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Effects of Soil Erosion and Degradation on Agricultural Lands in Anyigba, Dekina Local Government Area of Kogi State

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Abstract

Soil erosion and degradation has been a fundamental problem that has bedeviled the farming business of especially small-scale farmers across the world. This study was undertaken to examine the effects of soil erosion and degradation on agricultural lands in Anyigba, Dekina Local Government Area of Kogi State. The study specific objectives were to: identify the soil erosion forms which have greatest impact on farmers; determine the major causes of soil erosion; measure/estimate the amount of soil loss through rill erosion and measure/estimate the amount of soil loss through gully erosion in the study area. The study was undertaken in four agrarian communities namely Ogane-Aji, Agwudoko, Anwoku and Ofejikpi. Semi-structured questionnaire was used to gather information on socio-economic activities. Field-based measurement of erosion forms and quantity of eroded soil were employed in the study. Soil erosion is reported to have adverse consequences on the living conditions of inhabitants. Different forms of erosion are noted to be common in the communities where the soil is already of low fertility. Results of the field study indicates an estimated amount of soil loss by rills to be 79.5 ha and gullies of 251.9 ha. Land clearing methods and continuous cultivation, excessive grazing, ploughing along steep slopes contribute greatly to soil erosion in the study area. About 90% of the respondents indicated deforestation and over-cultivation of croplands, as contributory factors to the cause of soil erosion and land degradation in the area. Low infiltration rates resulting from high rates of runoff from rainfall, the texture of the soil, little or no soil cover were observed to contribute to high rates of soil loss from erosion. Farmer education on the negative effects of soil erosion on farmlands is therefore recommended as a way of conserving soil nutrients.

Keywords: Soil, Erosion, Degradation Agricultural land and Fertility.

Introduction

Gully erosion is a process where runoff water concentrates in constrained flow patterns, displacing soil or softening rock fragments, resulting in incised channels that are deeper and wider than rills and often only carry water during and right after intense rainstorms (Poesen et al. 2013). The amount of highly damaged agricultural land in the world is about 40%. If soil degradation trends in Africa continue, the continent may only be able to feed 25% of its population by 2025. (UNU, 2016).

Gully erosion significantly reduces the productivity of agricultural areas by causing soil loss, increased surface runoff, decreased soil water-holding capacity, decreased water quality and quantity, and decreased groundwater table. At the global level, productivity, growth,

and food security are not threatened by land degradation. But there are issues in some places, particularly where resources are weak and badly functioning (Wiebe, 2013).

Gully erosion in Nigeria might lower the amount of agricultural land available per person from 0.77 ha in 2022 to 0.38 ha in 2030. (Okorley et al., 2020). If suitable measures are not implemented to ensure land conservation in enhanced production and use practices, agriculture will undoubtedly be unable to expand and be sustained. Arid and hot humid alternating climate characteristics, powerful and time-concentrated rainfall, distinctive geomorphologic arrangement, and human activities are some of the causes of the significant gully erosion in several places of Nigeria (Zheng and Tang, 2021).

Due to decreased soil fertility and decreased land productivity caused by soil erosion, households' income from farming may decrease. Reduced soil fertility causes the soil to have a worse ability to retain water, which in turn limits agricultural development, especially when seasonal rainfall is also reduced. A basic description of the predominant farming system in Anyigba, Dekina LGA would be subsistence with low minimum external input. Over the years, the conventional farmers have been cultivating these soils without using mineral fertilizers. They preserved soil productivity by planting crops every four years over extended fallow periods of more than 15 years (Fugger, 2019).

The majority of the soil of Anyigba is sandy, and the sand content rises with soil depth. It is effortlessly eroded away by water. Continuous farming without adequate protection has increased soil erosion, which has resulted in a sharp fall in land productivity. The residents of the study region are badly affected by these issues. Declining soil fertility, soil erosion, a lack of finance programs, poor agronomic practices, and a lack of water conservation strategies are the main obstacles to growing agricultural production (Mercer-Quarshie, 2013; Albert, 2016).

