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Exploring Farmers' Local Knowledge and Perception of Soil Erosion Under Agricultural Lands in the Northern Part of Taraba State, Nigeria.

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Abstract: *Soil erosion by water remains the single most important environmental and economic problem in agricultural regions of Nigeria. However, increasing agricultural activities in the hillslope areas have increased in recent years. Moreover, mountainous regions and sloppy-lands, where agriculture is practiced are especially more prone to severe erosion hazards. This study investigates farmers' perception of soil erosion, and their reasons for cultivating hillslope, while flatland areas exist. A structured interview schedule was used to collect data from 383 respondents, using random sampling techniques, supplemented by field observation, and in-depth interviews. Most (88.3%) respondents are male, who are within the age-group bracket of 46-55 years old. The majority (90%) owned their land holdings, and have long years of farming experience (66.6%). All respondents are well aware and perceived soil erosion as a problem (91.9%), which is increasing over the years (80.2%). In-addition, most respondents reported erosion occurring naturally through heavy rainfall, and erosion was perceived to be severe mostly when visible signs-rills appeared on cultivated plots (53.5%). However, most respondents (95.5%), cultivate the hillslopes not because of the shortages of flatland areas, but, of less crop destruction by animals, less weed invasion, and historical reasons which they said outweighs erosion problems.*

Keywords: *Agricultural lands, farmer's awareness, farmers' perception, Nigeria, soil erosion.*

INTRODUCTION

Soil is a basic, important, and indispensable component of agriculture. Food security, economic growth and sustainability of any nation depend on the functional and structural capacity of its soil. Globally, a soil that is poorly fertile could not give the yield as expected and gradually turns to bare land and lacks any form of vegetation [37, 64-66]. Thus, being a limited and finite resource, this exceedingly fragile zone where nearly all of man's food, fiber, and industrial crops are cultivated and on which all of his livestock are reared is particularly fundamental in Nigeria, where the natural resources are limited [20, 60, 67]. However, soil erosion the process by which the soil is rendered less and less capable of achieving a medium for plant growth, remains the single most important soil degradation problem in agricultural areas of Nigeria [21, 32, 50, 68, 69]. Over 80 percent of the nation, today's cultivated land base of approximately 61 million hectares have been ravaged by soil erosion, with over 40% of the total cultivated land completely rendered useless for cultivation especially in the mountainous regions and sloppy lands where agriculture is practiced [70-72]. The average soil loss due to water erosion of the country is currently estimated at 10 to 200 tons/ha/year (1352 million Mg per year), with over 80% of the estimated value annually coming from cultivated fields [68, 73].

This situation is particularly more pronounced in the ecologically vulnerable areas of the northeastern part of the country, where rains have large raindrop sizes and are of high intensities, usually commencing when there is little or no vegetation to offer protection to the soils, and the slopes of the highlands which dominate the region accelerate run-off which subsequently encourages soil erosion [32, 36, 74].

The average soil loss of the region is presently estimated at between 158.8 and 450 tons/ha/year, and over 53,000km^2 (70 %) of the total cropland area

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of the region are affected by different and varying degrees of erosion menace; ranging from mild sheet wash to deep gullies, with over 50% completely rendered unusable for cultivation [68, 73, 75, 76], when ordinarily erosion rates in the region that exceed 10 to 40 tons/ha/year are considered problematic [67]. Besides, soil reformation is extremely slow and non-renewable over the human time-scale. For example, under tropical and temperate agricultural conditions, from 200-1000 years are required for the renewal of 2.5 cm or 340 tones (t) of topsoil for a reformation rate of 0.3 to 2 t/ha/yr, and severely eroded soils can only be restored in some cases with enormous investments, including adding either 2000 t/ha of quality soils or 500 t/ha (dry) of rotted cattle manure to the soil [77].

In spite of the above devastating threat of soil erosion; decline in soil quality due to water induced topsoil loss and nutrient extraction, prevalent in agricultural areas of northeastern Nigeria, recent agricultural activities in the sloppy areas of the region have increased, however, unlike in the other areas in the humid tropic and subtropical regions where the recent human impact of agricultural use on hill slope areas has increased because of population pressure and the influence of developmental activities, this was, well, flatland areas exist. The question remains, why are farmers in this area engaged in this practice? Could this mean they do not understand the magnitude of soil erosion problems prone to hill slopes? Therefore, it is on this premise that this study seeks to investigate farmers' perception and knowledge of soil erosion, and their soil conservation techniques. The specific objectives of the project are as follows:

1. Understand farmers' perceptions and knowledge of soil erosion problem.
2. Investigate the factors associated with on-farm soil erosion, and its magnitude.
3. Explore farmers' reasons for cultivating hillslopes
4. Discuss the influences of farmers' socioeconomic characteristics on soil erosion.
5. Investigate farmers' soil conservation knowledge and practices.

