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# FARMERS' PERCEPTION OF SOIL DEGRADATION IN SEMI-ARID AREAS OF KATSINA STATE, NORTHERN NIGERIA

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**ABSTRACT**

Perspectives of farmers on indicators and causes of soil degradation and the measures used in conserving the soil fertility were investigated in some selected villages in six local government of Katsina State. Household survey, key informants interview; focus group discussion and field observation were used in the data collection. The result indicated that farmers have an array of indicators for assessing the extent of soil degradation in their farms and also identified and explained the causative factors responsible for the phenomenon. Majority of the farmers prefer to use agronomic/biological conservation compare to mechanical measures which require a lot of materials hence costly, difficult to make and maintain. It is also found that individual views on soil degradation are influenced by many factors, thus when planning any programme to remediate soil degradation one must take cognizance of farmers' differences of environmental knowledge and their holistic perception of the problem.

***Keywords**: soil degradation, water erosion, wind erosion, soil fertility decline, soil and water conservation*

## INTRODUCTION

Soil fertility degradation on smallholder farms are widely believed to be the major cause of food insecurity and poverty in sub-Saharan Africa (SSA), where large percentage of the people live in rural areas and derive their livelihoods from farming and other related activities (Bielders et al., 2001; Mortimore, 2005; Moges and Holden; 2007). In dry lands, soil degradation processes, which have a more severe impact on land productivity, include, deforestation, water erosion, wind erosion, salinization, alkalinizaion and soil compaction (Olofin, 1998; Dregene, 2002; ). These degradation processes take place in three interlocking stages with one stage leading to another. These are soil physical degradation, chemical degradation, and biological degradation (Maigari 2002).

Since the first United Nations (UN) Desertification Conference of 1977 in Nairobi, the 1992 UN Conference on Environment and Development, which held in Rio de Janeiro, and the 1994 Inter-governmental Convention to Combat Desertification which held in Paris, science has played a leading role in defining land degradation, as well as determining its extent and assessing its impact and offered a variety of alternatives to remedy the problem. (Stringer and Reed 2007; Stringer et al., 200). Despite all these and other efforts, the problem still persists (Le Houerou, 2003). "Science has its own limitations and cannot always provide accurate diagnosis or solution to all problems" (Stringer and Reed 2007). Hence, many scientists are now advocating the need to consider the views and perspectives of the local communities because they may offer important revelations on their environment changes which analysis of scientific data alone cannot capture (e.g. Kiome and Stocking,1998; Kerr and Pender, 2005;.Okoba and Graarff 2005, Louis 2007, Wei et al., 2009 ).Even though some have argued that farmers and scientists contrasting views are influenced by their different aim, method and nature of work (Ingram et al., 2010).

Davies et al., (2010) and Odendo et al., (2010) also suggested that the identification of the indicators of soil degradation should no longer be considered an exclusive monopoly of the scientists. Because "it is not exclusive knowledge held by scientists that hold the key to understanding and solving environmental problems but the mutual inter dependence of both "expert" and indigenous knowledge" (Mahiri, 1998).

. In many countries, a few studies have been attempted to understand the causes, extent and severity of soil degradation from the point of view of the people directly affected by the problem (West et al., 2008). But a huge amount of resources has been allocated on experiment at national and international agricultural research and development centers, which have not always had a significant impact on third world farmers, whereas relatively few resources have been used for exploring the indigenous agricultural and environmental knowledge system of the communities living in an increasingly degraded land.

Perhaps a good way of addressing the complexities and contentious nature of the understanding of drylands' environments provided by western science is for the researchers of these environments to start giving emphasis in using the indigenous knowledge of environmental degradation to complement western scientific knowledge. As Lal (2009a) pointed out, "indigenous knowledge and modern innovation go hand-in-hand. One cannot solve current global issue without the other". Hence it was stressed that ''we can develop upon traditional knowledge, but those who ignore modern innovations must be prepare to endure more sufferings.'' Some scientists have emphasized the need for the use of both local and scientific environmental knowledge systems in the development planning process and in scientific investigations (e.g. Thomas and Twyman, 2004; Stringer and Reed 2007 Lindsay et al., 2007). Even though, from 1980s there is a lot of "bottom-up" and "participatory" rhetoric, the old habit of the top-down approach still persists and local views and perspectives were not given due consideration (Reed et al., 2007)..

Nigeria's grassland (savanna) region covers about 849,496km$^2$ or 86% of the country's land area and contains more than 60% of the country's population (Omijeh et al, 1989; Adegbehin et al., 1990; Mijindadi and Adegbehin 1991). Between 11$^0$N and 14$^0$N where the Sudano-Sahelian agro-ecological zone lies, is about 40% of the country's landmass which is very susceptible to land degradation than any other region of the country due to a variety of factors, including overgrazing, deforestation, wind erosion, soil depletion aggravated by continuous cropping, drought and bush fire (Adegbehin et al., 1990). The rate of land degradation in Nigeria appears to have extended below 11$^0$N because of uncontrolled human activities (Otegbeye, 2004).

It has been estimated that Nigeria is losing 350,000m$^2$ to desertification every year and the Sahara desert is advancing at an estimated rate of 0.6km per year (Federal Ministry of Environment Bulletin, 2008). Northern Katsina State (i.e. the six local governments bordering Niger Republic) is an area believed to be threatened seriously by land degradation (Effeh, 2000). In most agro-ecological zones of Nigeria, there is no much record documenting the indigenous environmental knowledge, thus, studying how local communities in this area understand soil degradation problems, and manage it, could help in building on the existing knowledge and experience of the scientists by enhancing and re-orienting their thinking of the problem. The objectives of this study are (i) to identify and describe farmers indicators of soil degradation, (ii) to investigate farmers perceive reasons/causes of soil degradation and (iii)cto document farmers' soil conservation knowledge and existing practices.

