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Empirical Analysis of Farmers' Perception on Causes, Variability and Control Measures of Soil Erosion on Different Lands in Yola and Environs of Nigeria

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ABSTRACT

Soil erosion is one of the most devastating phenomena affecting soil resources and food availability in Yola and environs. However, Farmers' perceptions on the causes, variability and control measures to conserve natural soil resources have received little emphasis in the study area. Therefore, this study aimed to understand farmers' perception on causes, the variability of soil erosion and their indigenous methods adopted in soil erosion control. The study was conducted in Yola where five farm locations were purposively selected (Yolde pate, Mbamba, Bole, Wuro-chekke and Namtari). Data was collected using household interviews where 30 farmers were selected and interviewed from each location making a total of 150 farmers in all. It was revealed that water and tillage erosions were the two major types of soil erosion in the study. Similarly, heavy rainfall, deforestation and steep were the major causes of soil erosion in all the farm locations. Gully and rill-gully erosion were the most prevalence on the farmlands and the erodibilty level was rated high to very high affecting the soil resources. For the control measures, farmers in the study area have adopted majorly contour ridging, planting of vegetative barriers and waters ways in controlling the erosion on their farmlands. The study recommends the establishment of erosion control scheme by the government in the area and farmers should be trained adequately on modern techniques of controlling erosion with respect to its causes and erodibilty level for optimum food production that will meet up the accelerated growing population in the area and beyond.

Keywords: *Farmers perception, Causes, Control measures, Variability, Soil erosion.*

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1. INTRODUCTION

Soil erosion is among the natural physical phenomenon that affects land resources and food availability in the world. Similarly, [1] explained that soil erosion is a major environmental problem worldwide. It is a known fact that soils of the tropical region is low in inherent fertility due to some consolidated factors (natural and anthropogenic factors) of which soil erosion is the most principal factor. In Nigeria, agricultural land is often results in the degradation of natural soil fertility and reduced productivity [2]. Reference [3] explained that Soil erosion occurs when soil particles are carried off by water or wind and deposited somewhere else. Likewise, [4] stated equally that soil erosion occurs in three phenomena detachment, transportation and deposition. Soil erosion is caused by two factors, natural phenomenon such as high rainfall intensity, soil type, slope/topography, vegetation and secondly due to anthropogenic factors such as deforestation, intensive cultivation, deep tillage, urbanization etc. The potential for erosion is dependent on certain factors which include soil nature/characteristics, nature of slope/topography, presence of vegetation and climatic conditions [5]. Thus, Modern accelerated soil erosion problems have been linked to irrational land exploration resulting from human activities [6]. However, Soil erosion is highly variable, both in time and in space**.** The variability of soil erosion is associated with different factors such as soil characteristics, amount of rainfall, vegetation, slope, wind, land use etc. Soil erosion shows high spatial variability with a few small areas contributing disproportionate high amount of pollutant loads to watershed outflow [7]. Those areas, which can be the source or transport area for soil erosion, are referred as critical source areas (CSAs). Soil erosion which is a global threat responsible for soil nutrient depletion, degradation of soil quality, and destruction of soil structure and disruption of ecosystem; have reduced the availability of productive lands for cultivation which in turn has greatly reduced chances of food sufficiency and security in the country [8]. Erosion is a two-way

problem; a), loss of soil fertility and thickness of the eroding soil (on-site problems) and the addition of unwanted sediments in the depositional sites (off-site problem). Hence, erosion removes soil particles that are necessary for water storage and denies root exploration for plant nutrients [3]. As for the off-site effects, eroded soil, deposited down slope can inhibit or delay the emergence of seeds, bury small seedling and necessitate replanting in the affected areas [9]. In West Africa, soil erosion gulps about 10-21 tons of top soils per ha on nearly gentle slopes of 0.4 - 0.8% and up to 30 - 35 tons on 1-2% slopes [10]. In Nigeria, it has been reported that over 25 million tons of valuable top soils are lost annually to erosion [11]. Farmers' decisions to conserve natural resources in general, and soil and water in particular are largely determined by their knowledge of the problems and perceived benefits of conservation [12].

Farmers in Yola and environs are seriously facing reduction in farm output annually due to the accelerated loss of topsoil through erosion from agricultural land which recognized as an important threat to their profitable farming. Thus, plates below described the glaring effects of soil erosion on different farm locations of the study area.

Plates 1 shows the devastating effects of soil erosion on different farm location in the study area.

However, the soil erosion in the area varies in terms of causes, types, variability, erodibility and methods of control adopted. In Yola, however, farmers' perception on soil erosion problems on causes, variability and control practices have received little emphasis either in status analysis or use in conservation planning**.** Therefore, there is need for identifying the distribution, causes and control measures of erosion on different farm locations in the area through farmers' perception with the aim of providing adequate and reliable information on the menace that will serve as a key knowledge towards providing practical workable solution. This study will help to understand perceptions of farmers on soil erosion, identifying the dominant soil erosion types and control mechanisms to device future research directions for the benefits of farmers Thus, this study is an empirical analysis of farmers' perception on causes, variability and control measures of soil erosion on different arable lands in Yola and environs.