Statement of Research Problem

Because soil fertility and land productivity are decreased by soil erosion, household income from farming is also decreased. Subsistence farming is the predominant farming method in Anyigba. These soils have been cultivated over the years by local farmers without the use of mineral fertilizers. They kept the soil productive by leaving it fallow for extended periods of time and then planting crops. Because soil fertility and land productivity are decreased by soil erosion, household income from farming is also decreased. Subsistence farming is the predominant farming method in Anyigba. These soils have been cultivated over the years by local farmers without the use of mineral fertilizers. They kept the soil productive by leaving it fallow for extended periods of time and then planting crops.

The challenges facing agriculture as a strategic tool for achieving policy goals of food and nutrition security and community wealth creation in Dekina LGA of Kogi state are further exacerbated by the population growth and food demand that is rising along with the depletion of the natural resource base and low yields as the main drivers. Due to these issues, farmers in Anyigba can no longer rely on farming to support their demands for a

living. The need for this study to investigate the effects of soil erosion and degradation on agricultural lands in Anyigba, Dekina Local Government Area of Kogi State resulted from the necessity to double efforts at enhancing agricultural productivity and production in the local government area.

Research Questions

The following questions guided the study:

i. Which type of soil erosion have greatest impact on farm lands in the study area?
ii. What are the major causes of soil erosion in the study area?
iii. What are the estimated amount of soil loss through rill erosion in the study area?
iv. What are the estimated amount of soil loss through gully erosion in the study area?

Aim and Objectives

The aim of this study to investigate the effects of soil erosion and degradation on agricultural lands in Anyigba, Dekina Local Government Area of Kogi State. The specific objectives are to:

i. Identify the soil erosion forms which have greatest impact on farm lands in the study area
ii. Determine the major causes of soil erosion in the study area
iii. Measure/estimate the amount of soil loss through rill erosion in the study area
iv. Measure/estimate the amount of soil loss through gully erosion in the study area.

Materials and Methods

The study was conducted at Anyigba, a suburban community in Kogi State's Dekina Local Government Area. The region is roughly located between latitudes 7° 15' and 7° 29' N and 7° 11' and 7° 32' E, respectively (see Figure 1). It is surrounded by smaller settlements and homesteads, whose residents have had a wide range of environmental effects. The research area, which has a mean temperature of 25°C and a mean annual rainfall of 1600mm, is situated between the tropical wet and dry (AW) climate region and the guinea savanna (Ifatimehin and Ufuah, 2006).

It is surrounded by regions of hydromorphic and rich leomey soils and is located on the sedimentary deposit of the Anambra basin. Anyigba's soil is laterite with a layer of lateritic iron pan. Due to an overabundance of oxides (sequioxides) on the surface, it has a reddish-yellowish color. The soils have a medium to coarse soil texture and are heavily worn. The suburbs of Anyigba, which are the subject of this study (Ogane-Aji, Agwudoko, Anwoku, and Ofejikpi), which were primarily agrarian villages before, are now serving as educational, residential, and commercial purposes due to the existence of the Kogi State University.