## MATERIALS AND METHODS

### Geographical settings of the study area

The study area lies between latitude 12$^o$52'N and13$^o$19'N and longitude 7$^o$16'E and 8$^o$43'E. The villages fall within six local government areas (LGA) of Katsina state, northern Nigeria. The landscape features are underlain by sedimentary rock, dominantly flat with an average height of 300 meters above sea level, with intersection in some parts by hills. Local vegetation adapts to climatic rhythm of long dry season and short wet season. The dominant trees in the area developed long tap roots, thick barks which allow them to withstand the long dry season and bush fires. The vegetation is facing various form of abuse, including, cutting, cultivation, overgrazing and bush fire. The area has unimodal rainfall pattern fallen between May to September, with annual average below 700mm. Temperatures are high in most parts of the year, with the mean daily maximum ranging between 27$^o$C-40$^o$C occur between March and May and minimum ranging between 18$^o$C-25$^o$C received between November to early February The study area has four different seasons; a cool dry season (December to February), a hot dry season ( March to May), a warm wet season ( May to September) and a season of low temperature ( September to November), (Tomlinson, 2010). The soils are sandy ferruginous type, of latosols group, highly weathered and markedly laterised and slightly acidic with low organic matter content and phosphorous, its total nitrogen rarely exceed 0.2%. (Abubakar, 2006) The subsistence rain fed farming is the major economic activity in the study area and fragmented farm land form the dominant characteristics of the land use pattern,

### Reconnaissance and pilot surveys

The research was conducted between January – March 2018, in four phases, first, reconnaissance survey of one week was conducted to be familiar with the study area. Prior to formal contact with the local farmers, the study and its purpose were explained to the local traditional rulers with a view of getting maximum cooperation from their subjects. Twelve villages were systematically selected and the number of respondents chosen in each village was determine by population size. A pilot survey was conducted to test the reliability and viability of the research tools and techniques. All the research assistants that helped in questionnaire administration have tertiary education, and are well familiar with the terrain and fluent in Hausa, language spoken by the majority of the people residing in the study area.

**Table 1**: **Sample Sizes and Some Characteristics of the Study Area**

| Local Govt. | Villages | | Location (Coordinate) | Estimated Population | No. of Sample Selected in the village | No. of Sample selected in the Local Govt. | Dominant tribe |
|---|---|---|---|---|---|---|---|
| Baure | 1 | Burdudu | $12^0$53'N, $8^0$43'E | 1,350 | 23 | 46 | Hausa/Fulani |
| | 2 | Sawani | $12^0$52'N, $8^0$49'E | 1,300 | 23 | | Hausa/Fulani |
| Maiadua | 1 | Bumbum | $13^0$16'N, $8^0$07'E | 1,700 | 17 | 39 | Hausa/Fulani |
| | 2 | Kwangwalam | $13^0$10'N, $07^0$32'E | 2,200 | 22 | | Hausa/Fulani |
| Mashi | 1 | Birnin Kuka | $13^0$19'N, $07^0$59'E | 3,200 | 32 | 57 | Hausa/Fulani |
| | 2 | Majigiri | $13^0$15'N, $07^0$53'E | 2,500 | 25 | | Hausa/Fulani |
| Jibia | 1 | Magama | $13^0$06'N, $07^0$16'E | 3,600 | 36 | 53 | Hausa |
| | 2 | Faru | $13^0$06'N, $07^0$11'E | 1,760 | 17 | | Hausa |
| Kaita | 1 | Dankama | $13^0$18'N, $07^0$47'E | 4,500 | 45 | 73 | Hausa/Fulani |
| | 2 | Gishirawa/Matsai | $13^0$10'N, $07^0$40'E | 2,800 | 28 | | Hausa |
| Zango | 1. | Yakubawa | $13^0$04'N, $08^0$29'E | 1,800 | 18 | 40 | Hausa |
| | 2 | Yardaje | $13^0$01'N, $08^0$34'E | 2,200 | 22 | | Hausa/Fulani |
| Estimated Population and Samples sizes respectively | | | | 28,910 | 308 | 308 | |

Sources: Field Work (2018)

**Transect Walk**

Secondly, transect walks with the key informants was held. They were asked to enumerate perceived reason/causes for soil degradation in their locality and identify observable indicators of soil degradation along the transects and conservation method adopted (Okoba and Sterk, 2006)

**Household survey**

Thirdly, baseline questionnaire with open-ended and closed-ended questions were used to get information on demography, size of land holding, livelihood, farming practices, livestock ownership constituted the closed type questions. Issues on soil degradation process were contained in open questions. The respondents were encouraged to mention many reasons and indicators of soil degradation and soil conservation and management practices in use.

**Focus Group Discussion**

Series of Focus Group Discussion (FGD) with 8-12 people were held in each village and another with one person representing each of the twelve villages. The FGD was aimed at weighing and balancing the information derived through questionnaire administration and transect walk with a view of getting a consensus and develops generalization about traditional knowledge on soil degradation of communities living in northern Katsina state. Selections of members of FGD took into consideration, the age, gender, literacy (western or Arabic/Islamic knowledge) and social status of the participants. As Mogotisi et al., (2011) pointed out that these factors affects variation in traditional knowledge in communities

**Data Analysis**.

Data were analyzed using descriptive statistic (frequency, percentages charts and tables) and inferential statistics (Kruka-Wallis). SPSS software package was used in the analysis

## RESULTS AND DISCUSSION

**Farmer's perspectives on soil degradation indicators**

Farmers describe soil degradation as a decline in soil productivity manifested itself through soil erosion and soil fertility decline. During the FGD most of the farmers believed that soil erosion and soil fertility decline (decline in crop yield) are the major degradation process in the area. In other words, farmers identified the physical and biological soil degradation process, while scientists included chemical degradation processes which are known through laboratory analysis (Lal, 1993; 2001). This is an indication that farmers have a holistic understanding of their resources (Desbiez, 2004) using what they can see or feel to describe their environment.

Farmers divided the time of erosion activities into two, i.e. during the dry and wet season and believed the severity of wind erosion is higher at the beginning of the rainy season. They noted that immediately after harvest, between October/November – January, Harmattan wind erosion changes from low to moderate wind erosion. The second most important erosion period is the early rainy season (May – July). The period is characterized by excessive wind and severe dust storm; the duration of the dust storm is usually short, from a few minutes to one hour. In most cases, it results in intense particles movement followed by heavy rain, causing partial deposition of the eroded soil particles. The farmers further explained that if the rain is heavy, it may result to severe water erosion by displacing sediment to different directions. However, all the farmers agreed that wind erosion is more destructive in the early rainy season than water erosion.