The study constitutes an important contribution as no previous study has been undertaken in this part of the country, and it will complement the few existing studies from other parts of the country. Besides, most research projects on soil erosion in Nigeria generally, including those of Senjobi, S. J. Akinsete [69], Jaiyeoba [75], Mohammad and Adam [78], Oruk, Ndik [79], were performed on station and only a few were on farm and include the participation of farmers [15, 25, 80]. Moreover, given the significant spatial variation in the country's physical environment, socioeconomic circumstances, and cultural practices, local scale studies such as this are critical to the design of regional appropriate soil conservation and economic development interventions.

MATERIAL AND METHODS

Site Description

The study was conducted in the northern part of Taraba State, ($6°30^1$ and $9°36^1$ N; $9°10^1$ and $11°50^1$ E), North- Eastern Nigeria. The study region has a total population of 778,131 people in 2013; projected annual growth rate of 3.1% and a population density of 54 people per SQ km [81], implying, the research region is spatially populated. Lies within a single geographic and ecological zone, the study region, is categorized into two zones highland/ mountain range and lowlands on relief configuration [82, 83]. The highlands are characterized by interlocking spurs and steep slopes which ranged from 20% to 30%, with an elevation fluctuating from an average of 1,800-2,400 meters above the sea level. The highlands constitute 30% of the region's total land area. While, the lowland, which is gentler and flat, occasionally interrupted by hills and rocky outcrops, made up the 70% of the region's total land area [73, 83, 84]. The study region enjoys abundant sunshine and rainfall, and characterized by unimodal rainfall regime, with an extended rainy season from April to October, with a dry spell often in about August, and the dry season which takes up the remaining months. The region has a mean annual precipitation of 1450mm and 1100mm in the highland and lowland areas respectively. Atmospheric temperature of (18-27°C), relative humidity (65-90%), earth temperature at 30cm soil depth (25-30°C), evaporation rate (2-5 cm/day) and sunshine hours (6-7) per day.

The major soil groups in the area are the hydromorphic and ferruginous tropical soil subgroups, which developed on crystalline acid rocks and sandy parent materials [73, 83, 84]. Characterizes by a sandy surface horizon, with clay subsoil of the lowland and clay loam in the highland areas [71, 73]. The soils are naturally fertile for agricultural productivity, but, susceptible to erosion, especially if the vegetation cover is removed and have low water holding capacity[84].

Agriculture, which is entirely rain-fed, is the principal economic activity in the study area, and is destined mainly for home consumption. Farm business is a family affair with the head of the household as the decision maker. The farming system practiced included: mixed cropping, crop rotation, and single cropping. Farm sizes vary with villages reflecting population density, accessibility to the farm and personal preferences of the occupants to each other. Common crops cultivated include yam, cassava, sorghum, maize, groundnuts, beans, rice and vegetables. Beside crops the inhabitants also keep livestock such as cattle, sheep and goats in large numbers.

The growth of these crops and animals threatened the natural resilience of the vegetation and soils of the region and hence erosion. The major soil conservation practices undertaken by the farmers in the study area are stone and soil bunds known locally as "*Kunya*" that were meant for water erosion control, and the application of organic and inorganic fertilizer to improve the fertility of the soil. Thus, the differences between all locations in terms of soil conservation practices were negligible.

Methods

The data used for the study were generated through a structure questionnaire survey of 383 sample farmers, mainly head of the household by lot (the serial number of each household was written on a piece of paper, wrapped, mixed and withdraw randomly), from the 72 villages, prior, randomly selected from the eighteen district, that were purposively selected from the six local government areas, which made up the study region. In-depth interviews and group discussions were also held with the farmers to obtain additional information and supplemented by field observations.