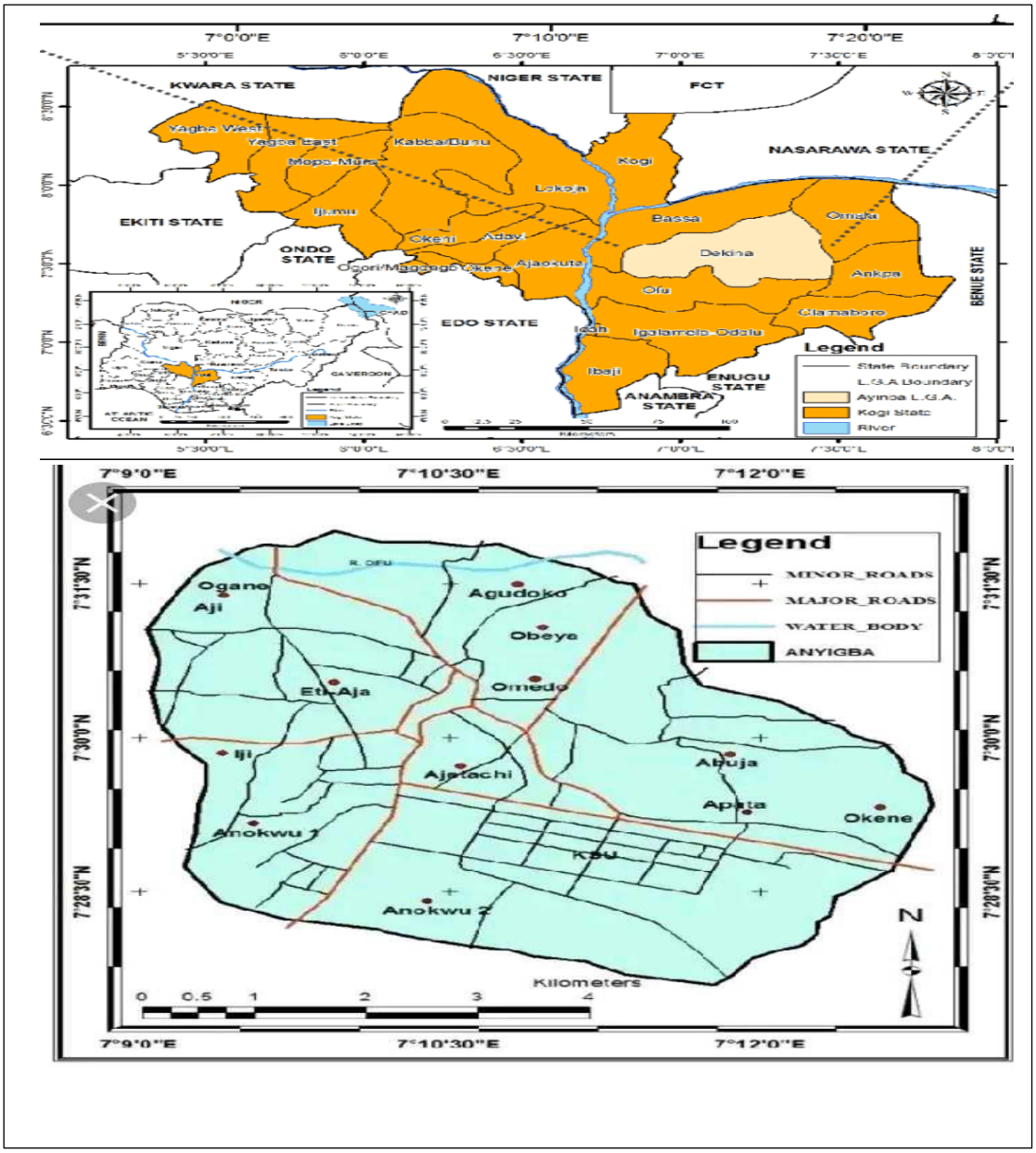

Figure 1: Nigeria showing Kogi state, Dekina LGA and Anyigba communities.
Source: Department of Geography, Kogi State University. Anyigba, 2021

To achieve the stated goals, the study combined both survey and experimental research designs. The design included field measurements of rills, gullies, and bulk density as well as the selection of erosion-prone sites in the study area through reconnaissance visits, simple random sampling for the selection of respondents from the study area, interviews with community representatives, district-level experts, and development agents. Core sampler (7.62 em x 7.62 em), sharp machete, balance with sensitivity of 0.01 gms, plastic bags,

weighing tins, metal disk, survey sheets, GPS etrex, metal and fiber tape measure, and Augur were the tools utilized for the investigation.

To choose sample households for the household survey, a straightforward random sampling technique was used. In the 366 households that make up the study region, 40 households and 40 individuals were chosen for interviews. A thorough questionnaire was employed to collect accurate data on soil erosion and degradation from farmers, family heads, and district heads. The actual regions for the data collection on erosion and deterioration were chosen using field measurements. The information acquired included the respondents' perceptions of soil erosion and degradation as well as results of these phenomena, such as decreased land production due to depleted soil fertility and lower farm earnings.

By measuring the depth, width, and length of rills, it was possible to determine the volume of soil that had been lost from a field. The average rill width and depth were then determined. By measuring the width of the upper lip, the breadth of the base, and the depth, the volume of soil loss from these gullies was approximated.

The statistical software for social science was used to carefully compile and analyze data collected from the field (SPSS). To accomplish the research goals, simple percentages, frequency, and equations were used in the data analysis.