**Water Erosion**

During the FGD an 82 year old farmer in Birni Kuka (Mashi LGA), described different stages of erosion and the features produce. He said;

"Erosion begins when rain drop strike the bare soil; soil aggregates are broken into fine particles that can easily be carried away by the run off (splash erosion). As water moves across the surface, soil particles are carried away (sheet erosion). As water continues moving across the soil surface, it cuts many small ditches across (rill erosion). If water concentrates flowing across one spot it creates large ditches (gulley erosion)"

This description is similar to the water erosion process explained by Lal (2001). Even though

the elderly man did not mention different forms of water erosion by name, at least, he was able to describe each process and the features produced. However, it is important to note that soil erosion by water is called Zaizayar Kasa in Hausa language. All the features produced have the same name rami (hole) particularly if it is deep. But the sizes of erosion are ranked, i.e. babbar or karamar zaizayar kasa (high or low erosion rate). If a hole (rami) is wide and irregular in shape; it is called kwazazzabo (gulley).

**Wind Erosion**

The farmers during the FGD the farmers described wind-erosion as the removal of soil particles by the wind .A 94 year old farmer in Bududu (Baure LGA), described how eroded materials are transported by wind. He said:

"When the wind blows, it lifts some particles a few centimeters away. Others are moved above the soil surface less than the height of a man. While the tiny particles are held up by the wind in suspense to faraway places."

The elderly farmer's description of the mode of the transport of wind-blown particles is similar to the scientific account, i.e. saltation, creeping and suspension, described by Sterk (2003).

**Soil Fertility Decline**

Soil fertility is described by the farmers as a reduction in the nutrient status of the soil, which crops depend on for nourishment and growth. Others see decline in soil fertility when the crop use of nutrient exceed their replenishment. Mortimore (2005) study supported the latter view of the farmers, where he found in all sub-Saharan Africa net nutrient removal exceeds replenishment by a factor of 3 to 4. Hence, consider the problem as the major reason of decline in food production in sub Saharan Africa countries.

**Table: 2 SOIL DEGRADATION INDICATORS IDENTIFIED BY FARMERS.**

| | SOIL DEGRADATION INDICATORS IDENTIFIED | Buare (n = 46) | | Jibia (n = 53) | | Kaita (n = 73) | | Mashi (n = 57) | | Zango (n = 40) | | Mai'adua (n = 39) | | Average % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | |
| 1 | Low Crop Yield | 37 | 82 | 38 | 73 | 55 | 76 | 45 | 80 | 31 | 78 | 27 | 69 | 76 |
| 2 | Colour Change of Crop | 28 | 62 | 29 | 56 | 50 | 68 | 34 | 61 | 23 | 58 | 26 | 67 | 62 |
| 3 | Increased Soil Looseness | 22 | 49 | 25 | 48 | 44 | 61 | 47 | 83 | 16 | 42 | 09 | 23 | 57 |
| 4 | Presence of Weeds | 24 | 52 | 16 | 30 | 21 | 30 | 24 | 34 | 16 | 42 | 14 | 37 | 38 |
| 5 | Absence of Worms and Insects | 03 | 07 | 14 | 09 | 08 | 11 | 07 | 13 | 03 | 09 | 1 | 02 | 09 |
| 6 | Soil Stoniness | 24 | 52 | 06 | 30 | 21 | 30 | 24 | 34 | 17 | 42 | 14 | 37 | 38 |
| 7 | Rill Formation | 06 | 13 | 10 | 27 | 15 | 21 | 12 | 17 | 04 | 11 | 11 | 30 | 20 |
| 8 | Splash Pedestals | 01 | 03 | 42 | 11 | 02 | 03 | 03 | 05 | 02 | 06 | 02 | 05 | 06 |
| 9 | Sheet Wash | 02 | 04 | 10 | 19 | 5 | 08 | 06 | 11 | 01 | 03 | 1 | 02 | 08 |
| 10 | Dissection of field & gullies | 22 | 48 | 42 | 80 | 38 | 52 | 28 | 50 | 17 | 43 | 20 | 52 | 54 |
| 11 | Soil Colour Change | 08 | 17 | 10 | 23 | 25 | 34 | 35 | 62 | 17 | 43 | 13 | 33 | 36 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 12 | Exposure of Underlying Rocks | 05 | 12 | 06 | 11 | 10 | 15 | 10 | 18 | 01 | 03 | 0 | 0 | 10 |
| 13 | Exposure of Roots | 12 | 27 | 20 | 38 | 38 | 52 | 21 | 37 | 23 | 57 | 14 | 35 | 33 |
| 14 | Deposition of Sediments | 14 | 32 | 11 | 21 | 08 | 11 | 10 | 18 | 05 | 13 | 06 | 16 | 19 |
| 15 | Decrease Grass Cover | 05 | 11 | 20 | 39 | 15 | 21 | 06 | 11 | 04 | 10 | 01 | 02 | 16 |
| 16 | Poor Water Holding Capacity | 03 | 07 | 01 | 03 | 04 | 06 | 09 | 17 | 01 | 03 | 0 | 0 | 06 |
| 17 | Increase Fertilizer/Manure Requirement | 28 | 62 | 30 | 57 | 05 | 68 | 41 | 72 | 24 | 60 | 27 | 69 | 65 |
| 18 | Poor Crops Performance | 30 | 67 | 33 | 63 | 51 | 70 | 39 | 68 | 29 | 73 | 27 | 69 | 68 |

Source: field Work (2018)