Villages were selected based on their high severity of soil erosion, posed by increased conversion of hillslope areas to agriculture, and the author's prior knowledge. The list of households in each village was obtained from TADP office. In the present study, a household was defined as a basic unit of production and consumption, composed of the persons who farm common fields and live under one central decision-maker, the household head. The investigation was undertaken between the months of July to September 2014, during the peak of farming activities and when the greatest amount of rainfall causing significant soil losses was recorded in the region and soil conservation practices was actively implemented.

The major issues included in the questionnaire were farmers' socio-economic characteristics, perception of soil erosion occurrence, causes, indicators, reason for cultivation hillslopes, extent and impact, and the knowledge and use of soil conservation and fertility improvement measures. The interviews were conducted in farmers' homesteads in the early morning or late afternoons and on their farms. Since most of the farmers were non-literate, they were interviewed by enumerators and their responses filled in the questionnaires. In cases where a selected household head was unavailable, a random substitute was included. In addition to the formal survey, informal discussion was held with six individual farmers (one from each local government area), to complement and cross check the information provided. The data were analyzed using the frequency and descriptive statistics modules of the Statistical Package for Social Sciences (SPSS) software version 22.

RESULTS AND DISCUSSION

This section presents and discussed the results in five successive sections. The first segment covers farmers' local-knowledge and perceptions of soil erosion in the study region. The second section appraises farmers' perceptions and knowledge of the factors associated with soil erosion problem, indicators, and its magnitude. The third section covers farmers' reasons for cultivating hillslopes. The fourth part discusses the influence of farmers' socioeconomic characteristics on soil erosion. Lastly, the fifth, explore farmers' soil conservation knowledge and practices.

Farmers' Local-knowledge and Perception About Soil Erosion in the Study Region

Farmers' perception of soil erosion is one of the important social factors determining their level of understanding about soil erosion and its effects [6, 41, 56, 85]. To gauge farmers' perception and knowledge of soil erosion problems, farmers' were asked whether they are aware and perceived soil erosion as a problem in their farm plots, and how the trend is of water erosion over the last ten years.

All of the interviewed farmers are well aware and the majority (91.9%) perceived soil erosion as a

problem constraining crop production in their farm plots (Table 1). Of course, farmers are acquainted with soil erosion from observations of their surroundings, where, farm lands have been left uncultivated and became rock outcrops with un-crossable gullies, and accumulated years of farming experiences. The majority of the farmers (80.2%) noted the problem of water erosion on their farm plots increasing. The rest, 12.5%, and 7.3%, of farmers also reported, no change and decreasing respectively. This implies that the farmers had a high level perception of the trend of water erosion as increasing in the study region. This result with regard to the trend of water erosion is most closely associated with the scientific findings of most researchers in Nigeria, and elsewhere in the humid tropical region [74, 86-88]. The reason given by the farmers for the increase in water erosion over the years includes: high rainfall intensity, fuel wood harvesting, bush burning, and inappropriate soil conservation techniques.

Summarizing, we can state that, all of the interviewed farmers are well aware and the majority (91.9%) perceived soil erosion as a problem constraining crop production in their farm plots and they had a high level perception of trend of water erosion increasing in the study region.

Table 1
Farmers' knowledge and perception of soil erosion problems

Variables	*Frequency*	*Percent*
1. *Do you know what soil erosion is?*		
Yes	383	100.00
2. *Is water erosion a Problem on farmland?*		
No	31	8.10
Yes	352	91.90
Total	383	100.00
3. *How is the trend of water over the years?*		
Decreasing	28	7.3
No change	48	12.5
Increasing	307	80.2
Total	383	100.0

Farmers' Local-Knowledge and Perception About Soil Erosion Problems and its Magnitudes

This section, present the perceptions and local-knowledge of farmers' about the causes and indicators of soil erosion problems, the effects and consequences of soil erosion under agricultural lands. To appraise farmers' knowledge and perception about the causes and indicators of soil erosion problems, farmers' were asked to list the causes of soil erosion, methods of identifying soil erosion and when.

Table 2; indicate the farmers' knowledge and perceived main causes of soil erosion in the study region by the respondents. The basic ones in order of preference, are, high rainfall, lack of government support policies and programs, inappropriate designed and delay of soil conservation, and, insufficient and delay in fertilizer. However, farmers did not consider slope steepness of cultivated farms, to be a major cause of erosion. Thus, an indication of the farmers' used of best practices over generations, which sustained agricultural production in the region, and their knowledge of soil erosion problems, as is seen in their ability to perceive insufficient and a delay in fertilizer (soil fertility depletion related factor) as a cause. This is consistent with most scientific research findings, including those of [61, 89].