Review of Related Literatures

The wearing away of the land surface by flowing water, wind, ice, or other geological forces, including processes like gravitational creep, are just a few examples of the many definitions that can be given to soil erosion (SCSA, 2020). Although it is a natural process, human land usage, particularly industrial agriculture, deforestation, and urban sprawl, speed it up (Kotke, 2017). Low organic matter, loss of soil structure, poor internal drainage, salinization, and soil acidity issues are additional types of soil degradation in addition to soil compaction (Wall, 2013). Geological erosion, also known as natural or normal erosion, is the unstoppable and ongoing process of the development of the earth's surface caused by geological agents including rainfall, snowmelt, streams, overland movement, etc. Accelerated erosion, on the other hand, is a more rapid process.

Causes of Erosion/Degradation

Studies have confirmed that productivity of African soils is endangered by rainfall erosivity and the erodibility of the soil as a result of high rainfall intensities and the ground being exposed at the beginning of the rainy season (Zegeye, 2013). Risks of erosion are accelerated by activities such as deforestation and overgrazing and are higher in intensive arable land use than in forest or pastures and the magnitude depends on cultural practices adopted. An estimate shows that as many as 2 million hectares of arable land is lost annually to severe soil erosion (Lal, 2020).

Motorized farm operations usually cause more severe erosion than manual (hoe and machete) farm operations. Risks of erosion are greater in mono-cropping than rotation and

mixed farming, in open row cereals than close canopy legumes, in clean cultivation than in mulch farming and in plough than zero till lands (Lal, 2020) and (Morgan, 2015). Gullies, Pedestals, rills, sediments deposits and root exposures are indicators that measure the extent of soil loss through erosion (Stocking and Niamh, 2011).

If natural hazards are left aside, the causes of land degradation can be divided into direct and underlying causes. Direct causes are inappropriate land use and unsuitable land management practices, such as the cultivation of steep slopes without soil conservation measures. Fundamental causes are the reasons why these inappropriate practices take place, for instance the slopes may be cultivated because the landless poor need food, and conservation measures not taken because farmers lack security of tenure. (FAO, 2014).

Soil degradation is a process that leads to decline in the fertility or future productive capacity of soil as a result of human activity (UNEP, 2013). It occurs whenever the natural balances in the landscape are altered by human activity through misuse or overuse of soil. Degraded soils which result in poor or no production are also called poor soils. Waste lands are those which for one or the other reason have poor life sustaining ability. Out of 100 % potentially active lands only 44 % are available for cultivation and 56 % of lands are non-available for cultivation. The wasteland can be made useful by increasing productivity of land by using some useful methods as afforestation or by using bio- fertilizers (UNEP, 2014).

Results and Discussion

The section reviewed and displayed the respondents' socioeconomic and demographic information (see Table 1).

Table 1: Demographic Characteristics of the Respondents

Age (years)	**Number of Respondents**	**Percentage (%)**
0-19	10	25.0
20-40	27	67.5
40 +	3	7.5
Total	**40**	**100.0**
Level of education		
No formal education	36	87.5
Basic education	1	2.50
Secondary education	4	10.0
Total	**40**	**100.0**
Occupation		
Crop farming	13	32.5
Mixed farming	13	32.5
Trading with farming	7	17.5
All combined	7	17.5
Total	**40**	**100.0**

Crops		
Vegetables	7	15.0
Cereals and root tubers	31	77.5
All	2	7.50
Total	**40**	**100.0**

Source: Field Work, 2021

Table 1 revealed that 25% of the respondents were between the ages of 0 and 19 years, while 67.5% of the respondents were between the ages of 20 and 40, constituting the majority, and 7.5% were over the age of 40, constituting the minority. Results on respondents' educational backgrounds reveal that 2.5% had only a basic education, while 10% had a secondary education. About 87.5 percent of the household heads lacked a formal education. The implication of this finding is that majority of the respondents are of reproductive age and are engaged in farming activities that is being threatened by soil erosion.

According to Table 1, around 32.5% of the respondents worked only in the arable sector, and a similar number worked in the mixed sector. While the same number of respondents were involved in all the previously described means of obtaining a living, trading with farming accounted for 17.5% of all livelihoods (including petty dealing and the selling of vegetables). The findings showed that 77.5% of respondents grew grains and root tubers, 15% of respondents engaged in small trading, and 7.5% both cultivated crops and engaged in petty trading.

Soil Erosion Issues

This part presents the findings and a discussion of land degradation activities that have a detrimental and unfavorable impact on the people's farms in the research area, including soil erosion (Table 2).