**Analysis of the Identified Indicators**

Looking at the trend of the soil degradation indicators in the study area (table 2), it could be observed that soil degradation has depicted nearly the same indicators in the area. Low crop yield (76%) poor crop performance (68%) increasing requirement of fertilizer and manure by crops (65%), and colour change of crops (62%), were the common indicators of soil degradation mentioned by the majority of farmers in all the area. However, looking at the indicators at the village, level, gulley erosion (80%) was the critical indicator in villages of Jibia (LGA), while in Mashi (LGA) increasing soil looseness (83%) was the major indicator mentioned by the farmers. In Zango (LGA), apart from four major indicators, the exposure of crop roots and trees (57%) was another visible indictor signifying soil degradation. Soil stoniness (52%) and the presence of weds (52%) follow the four major observed indicators in Baure (LGA). *Kruskal-Wallis* test indicates that, there is a significance differences in soil degradation indicators values identified in the six local government *(Kruskal-Wallis or F Values = 9.761, df = 5 , P = 0.082)*

**The Classification of Soil Degradation Indicators**

To assess the level of farmers' understanding of soil degradation indicators and other related process, during the FDG, the key informants were asked to re-classify the listed indicators with regard to the time taken before they were clearly detected. The indicators were reclassified into ongoing and later soil degradation indicators (Okoba and Sterk, 2006). The key informants maintained that later indicators were usually observed after a long time of continued action of water and wind that lasted for months or years or long period of unsustainable cultivation and other human activities.

While ongoing soil degradation indicators could be seen after a single excessive rain or windstorm or single poor cultivation practice. They all agreed that the ongoing indicators could easily turn or change into the later degradation indicators if appropriate measures are not taken on time to remedy the situation.

T**able3: Farmers' Classification of Ongoing and Later Degradation Indicators**.

| ON GOING SOIL DEGRADATION | LATER SOIL DEGRADATION INDICATORS. |
|---|---|
| Splash pedestal | Rock exposure |
| Rill | Root exposure (*In trees)* |
| Sedimentation | stoniness |
| Sheet wash | Gullies |
| Root exposure (In foods crops) | Loose soil |
| Decrease grass Cover | Low crop yields |
| Poor water holding Capacity | Colour change of crops |
| Increase fertilizer and manure requirement | Absence of worms and insects |
| Presence of weeds | Soil colour change |
| Poor crop performance | |

**Source**: Field Work (2018)

Even though, the farmers seemed to be aware of both short term (ongoing) and long term (later) indicators menace, concrete measures were not taken to minimize the problems of ongoing degradation indicators. They felt that ongoing indicators could be overcome through seasonal harrowing, ploughing and weeding. Many farmers believed these indicators were not responsible for reduction in crop yield and therefore not a problem in crop production. Okoba and Sterk

(2006) noted that ongoing indicators could easily be changed by change in land use and management practice that would improve soil structure and organic matter content.

**Table: 4 Farmers Views on the Extent of Soil Degradation and Rating its Seriousness Overtime.**

| | Baure (n=46) | | Jibia (n=53) | | Kaita (n=73) | | Mashi (n=57) | | Zango (n=40) | | Maiadua (n=39) | | Aver-age % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Local Government | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | Freq | % | |
| **Extent of Soil Degradation** | | | | | | | | | | | | | |
| High | 29 | 62 | 34 | 64 | 53 | 72 | 29 | 50 | 20 | 50 | 21 | 54 | 59 |
| Moderate | 8 | 18 | 14 | 26 | 12 | 17 | 27 | 47 | 17 | 43 | 16 | 42 | 33 |
| *Low* | 9 | 20 | 5 | 10 | 8 | 11 | 01 | 03 | 03 | 07 | 02 | 04 | 10 |
| **Severity of Soil Degradation Overtime** | | | | | | | | | | | | | |
| Increasing | 36 | 78 | 38 | 72 | 60 | 82 | 43 | 76 | 32 | 80 | 30 | 78 | 78 |
| Same | 06 | 12 | 11 | 20 | 12 | 16 | 12 | 21 | 07 | 17 | 09 | 22 | 18 |
| *Decreasing* | 04 | 10 | 04 | 08 | 01 | 02 | 02 | 03 | 02 | 03 | 0 | 0 | 5 |

Source: Field Work (2018)

They maintained that farmers who failed to take permanent measures on ongoing soil degradation indicators risk allowing permanent and irreversible indicators to develop. Majority of the respondents in Kaita (72%), Jibia (65%), Baure (62%) and Mai'adua (54%) LGs 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 (table 3).

**Farmers' Qualitative and Quantitative Estimates of Soil Degradation**

Apart from the FGD at the local level, another FGD was held with 12 key informants, one selected from each of the 12 sampled villages. The aim was to assess the extent and severity of each of the soil degradation indicators (both qualitatively and quantitatively). The discussants were asked to use their farming experience to determine which of the listed indicator relatively signify a more severe level of soil degradation. They estimated degradation indicators qualitatively by rating the severity of the indicators (whether extreme, average or low) and they were also introduced to quantitative estimates using the Pairwise Matrix analysis approach to rank each of the identified soil degradation indicators.

**Farmers' Qualitative Estimate of Soil Degradation**

During the FGDs, key informants categorized soil degradation into three (extreme, average and low). and mentioned the relationship between soil degradation indicators and degradation levels. In other words, the nature of soil degradation in a field reflected the extent of soil degradation. However, the key informants admitted that they could not quantify the actual soil degradation level on the field, but could only relate certain soil degradation indicator to different soil degradation rates (whether extreme, average or low)

**Table 5: Farmers' Qualitative Estimate of Soil Degradation Rates, Using Soil Degradation Indicators**

| Extreme soil degradation rate | Average soil degradation rate | Low soil degradation rate |
|---|---|---|
| Low crop yield | Root exposure (trees) | Loose soil |
| Rills | Sheet wash | Root exposure (crops) |
| Sedimentation | Soil colour change | Splash |
| Gullies | Rock exposure | Presence of weeds |
| Stoniness | Increase fertilizer & manure requirement | Absence of worms |
| Poor crop performance | Colour change of crops | |
| Poor water holding capacity | | |

Source: fieldwork (2018)

The key informants revealed that when the soil surface exhibits root exposure (for trees), sheet wash, soil colour change, colour change of crops, exposure of underlying rock and increased fertilizer and manure requirement is an indication of moderate soil degradation level.