Indeed, transect surveys in the entire region confirmed that rainfall was more intense than in the neighboring regions, and soil conservation technologies were properly designed and most of them are not damaged. Also, as recognized from group discussions farmers perceived soil erosion to be severe on farm plots at rainy or summer season locally called "*damuna*", (this shows that the major cause of soil erosion in the study region is water erosion), but, they do not agree that erosion is an individual problem on their farms. These research findings clearly provide support for the conclusion of Okoba and De Graaff [90], Kerr and Pender [91], who indicated that farmers see a relationship between erosion and crop yield, but are reluctant to accept that erosion is an individual problem on their own farms.

The surveyed households consider erosion to be severe mostly when visible signs-rill and gullies appeared on their cultivated plots 53.5%, and drop in crop yield 30.3% (Table 2). These mean that above 80% of the sampled farmers in the study region; look for physical signs on their farmlands as the major indicators of soil erosion. This reason is partly explained by the fact that, the region is having high rainfall and farmers' have relatively low levels of formal education and cultivate mostly on erosion prone areas. This research finding corroborated [3, 56, 90, 92], conclusions, that most farmers, particularly the untrained ones decide on how to use their land in line with their own objectives and understanding about soil, and often disagree with the scientific evaluation of erosion condition by professional soil scientist and agricultural extension agents.

Summarizing, we can state that, farmers are aware of factors associated with soil erosion, but, are reluctant to accept that erosion is an individual problem on their farms. The surveyed households perceive erosion to be severe mostly when visible signs-rill and gullies appeared on their cultivated plots 53.5%, and drop in crop yield 30.3%. Besides, the farmers had a good knowledge and perception towards the importance of soil conservation methods on farm plots.

Table 2
Farmers' knowledge and perception of the main causes and indicators of soil erosion

Variables	*Frequency*	*Percent*
1. *Farmers' causes of soil erosion*		
Absence of fallowing	31	8.10
Slope steepness of cultivated farms	32	8.40
Careless cultivation	34	8.90
Increase pressure of human and bovine population	13	3.40
Lack of Govt. support policies and programmes	50	13.10
Land tenure	30	7.80
Types of soil and erodilbility	20	5.20
Insufficient and delayed fertilizer	46	12.00
Poor designed and delay of soil conservation	49	12.80
Improper crop management practices	26	6.80
Intensity of rainfall	52	13.60
2. *Farmers' indicators of soil erosion*		
Drop in yield	116	30.3
Development of rill/gullies	205	53.5
Decline in soil fertility	27	7.0
When root of plants began to expose	35	9.1

Perception of Farmers' About the Effects and Consequences of Soil Erosion

From table 3, it can be seen that, 29.2% of the farmers forming the majority, indicated that their farmland sizes have been reduced by erosion, 23.8% and 22.5%, reported that their farmlands were reduced in size by being submerged, and drop in yield respectively. This shows that a greater proportion of the farmers perceived reduction of arable land as the main effect of soil erosion in the study area. The main reason of such a perception is that the study region has high rainfall, coupled with increasing agricultural activities on sloppy areas. Informal discussion with farmers confirmed their general focused on rainfall and water as a limiting factor for agricultural lands.

On whether erosion has more consequences on slopes of farmlands than flatland farmlands, the majority of farmers measuring 62.7% exhibit ignorant, while only 37.3% are aware. Although, a relatively larger proportion of the farmers are not aware, these farmers still were able to decipher that a reduction in crop yield is also a consequence of the effects of soil erosion. The main reasons for such a difference in perception are the farmers' long years of farming experiences and their adoption of soil conservation measures.

Moreover, the information gathered from the oral interview and group discussion conducted with the farmers, revealed that, not that the farmers are not aware, but rather they do not see it as a threat because of the advantages they derive outweigh erosion problems. This is the reason why farmers in the study area cultivate hill slope areas whereas flatland areas exist.

These findings of this research clearly provide support for the conclusion of Moges and Holden [3], Teshome Firew, Graaff de J [93], who indicated that, although farmers are aware of the added effort and cost of controlling soil erosion, the damage caused by erosion often goes unnoticed. In addition, Rickson, [92], state that due to the insidious nature of the pervasiveness of soil erosion, farmers misperceive either or both the existence or extent of erosion on their farmlands.