2. STUDY AREA

The study was conducted in Yola South LGA and Environs of Adamawa State, Nigeria which lies on latitude 09^0 14'N and 09^0 20'N of the equator and longitude 12^0 25'E and 12^0 28'E of the Greenwich meridian with an average annual rainfall in the study area ranges between 850mm-1000mm with over 41% of rain falling in August and September. Temperature also has a significant temporal variation in the study area; with an average maximum temperature of 42^0C with an average relative humidity of about 29% [13].

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3. MATERIALS AND METHOD

This study was quantitative in nature which largely based on data collection from five selected farm locations in the study area namely; Yolde pate, Mbamba, Bole, Wuro-chekke and Namtari The research adopted face-to-face approach using well defined and structured questionnaires that consist of six parts: field parameters, types, major causes, variability, erodibility level and control measures of soil erosion on different farmlands in the study area. For each farm location in the area a number of 30 questionnaires were randomly administered to the sampled farmers making a total numbers of 150 sampled farmers in all. Additional relevant data such as journal, textbooks, unpublished thesis and maps were sourced as secondary sources from library, internets institutions and agencies respectively.

4. DATA ANALYSIS

The data collected were subjected to descriptive statistical analysis where simple percentages, frequency distribution and charts were obtained.

5. RESULTS AND DISCUSSIONS

Table 1.Field Parameters

Farm location	C.F experience (years)	Present land use	Vegetative	Major crop grown	Erosion type	Slope type
Mbamba	5-35	Arable farming and animal grazing	Few tress and grasses	Rice, maize and cassava	Gully	Steep
Namtari	10-45	Arable farming and animal grazing	Trees, shrubs and grasses	Rice, cassava and maize	Rill	Moderate to steep
Bole	5-20	Arable farming, animal grazing and Orchards	Tall grasses, trees and shrubs	Maize, groundnut, beans and rice	Rill to gully	Steep
Yolde pate	10-25	Arable farming and animal grazing	Few trees, grasses and shrubs	Maize and rice	Sheet to gully	Gentle to moderate
Wuro-chekke	5-15	Arable farming and irrigation/orchards	Tall grasses and few trees	Rice and cocoyam	Gully	Steep

C.F; Conservation farming. Source: [14].

Table 2. Major types of soil erosion in the study area (Number of respondents (N) =40 for each district).

Types of soil erosion	Yolde pate N=30 P=(%)100		Mbamba N=30 P= (%)100		Bole N=30 P=(%) 100		Wuro-chekke N=30 P= (%)100		Namtari N= 30 P= (%)100	
Water Erosion	9	(29)	10	(33)	9	(30)	8	(27)	9	(29)
Wind Erosion	4	(12)	3	(10)	4	(13)	4	(14)	2	(7)
Tillage	6	(21)	8	(27)	8	(27)	7	(23)	8	(26)
Channel erosion	7	(24)	7	(23)	6	(21)	8	(26)	6	(21)
No Erosion	4	(14)	2	(7)	3	(9)	3	(10)	5	(17)
Total N and P (%)	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**

N= Number of respondents on each farm location. **P** = percentage of the respondents. Source: Field Survey, 2019

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Table 3. What are the Major Causes of soil erosion identified in all study area

Major causes of soil erosion	Yolde pate N=30 P=(%) 100		Mbamba N=30 P=(%) 100		Bole N =30 P= (%) 100		Wuro-chekke N=30 P= (%) 100		Namtari N=30 P=(%) 100	
Heavy rainfall	7	(23)	6	(21)	7	(24)	5	(17)	6	(19)
Deforestation	5	(18)	3	(10)	8	(26)	6	(21)	6	(20)
Steep slope	3	(10)	8	(25)	5	(18)	7	(24)	4	(13)
Overgrazing	4	(14)	2	(8)	4	(13)	4	(12)	4	(14)
Excessive tillage	5	(15)	6	(20)	2	(6)	3	(11)	4	(12)
Soil type	3	(9)	3	(10)	3	(10)	3	(9)	3	(11)
Poor management	3	(11)	2	(6)	1	(2)	2	(7)	3	(11)
Total N and P (%)	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**

N= Number of respondents on each farm location. **P** = percentage of the respondents Source: Field Survey, 2019.

Table 4 Farmers' Perception on Soil Erosion Variability on their Arable Land.

Variability level of soil erosion on arable	Yolde pate Fx (%)		Mbamba Fx (%)		Bole Fx (%)		Wuro-chekke Fx (%)		Namtari Fx (%)	
Gully	8	(27)	8	(28)	7	(22)	8	(27)	6	(19)
Rill-gully	6	(21)	8	(25)	8	(27)	8	(26)	6	(21)
Rill	5	(15)	6	(20)	5	(18)	4	(14)	7	(23)
Sheet-rill	4	(13)	5	(17)	5	(15)	4	(13)	5	(16)
Splash-sheet	5	(17)	2	(6)	3	(11)	3	(11)	4	(13)
Splash	2	(7)	1	(4)	2	(7)	3	(9)	2	(8)
Total N and P (%)	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**

N= Number of respondents on each farm location. **P** = percentage of the respondents Source: Field Survey, 2019.