**Farmers' Quantitative Estimate of Soil Degradation**

In the quantitative estimation of soil degradation, Pairwise matrix analysis was used. It involves comparing one soil degradation indicator against all the others. The key informants decided between indicators by consensus. In other words, the farmers discussed and justified why they thought certain indicators should be considered to represent higher or lower soil degradation status than the others. After all the indicators were compared, the number of times the indicator was superior over the other was recorded against it. The relative importance of each indicator's contribution to soil degradation was computed and expressed as a weight that is the ratio of frequency count for the individual indicator to the total count of all the indicators (Okoba and Sterk, 2006). Different ways on how the assigned weight count could be used to determine the extent of soil degradation was demonstrated to the farmers after carrying out a transect walk across the nearby farms with a view of seeing the existing soil degradation indicators. Table 5 shows the higher the indicator weight the more severe the soil degradation and the overall effect on soil productivity.

**Table: 6 List of Indicators and Relative Severity Weight Ratio Ranked by Farmers**

| Degradation indicators | Total Frequency Count | Weight | Severity Ranking |
|---|---|---|---|
| Low crop yield | 18 | 0.105 | 1 |
| Gullies | 17 | 0.099 | 2 |
| Rills | 16 | 0.093 | 3 |
| Stoniness | 15 | 0.087 | 4 |
| Poor crops performance | 14 | 0.081 | 5 |
| Poor water holding capacity | 13 | 0.076 | 6 |
| Sedimentation | 12 | 0.070 | 7 |
| Soil Colour Change | 11 | 0.064 | 8 |
| Rock exposure | 10 | 0.058 | 9 |
| Sheet Wash | 9 | 0.052 | 10 |
| Root exposure (trees) | 8 | 0.046 | 11 |
| Colour of changed crops | 7 | 0.040 | 12 |
| Increase fertilizer & manure requirements | 6 | 0.35 | 13 |
| Root exposure (Crops) | 5 | 0.029 | 14 |
| Loose soil | 4 | 0.023 | 15 |
| Presence of weeds | 3 | 0.017 | 16 |
| Splash pedestals | 2 | 0.011 | 17 |
| Absence of worms | 1 | 0.00 | 18 |

Source: Field Work (2018)

The key informants unanimously agreed that the use of a relative weight index was simple and useful, particularly if one wants to quantify the effects of multiple soil degradation indicators on a given site or different sites. Weight ratio was used to rank soil degradation indicators in six selected farms (table 6). The result of weighting the indicators indicates that field B has only two indicators; its overall weight value (0.204) is higher than field A with five soil degradation indicators. The overall weights (0.133) from the selected field are illustrated.

**Table 7: Relative Degradation Weights to Express the Effect of Soil Degradation in Six Selected Farms**

| S/N | Case | Indicator observed | Severity of soil degradation |
|---|---|---|---|
| 1 | Field A | Absence of Worms, splash pedestals loose, soil, presence of weeds, root exposure (crops) | 0.00 + 0.011 + 0.017 + 0.023 + 0.29 = 0.133 |
| 2 | Field B | Low Crop yield, Gullies | 0.105+0.099 = 0.204 |
| 3 | Field C | Sheet wash, root exposure (tree) Root exposure (crops) | 0.052 + 0.046 + 0.029 + 0.127 |
| 4 | Field D | Sedimentation, poor crop performance Presence of weeds, absence of worms | 0.070 + 0.081 + 0.11 + 0.000 = 0.162 |
| 5 | Field E | Colour change of crops, Increase fertilizer and manure requirement | 0.040 + 0.035 = 0.075 |
| 6 | Field F | Stoniness, poor crop performance | 0.087 + 0.081 = 0.168 |

Source: Field work (2018)

**Farmers Perspectives on Reasons/Causes of Soil Degradation**

The farmers have identified 18 reasons/causes of soil degradation, however, the frequent reasons given by the farmers for soil degradation in the area was deforestation, aggravated by large scale land clearing, cutting and lopping of trees for livestock feed in the dry season and the frequent drought. The villagers admitted that whenever there is a crop failure as a result of drought or pest, farmers intensify exploitation of meager vegetation resources to meet the demand of livestock and cut tree for wood to generate additional income to supplement the crop deficit. It is not surprising 84% of the respondents believed that deforestation was responsible for soil degradation in the area, followed by inadequate manure (80%) and lack of land following (53%). But only 9% of the respondents believed that poor cultivation practice could lead to soil degradation.( See figure 1) This is similar to what Moges and Holden (2007) found in Ethiopia and Bielders et al (2001) in Niger, where 66% and 98% respectively of their respondents attributed erosion problem to deforestation, Hence, for any recommended soil conservation measure to be successful it must take into cognizance the local land husbandry and the holistic thinking of the farmers

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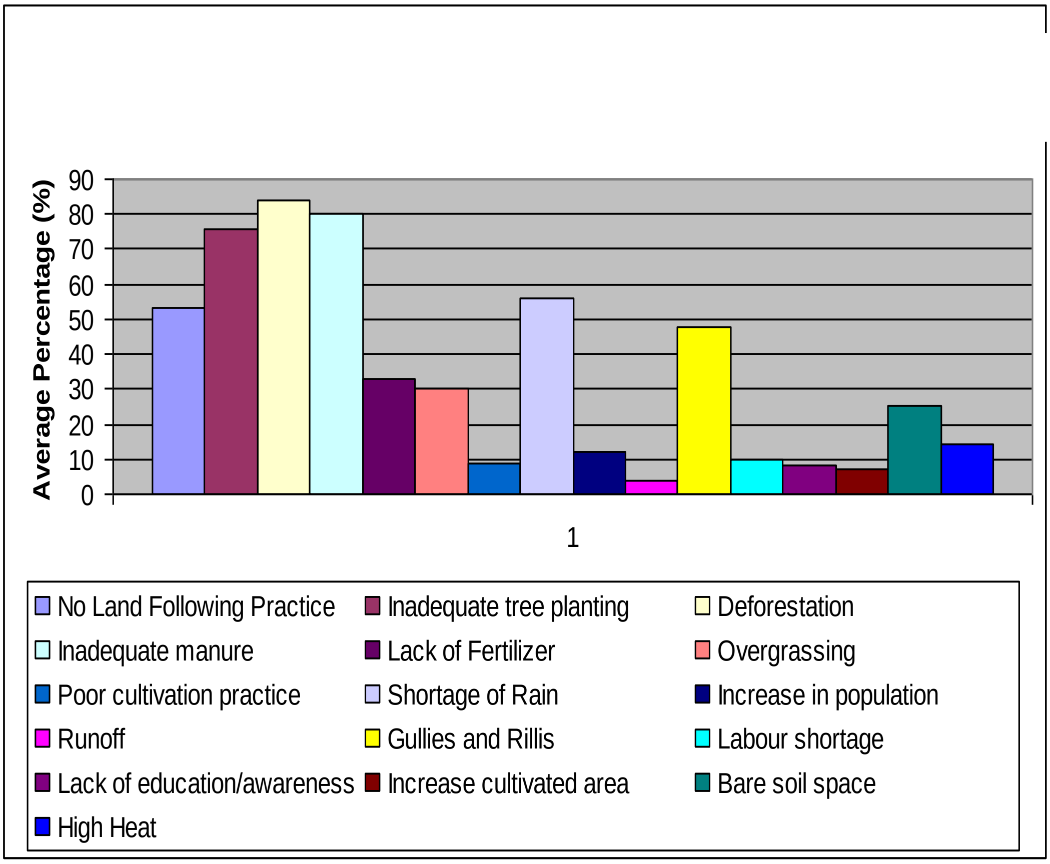