Summarizing, we can state that, farmers perceived the effects of soil erosion on the farms, mostly by visible signs of reduced farmland sizes, 29.2%, by submerged 23.8%, and drop in yield 22.5%. The farmers are well aware of the erosion consequences on slopes farmlands than flatland farmlands, but they do not see it as a threat because of the advantages they derive outweigh erosion problems. This is the reason why farmers in the study area cultivate hill slope areas whereas flatland areas exist.

Table 3
Farmers' perception of the effects of soil erosion on cultivates farm plots

Variables	*Frequency*	*Percent*
Farmers' effects of soil erosion		
Reduction in fallow period	20	5.2
Require high input and management	30	7.8
Reduction of arable land	112	29.2
Drop in yield	86	22.5
Loss in productivity of cropping lands	48	12.5
Submerges of fertile arable land	87	23 .8
Total	383	100.0
Farmers' awareness soil erosion consequences on slope compare to flat land areas?		
Aware	143	37.3
Not aware	240	62.7

Farmers Reasons, for Cultivating Hillslope Areas

To assess farmers' reasons for cultivation hillslopes, while, flatland exists, farmers were asked about the suitable land they use for cultivation and their reasons.

The results indicated in Table 4, revealed that, respectively, 36.3% and 32.4% constituting the majority of the farmers have their farmlands either located in the steep or gently slopes, a place where most soil erosion is taking place and only 31.3% farmed on flatland areas. A situation, Ovuka and Ekbom [94], described to be symptoms of a lack of awareness of soil erosion in their studies of farmers resources level, soil properties and productivity in Kenya's central highland. But, in the present study the farmers in the study area are aware of the erosion problems prone to such areas, given their evidences of on-farm erosion causes and indicators (Table 2). In addition, most of the farmers interviewed indicated that their consideration is not erosion, but, weed, and grazing animals which outweighs erosion problems.

On why farmers in the study region cultivate hillslopes while flatlands exist, 42.8% of the farmers forming the majority reported less crop destruction by animals, as the main reason. Respectively, the rest, 27.7%, 25.2% and 4.4%, of farmers also reported less weed invasion, historical reasons/inheritance and shortage of farmlands. This implies that the majority of farmers forming 95.5% prefer to cultivate the hill slopes not because of the shortages of flatland areas, but because of less crop destruction by animals, less weed invasion, and historical reasons. During the group discussion, most farmers confirmed the above findings, when they stated that, they are aware of soil erosion, but they are forced to intensify cultivation in hillslopes areas to produce more food crops for their basic livelihood because of weeds, grazing animals and inheritance.

Summarizing, we can state that, the majority of the farmers has their farmlands either located on the steep or gentle slopes, a place where most soil erosion is taking place not because of the shortages of flatland areas but because their consideration is not erosion but, weed, and grazing animals which outweigh erosion problems.

The Influence of Farmers' Socioeconomic Characteristics on Soil Erosion

Globally, soil erosion associated with agricultural land is more widespread than that associated with other land uses. Soil conservation the wise use of land, especially with respect to soil erosion control, is therefore, not only limited to the technical part of solving erosion problems, but, is also strongly influenced by a set of socio-economic factors that encourage or discourage farmers from adopting soil conservation practices [35, 38, 42, 85, 95]. Thus, this section, examines the factors that influence the adoption of soil conservation from farmers' socio-economic point of view in the study region. This is paramount because, decisions about land use are ultimately made by farmers themselves, and not by social planners or government agencies, and farmers choose how to use their farmlands best on their own objectives, production possibilities and limitations, not on the basis of any empirical methods.

Table 4
Farmers Reasons for cultivating hillslope Areas

Variables	*Frequency*	*Percent*
Respondent's suitable land for cultivation		
Gentle Slopes	124	32.4
Steep Slope	138	36.0
Flat land	120	31.3
Respondent's reasons for cultivating hillslopes		
Shortage of farmland	7	4.4
Less crop destruction by animals	68	42.8
Historical reason	40	25.2
Less weed invasion	44	27.7

Table 5, presents the demographic profile of the farmers in the study region. The results show that the majority of the farmers (68.4%) are in the age group bracket of 46-55 years old. This result indicates that, the farmers were mainly middle ageds who are still in their economically active stage that could result positively in soil conservation. This is because, as noted by Anjichi, Mauyo [96], Matata, Ajayil [97], the peasant farmers of middle aged are more enthusiastic, and have more physical vigor and family responsibilities than the young and old farmers. Most of the farmers (88.3%) are males, while (11.7%) the minorities are females and nearly all (90.9%) are married.

