 |
| Crop, animal husbandry and forestry | 1 | 2.1 |