Table 2: Factors affecting Farming Practices

Factors	**Number of Respondents**	**Percentage (%)**
Exhaustion of soil nutrients	29	72.5
Rainfall fluctuations	4	10.0
Removal of top soil	6	15.0
All factors combined	1	2.50
Total	**40**	**100.0**
Are you using chemical fertilizer?		
Yes	34	85
No	6	15
Total	**40**	**100.0**

Type of Fertilizer used		
None	1	2.5
Organic fertilizer	11	27.5
Inorganic fertilizer (chemical fertilizer)	13	32.5
Both	15	37.5
Total	**40**	**100.0**
Reasons for using fertilizer		
To increase yield	38	95
To improve fertility of the soil	1	2.5
To bind the soil together	1	2.5
Total	**40**	**100.0**

Source: Field Work, 2021

According to Table 2, the farmers say that variables affecting their farming techniques include soil nutrient depletion (72.5%), changing rainfall patterns (10%), soil erosion (15%), and the sum of all these causes (2.5%). According to Table 4.2, 85% of respondents concurred that they use chemical fertilizer as a result of the decline in soil fertility, whereas 15% disagreed, indicating that they did not. This corroborate the finding of Albert (2016) on the effects of gully erosion on farm lands in Ghana. Table 2 shows that one farmer used no fertilizer, 27.5 % of farmers used organic fertilizers, and 32.5% of farmers said they used inorganic fertilizers (chemical fertilizers). Furthermore, 37.5% of people additionally utilized fertilizers that were both organic and inorganic. 95% of the respondents claimed to use chemical fertilizers to boost yields, 2.5% to improve soil fertility, and the other 2.5% claimed that fertilizer acts as a binding agent for the soil. This is in agreement with the finding of Okorley and Kwarteng (2020) who carried out a research on current status of the use of pesticides in urban and peri-urban vegetable production in the central region of Ghana.

Table 3: Problems associated with erosion

Problem	**Number of respondents**	**Percentage (%)**
Loss in agricultural production	5	12.5
Channels and gullies on farm.	3	7.5
Loss of soil fertility	10	25
Damage to houses	3	7.5
All combined	19	47.5
Total	40	100.0

Source: Field Work, 2021

Regarding the issues with soil and land degradation, it was discovered that 12.5% of farmers said they experience a decrease in agricultural production, while 7.5% said there are visible channels and gullies on their property, 25% of respondents said there has been a noticeable

loss of soil fertility due to erosion, 7.5% said the issue is causing damage to their homes, and 47.5% said they have seen a change in the condition of the land. This finding is not different from that of Fitton, Saffouri and Blair (2015) who studied environmental and economic costs of soil erosion and conservation benefits in Tanjania.

Table 4: Soil Conservation Practice of the respondents

Conservation practices	Number of Respondents	Percentage (%)
Terracing	11	27.5
Tree planting	18	45
Compost making	1	2.5
Water way creation	1	2.5
Drainage	9	22.5
Total	40	100.0

Source: Field Work, 2021

According to Table 3, the majority of conservation practices were terracing, which accounted for 27.5%, tree planting, which accounted for 45.0%, compost, which made up the least amount at 2.5%, the creation of waterways, which also made up the least amount at 2.5%, and drainage, which increased to 22.5%. These findings also corroborate with that of Fitton, Saffouri and Blair (2015).

Table 4: Changes in farmer's income due to soil erosion

Observed Changes	Number of Respondents	Percentage (%)
Decrease in production per kg	29	72.5
Decrease in livestock production	6	15
both	2	5
Equivalent in cash per year	3	7.5
Total	40	100

Source: Field Work, 2021

According to the respondents' responses, 72.5% of the farmers said there was a decrease in production per kilogram, which was the majority, 15% said there was a decrease in livestock production as well, and 5.0% said there was a decrease in both production per kilogram and livestock production, which was the least significant. The study of Fugger, (2019) on evaluation of potential indicators for soil quality in Savanna Soils of Ghana also discovered same results. The results of the subsequent question about the effects of the decline in revenue due to soil erosion are displayed in table 5.