However, the majority of the farmers (24%) had primary education, (20.6%) secondary education and only (10.7%) exceeded secondary school education. This implies that, the education level of farmers in the study region is low, and could influence the farmers' ability to adopt soil conservation negatively. This is because as, Deininger and Jin [98], noted, formal education is a critical factor in influencing the

Table 5
Summary of Socio-Economic Characteristics of Farmers Interviewed

	Local government areas						
	Ardo-Kola	*Jalingo*	*Karim lamido*	*Lau*	*Yorro*	*Zing*	*Total responses*
Variables	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*	*n (%)*
Age group17-36 years	19(29.7)	12(16.7)	4(6.1)	13(23.6)	13(17.3)	13(17.3)	74(19.3)
37-55 years	36(56.3)	53(73.6)	55(83.3)	35(63.6)	52(69.3)	52(69.3)	262(68.4)
> 55 years	9(2.3)	7(9.7)	7(10.7)	7(12.7)	10(13.3)	10(13.3)	47(12.3)
Gender MF	56(87.5)	56(77.8)	56(84.8)	54(98.2)	46(90.2)	70(93.3)	338(88.3)
	8(12.5)	16(22.2)	10(15.2)	1(1.8)	5(9.8)	5(6.6)	45(11.7)
Marital Status							
Unmarried	3(4.7)	2(2.8)	1(1.5)	–	–	1(1.3)	7(1.8)
Married	56(87.5)	59(81.9)	60(90.9)	54(98.2)	49(96.1)	70(93.3)	348(90.9)
Divorce/widow	5(7.8)	11(15.3)	5(7.6)	1(1.8)	2(3.9)	4(5.3)	28(7.3)
Educational Status							
NFE	15(23.4)	24(33.3)	12(18.2)	4(7.3)	4(7.8)	4(5.3)	63(16.4)
KE	12(18.8)	8(11.1)	8(12.1)	7(12.7)	6(11.8)	16(21.3)	57(14.9)
AE	–	16(22.2)	13(19.7)	7(12.7)	10(19.6)	5(6.7)	79(20.6)
PS	8(12.5)	6(8.3)	13(19.7)	15(27.3)	12(23.5)	38(50.7)	92(24.0)
SS	18(28.1)	13(18.1)	13(19.7)	16(29.1)	16(31.4)	3(4.0)	51(13.3)
PSS	11(17.2)	5(6.9)	7(10.6)	6(10.9)	3(5.9)	9(12.0)	41(10.7)
Farm income (in thousand)							
N1-N15,	1(1.6)	4(5.6)	3(4.7)	1(1.8)	1(2.0)	3(4.0)	13(3.4)
N16-N30,	24(37.5)	28(38.9)	19(28.8)	15(27.3)	24(47.1)	27(36.0)	137(35.8)
N31-N45,	24(37.5)	18(25.0)	21(31.8)	15(27.3)	11(21.6)	30(40.0)	199(31.1)
N46 –N60,	12(18.8)	15(20.8)	15(22.7)	13(23.6)	8(15.7)	10(13.3)	73(19.1)
> N60	3(4.7)	7(9.7)	8(12.1)	11(20.0)	7(13.7)	5(6.7)	41(10.7)
Farming Experience (years)							
1-5	6(9.4)	3(4.2)	2(1.8)	1(1.8)	4(7.8)	2(2.7)	18(4.7)
6-10	13(20.3)	3(4.2)	5(7.6)	14(25.5)	8(15.7)	12(16.0)	55(14.4)
11-15	15(23.4)	11(15.3)	11(16.7)	3(5.5)	4(7.8)	11(14.7)	55(14.4)
16 and above	30(46.9)	55(76.4)	48(72.7)	37(67.3)	35(68.6)	50(66.7)	255(66.6)
Farm ownership							
Yes	61(95.3)	71(98.6)	66(100)	55(100)	51(100)	75(100)	379(99.0)
No	3(4.7)	1(1.4)	–	–	–	–	4(1.0)
Farm size							
< 0.5 ha	22(934.4)	17(23.6)	40(60.6)	42(76.4)	29(56.9)	65(86.7)	215(56.1)
0.5-1.0 ha	39(60.9)	48(66.7)	25(37.9)	12(21.8)	20(39.2)	10(13.3)	154(40.2)
1.1-1.5 ha	3(4.7)	6(8.3)	1(1.5)	1(1.8)	2(3.9)	–	13(3.4)
1.6 -2 ha	–	1(1.4)	–	–	–	–	1(0.3)
> 2ha	–	–	–	–	–	–	–
Number of farms cultivated by farmers							
1 – 3	16(25.0)	16(22.2)	19(28.8)	14(25.5)	12(23.5)	10(13.3)	87(22.7)
4 – 6	25(39.1)	36(50.0)	31(47.0)	29(52.7)	25(49.0)	32(42.7)	178(46.5)
7 – 9	11(17.2)	15(20.8)	16(24.2)	9(16.4)	12(23.5)	26(34.7)	89(23.2)
> 9	12(18.8)	5(6.9)	–	3(5.5)	2(3.9)	7(9.3)	29(7.6)
Farm Distance (km)							
< 1	1(1.6)	–	–	–	–	–	1(0.3)
1 – 2	38(59.4)	39(54.2)	37(56.1)	25(45.5)	19(37.3)	15(20.0)	173(45.2)
2.1 – 3	25(39.1)	29(40.3)	27(40.9)	27(49.1)	28(54.9)	51(68.0)	187(48.8)
3.1 – 4	–	4(5.6)	2(3.0)	3(5.5)	4(7.8)	9(12.0)	22(5.7)
> 4	–	–	–	–	–	–	–