*Fig. 1: Farmers' Perceived Reasons/causes of Soil Degradation in Northern Katsina State*

The result of Kruskal-wallis test shows statistically there is no significance differences in mean rank values of perceived reasons/focuses of soil degradation in the six local government *(Kruskal-Wallis or F values = 5.521, df = 5, P = 0.356)*

**Farmers' Soil and Water Conservation Strategies**

Farmers' perspectives on soil degradation is a clear testimony that local farmers have been observing environmental changes in their immediate habitat, and have devised large repertoire of land management and soil conservation practices to minimize the effect of soil degradation. But most of the farmers were commonly using agronomic/biological conservation measures, which they believed are better, easy to make, less costly and do not require much labour compared with mechanical soil conservation measures. The most common agronomic/biological measures adopted by more than 90% of farmersin all the villages are manure application, weed mounds, intercropping, agro forestry, weeding, and thinning(figure 2).The farmers relied heavily on organic input (animal dung, crop residue and household refused) which many believed have long residual effects and does not need to be applied every year like chemical fertilizer. That is the reason majority of the farmers (80%) in the area kept livestock at home for animal dung and have family refuse dump site.

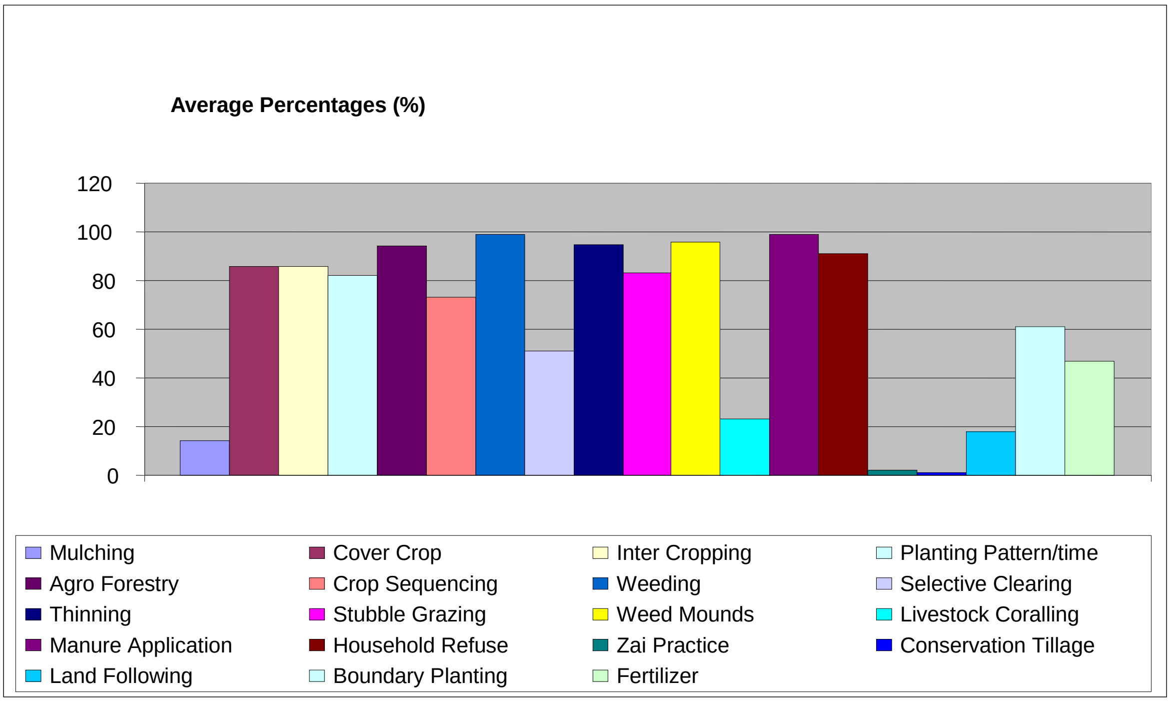


*Fig. 2: Pattern of adoption of Biological/Agronomical soil and water conservation*