Table 5: Consequences of the Reduction of Income as a result of Soil Erosion

Response on reduced income	Number of respondents	Percentage (%)
Reduced number of meals	2	5
Reduced quantity of food per meal	1	2.5
Withdrawal of children from school	7	17.5
Poor health	8	20
Move to marginal land cultivation	1	2.5
All	21	52.5
Total	40	100.0

Source: Field Work, 2021

Some of the responses from table 5 indicated that it decreased the frequency of meals. 5.0% of those surveyed reported eating less at each meal. About 2.5% of them suggested that kids should stop going to school, and 17.5% said erosion was bad for their health. 2.5% of respondents believed that increased marginal land cultivation was a result of soil erosion, and 52.5% of respondents mentioned and agreed with all five of the conditions listed below, which were the most prevalent as shown in table 5.

Table 6: Environmental changes observed by the Respondent

Reasons for changes	Number of Respondents	Percentages (%)
Soil erosion	7	17.5
Deforestation	15	37.5
Both erosion and deforestation	17	42.5
Total	40	100.0

Source: Field Work, 2021

It was evident from Table 6 that the environment had changed. Additionally, it was clear that soil erosion (17.5%), deforestation (37.5%), and both together (42.5%) represented the biggest physical changes to the environment. This strongly suggested that the respondents were concerned about the environment. This finding support that of Ifatimehin, Falola and Odogbo (2004), Okoroafor and Akinbile (2017) in their studies on soil erosion in South Eastern Nigeria.

Table 7: Changes with respect to environment and their effect on respondents

Response	Number of respondents	Percentage (%)
Poor living condition	37	92.5
Decrease income	1	2.5
Loss of green cover/vegetation	2	5
Total	40	100.0

Source: Field Work, 2021

Environmental changes revealed that 92.5% of respondents currently lived in worse conditions than they had in the past, 2.5% reported a decline in income, and 5.0% said they had also seen other changes, like the loss of greenery in their surroundings. Similar result was penned by Albert, (2016) on the status of farm household systems in northern Ghana.

Table 8 Estimate amount of soil loss by rill erosion in four communities

Community	Estimated amount in volume of soil loss by rill in t/h	Location of rill
Ogane-Aji	165.75	Elev. 178m, Lat. 7° 30' 0"N Long. 7° 9' 00"E
Agwudoko	95.37	Elev. 171m, Lat. 7° 28' 30"N Long. 7° 12' 00"E
Anwoku	1.08	Elev. 165m, Lat. 7° 31' 30"N Long. 7° 10' 00"E
Ofejikpi	55.93	Elev. 182m, Lat. 7° 27' 0"N Long. 7° 13' 01"E

Source: Field Work, 2021

N/B: Number of measurements: n=80

Standard Deviation: SD=47.06

Data from Ogane-Aji, Agwudoko, Anwoku, and Ofejikpi were collected and analyzed. It was found that the maximum estimated volume of soil loss by rill erosion was 165.75 ton/ha, indicating that that community had the most severe erosion damage. According to Table 8, it was 95.37 tonnes per hectare, with Anwoku having the least amount of soil loss (1.08 tonnes/ha).

Conclusions

The detrimental impacts of soil erosion and degradation result in a number of issues, including decreased soil fertility, which has an impact on agricultural productivity. However, using conservation techniques like ridging across slopes, contour plowing with tractors or animals, applying organic manure or fertilizer, and mounding with mulching, which promotes crop growth and increases yields, farmers in the study area are able to conserve the soil and control erosion to some extent. The majority of respondents acknowledged that physical damage to infrastructure and rills and gullies were the least noticeable erosion-related issues. The biggest impact of erosion was the loss of fertility.

Recommendations

The following points are worth recommending:

- General awareness should be created at all levels on the negative effects of soil erosion and land degradation on the livelihoods of farmers.
- The soil should be loosened to make way for water to infiltrate easily into the soil, so as to prevent run-offs or flooding.
- The significant high values from rill erosion can be prevented by the application of green manure, farmyard manure and compost, which serve as mulch on the surface of the exposed farmlands.
- Generally, observation revealed that the soil types in the farmlands were mainly sandy, which could not retain water and hence washed away the topsoil during heavy downpour.
- Community mobilization to improve soil fertility through the application of compost and dynamic kraaling should be given due consideration to reduce the rising expenses that farmers incur as a result of increasing cost of chemical fertilizers.

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