*NFE = Non-formal Education, KE = Koranic education, AD = Adult education, PS = Primary school, SS = Secondary school, PSS = Post-Secondary school

efficacy of the farmers' decision to adopt soil conservation measures. In addition Huffman [99], had earlier stated that, both theoretically and empirically, farmers, with higher education possess high allocative ability and adjust faster to the understanding of soil erosion on their farms.

Similarly, the majority of the farmers have large family size of 7-12 members and most (70.3%) earned less than N46, 000 (USD278.79) annually as income from their farm precedence. As recognized, from the group discussion, almost all the farmers depend directly on their farms precedence as their source of income. Thus, as reported, inadequate education and poverty are two key characteristics which impact on farmers' poor farming decision/ or perceptions which result to soil erosion [96, 97, 100], this is because; high agricultural economic efficiency was found to increase households' enthusiasm for agricultural investment. Hence, under relatively high level, high demand for outputs, besides the personal perception and knowledge of the individual farmer, farmers tend to increase their efforts in soil erosion control. Similarly, having off-farm income was found to influence the farmer's willingness and ability to use effective soil conservation options.

The findings with respect to landownership indicated that, the majority (90%) of the farmers owned their land holdings. This is connected with the fact that traditionally, land ownership in this area is basically communal. The results further show that, most of the farmers (51.6%) have farm sizes of less than 1 hectare. This is because of inheritance and the farm sites, most of which are located on hill slopes and farmers have to work hard to locate spaces where the soil is deep. The majority (77.3%), also, worked on more than 4 farms, with the distances between farms from the home greater than 2km (54.5%).

During the survey, it was observed that erosion has impacted more on small and distant farm plots far away from home. Most farmers during group discussion explain that, they worked on more than 10 farm plots that are located at different or scattered places and the distance between farms plots are far away from home. As a result, they do not have enough chance to observe their farm plot daily or even for weeks. Therefore, the ignored cultivated plot could be eroded by sudden runoff if the cut of drain or other soil conservation practices destroyed by run off at the time of high intensity of rainfall. Hence, the reason for the severe nature of on farm soil erosion in the study.

However, most (66.6%) of the farmers have been in the farming business for more than 15 years. Thus, the environment offers them with traditional knowledge that was experienced through the passage of time and shared with each other that could either positively or negatively negate their conservation practices.

Table 6
Farmers soil conservation practices

Variables	*Frequency*	*Percent*
Farmers' erosion control practices		
Waterways	22	5.7
Crop rotation	60	15.7
Contour ploughing	145	37.9
Soil and stone bunds	139	36.3
Bush fallowing	2	.5
Mulching	15	3.9

Summarizing, we can say, the majority of farmers in the study region are of middle aged, male and married and they owned their landholdings and have long years of farming experience. However, they have, large family size member, small and scattered farm sizes, low formal education, absent of off-farm and inadequate farm incomes.