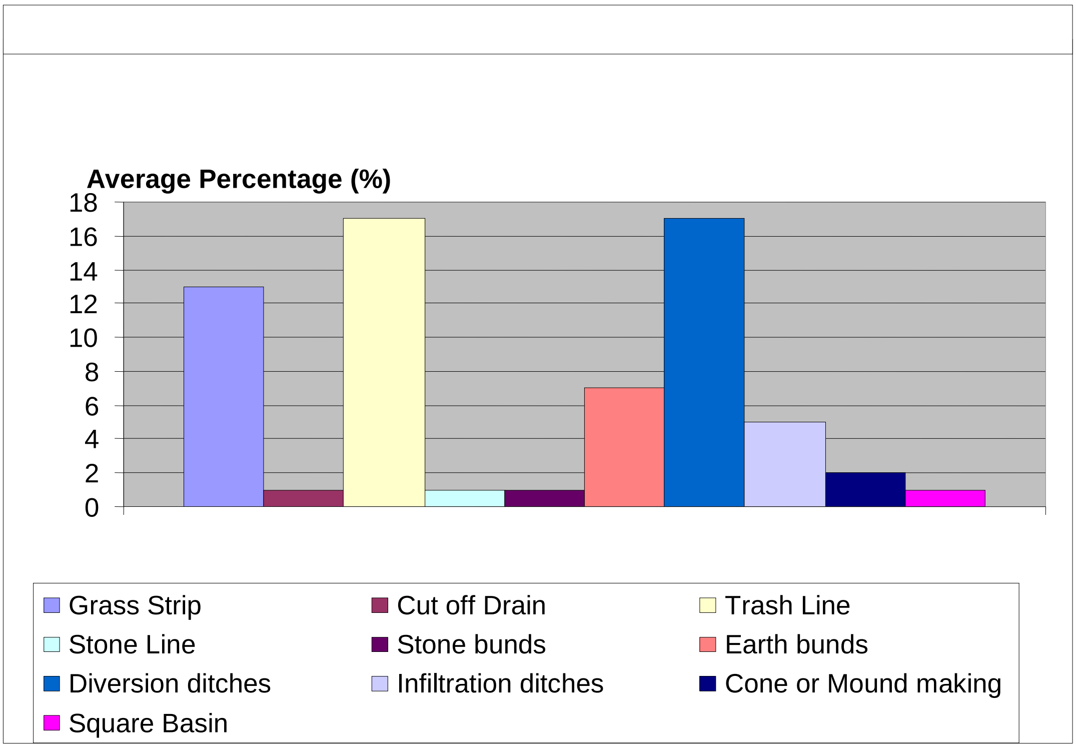


*Fig. 3: Mechanical soil and water conservation measures*

Some farmers have pointed out that in certain places and instances, mechanical measures (figure 4) are more appropriate, but due to inadequate materials needed, the cost involved and labour required, they resort to using agronomic/biological measures. Trash line of sack filled with sand is the common mechanical conservation measure used by the farmers (plate 1)

Plate 1. Trash line of sacks filled with sand to prevent soil erosion in Dankama, Kaita (LGA)

Most of the farmers attributed the increased adaptation of soil and water conservation measures to rapid population growth and decline in the availability of cultivable land. A similar trend of adaptation of biological and agronomic conservation measures due to the above reasons were reported by Muzzacato *et al.*, (2001) and Oudwater and Martin (2005) in Burkina Faso and Osbahr and Allan in Niger.

## CONCLUSION

The farmers' account on soil degradation indicated that people living in a semi-arid environment are observing slowly operating process such as weathering, erosion and deposition. Apart from identifying soil degradation indicators, the farmers were able to differentiate between ongoing(splash pedestals, rill formation, sheet wash, decrease grass cover, crops root exposure, poor water holding capacity, increasing manure and fertilizer requirement and presence of weeds) and later indicators( rock exposure, root exposure in trees, stoniness, gullies, loose soil low crop yield colour change of crop, absence of worm and insect, and poor crop performance) which occur as a result of ignoring ongoing indicators. Although the study has demonstrated farmers' familiarity of soil degradation, however; their understanding of its severity is limited only to what they can see. Although, the farmers knew a range of techniques of soil conservations, limited resources and socio-economic situation impaired their ability to use appropriate conservation measures. Hence any project designed to ameliorate soil degradation has to be cognizant of farmers' knowledge and perception and their holistic views on the problem.

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**REFERENCES**

Abubakar S. M. (2006) Assessment of Land Degradation under different agricultural land use type in a part of Katsina State in: Falola J A, Ahmed K, Liman M A, Maiwada A, (eds) *Issues in Land Administration and Development in Northern Nigeria. Jaoji Pulishers 112-120*

Adegbehin, J O. Omijeh, J E.& Igboanugo A. B.(1990) Trials and Growth of pines in the Northern Nigeria *Savanna* 6:23-45

Albaladje, J. Masrtinex – Mena M. & Roldan, A. Castillo V. (1998.) Soil degradation and Desertification Induced by Vegetation removal in Semi-arid environment. *Soil Use and Management14:1-5*

Adamu, A. U. (2006) Qualitative and Quantitative and Mixed Research Methodologies in Adamu Y.M, Mohammed H. Dandogo K.I (eds) *Readings in Social Science Research*. Adamu jaoji Publishers 134-145

Bielders C.L. Alvey, S. & Cronyn N (2001) Wind Erosion: The perspective of grass-root communities in the sahel *Land Degradation and Development* 12: 57-70

Dregene H. E. (2002) Land Degradation in Drylands.*Arid Land Research and Management*16:2, 99-132

Desbeiz A, Mathew R, Tripathi B, Ellis – Jones J (2004) Perception and Assessment of Soil Fertility by Farmers in the Mid – hills of Nepal. *Agriculture, Ecosystem & Environment* 103:191-206.

Davies, G.M, Pollard L. & Mwenda M.O. (2010) Perception of Land Degradation, Forest Restoration and Fire Management: A Case Study from Malawi. *Land Degradation and Development* 23; 546 – 556.

Effeh, J.E. (2000) Peasant Adjustment to Drought the Case of Jibia Local Government Area, Katsina State. *Unpublished Ph D Thesis, Department of Geography ABU Zaria. Nigeria*

Federal Ministry of Environment (2008) Challenges of Desertification in Northern Nigeria Bulletin number 15, vol 3 23-25

Kerr, J & Pender, J. (2005) Farmers Perception of Soil Erosion and its Consequence in India' s semi-arid Tropics. *Land Degradation and Develoment*16:257 – 271.

Kiome, R. M. & Stocking, M. (1995) Rationality of Farmers Perception of Soil erosion. The Effectiveness of Soil Conservation in Semi- Arid Kenya. *Global Environmental Change.* 5: 4, 281 – 295.

Lal, R.& Elliot, W (1994) Erodibility and Erosivity: In Soil Erosion Research and Methods Lal R. (ed) *Soil and Water Conservation Society* and St. Lucie Press Academy USA 181-208 second edition.

Lal, R. (2009a) Laws of Sustainable Soil *Management. Journal Agronomy for Sustainable Development.* 29: 1, 9.

Lal R (2009b) Soil and Foood Sufficiency: A Review *Journal Agronomy for Sustainable Development* 29: 1,113-133

Le Houerou, H.N (2003) Man-Made Deserts: Desertization, Process and Threats. *Arid Land Research and Management* 16: 1 – 36.

Lindsay, C. S, Twyman C,&Thomas, D. S. G.(2007) Combatting Land Degradation Through Participatory Means.The Case of Swaziland. *Ambio,* 36:5, 56-65

Louis, R P (2007) Can You Hear Us Now? Voices from the Margin: Using Indigenous Methodologies in Geographic Research: *Geographic Research*45(2): 130 – 139

Mazzucato, V. Neimeyer, D. Strosnijder L, & Rolin, N. (2001) Social Network and the Dynamics of Soil and Water Conservation in the Sahel. *Gatekeeper SeriesNo.* 101 International Institute for Environmental Development.

Maigari, l .A. (2002) *lntroduction to Environment Problems and Management*: WaAdallah Environmental Consultant.

Mahiri, I.O. (1998) The Environmental knowledge and frontier: Transects with Experts and Villagers. *Journal of International Development 10: 527 – 537*

Mijindadi, N B, and J.O Adegbehin (1991) Drought, Desertification and Food Production In Nigeria. *Savanna* 12 ( 2) 25- 40.

Mairura. D N, Mugendi J.l. Mwanje J.J; Ramisch P K, Mbugua P K & Chain U J N (2008) Scientific Evaluation of small holder landuse knowledge in central Kenya *Land Degradation and Development*19; 77 – 90.

Moges, A & Holden N. M (2007) Farmers Perception of Soil Erosion and Soil Fertility Loss in Southern Ethiopia.*Land Degradation and Development* 18:543-554.

Mogotisi, K, Moroko, A. B, Sitang, O. and Cibua R (2011) Seasonal Precipitation forecast; Agro-econological Knowledge among Rural Kalahari Communities. *Africa Journal of Agriculture Resources* 6(4) 916-922

Mortimore, M. J (2003) Is there Any Paradigm for Dry Land Development. *Annals of Arid Zone*42:3 & 4 459 – 481.

Mortimore, M. J. (2005) Social Resilience in Africa Dryland Livelihood: Deriving Lesson for Policy *Nordiska Africa Institute 46- 69.*

Niemaijer, D. and Mazzucato, V. (2002) Soil degradation in West African Sahel; How Serious Is it? *Environment* 44 (2): 20-31

Odendo, M, Obare, G, Sola, S B (2010) - Farmer's perceptions and knowledge of soil fertility degradation in contrasting sites in eastern Kenya. *Land Degradation and Development* 21:557-564

Okoba, B O, Sterk, G (2006) Farmers Identification of Erosion Indictors and Related Erosion Damage in the Central Highlands of Kenya *Catena* 65:292 – 301

Oba, G and Kotile, D. G (2001) Assessment of Landscapes Level Degradation in Southern Ethiopia: Pastoralist versus Ecologist. *Land Degradation and Development 12; 461 - 475*

Olofin, E. A (1998) Food, Population and Land Degradation. *Text of a lecture delivered to the participants of course 7 at the National war college Abuja*, Nigeria October 1998.

Okoba B O & Graaff J D. (2005) Farmers Knowledge and Perception of Soil Erosion and Cconservation Measures in the Central Highland, Kenya. *Land Degradation and Development* 16: 475 – 487.

Osbahr, H and Allan, C (2003) Indigenous Knowledge of Soil fertility Management in South- Western Niger. *Geoderma* 111: 457 – 479.

Oudwater, N and Martin, A (2003) Methods and Issues in Exploring Local Knowledge of Soils. *Geoderma*111: 387 – 401.

Otegbeye, G.O (2004) Drought and Desertification:- Challenges for Afforestation in Nigerian and Semi -Arid Region *Savanna*19 : . 32- 40

Omijeh, J E, Adegbehim J O, Igboanugo A B J (1989) Trail and Growth of Pines in the Northern Nigeria Savanna. *Savanna*10: 23-34

Reed, M. S, Dougil, A. J, Taylor, M. J (2007) Integrating Local and Scientific Knowledge for Adaptation to Land Degradation: Kalahari, Rangeland Management option *Land Degradation and Development*18: 249 – 268.

Stringer, L.C, Chasca, T, Thomas D.S.G. (2007) Combating Land Degradation through participatory means: The case of Swaziland *Ambio* 36 (5) 387- 393.

Stringer L.C. & Reed M.S. (2007) Land Degradation Assessment in Southern Africa: integrating local and Scientific knowledge bases. *Land Degradation and Development 18: 99-116.*

Sterk G. and Haigis J. (1998) Farmer's knowledge of wind erosion precess and control Methods in Niger. *Land Degradation and Development* 5: 107 – 114.

Sterk G. (2003) Causes, Consequences and control of wind erosion in sahelian Africa: A review. *Land Degradation and Development* 14: 95 – 108.

Thomas, D. S. G. and Twyman C. (2004) Good or Bad Range land? Hybrid knowledge, ``` ```` science and local understandings of vegetation dynamics in the Kalahari.*Land Degradation and Development*15: 215 – 231

Tomlinson, J. (2010) Observed Trends in Rainfall: Northern Nigeria. Water Master Planning Report for Katsina State, Nigeria

West, C. T. Roncoli, A, & Ouattara, F.(2008) Land Degradation Perception and Regional Climate Trends on the Central Plateau of Burkina Faso. *Land Degradation and Development* 19:289-404

Wei, Y. P. Chen D, White, R. E. Willet, I. R. Edis, R, and Landford J. (2009). Farmers Perception of Environmental Degradation and their Adoption of improved Management Practices in Alxa, China. *Land Degradation and Development Dol: 10.1002/dr.922*