Farmers' Soil Conservation Practices

Soil erosion necessitates that, soil conservation is an important part of agriculture [31, 62, 85]. Soil conservation is conceptualized as all effort made by farmers to minimize the rate of soil erosion and improve soil fertility on farm plots to achieve an acceptable level of food production [23, 101, 102]. Thus, erosion and/or conservation cannot be understood without studying how people use the land and the reasoning that guides their decisions about land use [1, 4]. In this respect, for information on the types of soil conservation investments for water erosion control, farmers were asked to state the type of practices employed on their farms. Findings in Table 6, depicts shows that a number of water erosion control techniques are employed by the farmers. Contour ploughing, with a mean percentage of 37.9%, soil and stone bunds, 36.3%, and crop rotation, 15.7%, tops the list. While respectively, waterways, mulching and bush fallowing 5.7%, 3.9% and 0.5%. This suggests that, the farmers in the study region are employing soil conservation methods.

From the interview and group discussion, all the farmers noted that soil conservation measures were very helpful for erosion control and had the potentials to improve soil productivity. The soil conservation practices widely employed by farmers in the study region include: contour plowing, soil and rock bunds, diversion ditches (cut of drain), crop

rotation, intercropping, mulching, fallowing and waterways for water erosion control, and soil fertility improvement, in addition to application of organic and mineral fertilizers.

Contour plowing - is the practice of cultivating crops on the contour where the slopes are steep in order to minimize runoff and erosion on their farm plots, in addition to decreasing the required traction power of animals during plowing. Soil and stone bunds – is an embankment, or ridge that is generally constructed across a slope along the contour line. Both techniques are introduced, which can be used alternatively based on the availability of stones and labours and often build on moderately sloping areas for erosion control. On the other hand, cut off drains –are physical structure constructed by tilling or digging the soil deep in order to divert the runoff before reaching the farmland to discharge flow of water into the river channel or stream channel. And, crop rotation:– in the region, the practice of crop rotation is another widespread practice aimed at improving crop yield, through soil moisture and soil fertility enhancement, where, yam, groundnut, sorghum, beans are rotationally cultivated. Thus, the farmers of the research region are aware of soil erosion and its magnitudes, as is seen in their ability to perceive that alternating high residue producing crops with the growing low residue producing crops improves crop yields, as of the scientific method improved soil fertility.

CONCLUSION

This study focused on an appraisal of farmers' perception and awareness of soil erosion problems, causes, effects and consequences. This was in realization that farmers in the study area cultivate the hillslope site (areas where erosion is more prone) whereas, flatland areas exist.

To arrive at the results obtained a total of 383 questionnaires were administered to solicit for responses of the farmers in the region. Descriptive statistics of the SPSS version 22 were used in analyzing data obtained.

Most respondents are male, who are within their active farming age, and married. Most of whom owned their land holdings, and have long years of farming experience. However, the majority of respondents had education below secondary, low income and depends on farming precedence as sole source of income. The study also showed that, farmers had large family size members, and small and scattered farm sizes.

It is also clear from farmers' responses that there is widespread awareness of soil erosion in the study region. However, they related soil erosion to natural factors (high rainfall), and were reluctant to accept that erosion is an individual problem on their farms. They mostly consider erosion to be severe when visible signs-rill and gullies appeared on the plots, followed by reduction in farmland sizes, and, by being submerged as the consequences of soil erosion in the study region.

Also the study revealed that the farmers prefer the steep slope to the lowlands because they try to avoid animals grazing from destroying their crops, less weed invasion and for historical reasons which they affirmed to far outweigh erosion problems.

However, the chief contributing factor to the advancement of farming has been the best practices used by the farmers over generations to sustain their agricultural problems in this area especially terracing, contour ploughing, and crop rotation. Hence, it was discovered that indigenous knowledge is good, and some times better than the scientific practices offered to farmers.

It is recommended that

(i) Effective extension advisory services on better and modern method of farming which will conserve soil fertility needs to be directed at farmers.

(ii) It is also recommended that formal credit through public or private financial institutions should be provided to farmers in the study area.

(iii) It is believed that, since money forms the basic bedrock of procurement of necessary improved inputs such as fertilizer, improved plant varieties and herbicides, this will go a long way in improving the degraded farmlands and hence improving total crop output.

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