Table 5 Farmers' Perception on Soil Erodibility Level on their Arable Land.

Erodibility level of soil erosion on arable	Yolde pate Fx (%)		Mbamba Fx (%)		Bole Fx (%)		Wuro-chekke Fx (%)		Namtari Fx (%)	
Very high	6	(20)	9	(30)	6	(20)	7	(23)	6	(19)
High	9	(29)	7	(24)	8	(27)	8	(28)	8	(25)
Medium	7	(23)	7	(23)	7	(24)	8	(25)	8	(28)
low	5	(18)	4	(14)	5	(16)	4	(13)	5	(18)
None	3	(10)	3	(9)	4	(13)	3	(11)	3	(10)
Total N and P (%)	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**

N= Number of respondents on each farm location. **P** = percentage of the respondents Source: Field Survey, 2019.

Table 6 Methods of Soil Erosion Control in the study Area

Location	Yolde Pate Fx (%)		Mbamba Fx (%)		Bole Fx (%)		Wuro-chekke Fx (%)		Namtari Fx (%)	
Water ways	5	(16)	4	(14)	6	(21)	7	(22)	5	(16)
Cover Cropping System	3	(10)	6	(19)	4	(12)	3	(11)	4	(14)
Sand-stone bags	3	(11)	3	(11)	4	(13)	4	(14)	3	(11)
Contour Ridging	8	(26)	8	(28)	5	(16)	4	(13)	7	(23)
Vegetative Barriers	5	(18)	5	(15)	6	(21)	8	(27)	4	(12)

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Mulching	3	(10)	2	(7)	1	(4)	2	(8)	5	(17)
Agroforestry	3	(9)	2	(6)	4	(13)	2	(5)	2	(7)
Total N and P= (%)	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**	**30**	**(100)**

N= Number of respondents on each farm location. **P** = percentage of the respondents Source: Field Survey, 2019.

6. DISCUSSIONS ON INDIVIDUAL FARM LOCATION OF THE STUDY AREA

Results on each farm location were presented on table 1,2,3, 4, 5 and 6 above while some were depicted using figurative charts respectively.

6.1 Yolde pate farm location.

The area occupies a gentle to moderate slope rejuvenating rill to gully erosion having considerable effects on the arable farmlands dominated with maize and rice as major crops grown over 10- 25 years of farming respectively (Table 1). Few tress, grasses and shrubs made the vegetation of the area [14]. From the result obtained as shown in table 2 above, it was revealed that 29 % of the farmers in the area perceived water erosion as the major types of soil erosion affecting the farming activities. The apparent resultant effects of water erosion in the area might be accredited to heavy rainfall experienced in the area. Channel erosion which also received 24 % of the respondents was perceived also as major erosion type. This might be linked to the terrain of Yolde pate located at middle course of river chochi where lateral erosion is dominant over vertical erosion, resulting in widening of the valley. Moreover, 21 % of them observed it to tillage erosion respectively. Similarly, heavy rainfall was revealed to be the major cause of soil erosion with 23 % respondents as depicted in table 3. The apparent resultant effects of water erosion in the area might be attributed to fluctuating increase in the annual rainfall amount in the study area for the recent decade as it was reported recently by [15] that high amount of rainfall experienced in the area (Yola) was found to be the major factor of soil degradation among the hydro-climatic parameters. This is because the flood frequency and magnitude, rate of run-off, erosion and soil loss depends directly on the amount of rainfall intensity. Similar finding was made by [16] who reported that 28.5% of the respondents believed that high amount and prolong duration of rainfall was responsible for flooding in the area which hampered hundred hectares of land. Deforestation was perceived with 18 % of them where as overgrazing received 14 % of the farmers' perception as causal of soil erosion. The area is among the most intensive grazing activities thereby exposing the soil to erosion. This finding concord with the report of [17] estimated rates of soil erosion of arable or intensively grazed lands have been found to be 100-1000 times higher than natural background erosion rates. Thus, overgrazing affects soil structure, compaction rates, porosity, and top soil depletion which have led to soil erosion and reduced soil fertility. [18]. Result from [15] was revealed that overgrazing by the animals was perceived by 19 % of the respondents to had caused soil degradation in the study area. Perhaps, it might be due to their traction effects on the soil physical properties such as structures, texture, porosity and compaction as portrayed on plate 2 below.

Plates 2. The grazing animals trampling on farmlands thereby destructing the soil structure. Adopted from [15]

In the farm area, gully erosion was revealed as most variable and common with 27 % of the respondents while others (21%) perceived it to rill-gully erosion and 17 % of the identified splash-sheet erosion are mostly dispersed and dominated the area (table 4). The level of soil erodibility were depicted in table 5, where 29 % of the farmers considered the level as high in Yolde pate farm location, this might be linked to the increase in volume of water at middle river course with transportation effects of river

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cliff and meanders than depositional effects. Thus, Soil erodibility refers to the degree or intensity of a soil's state or susceptibility to being eroded [19].While 23 % of them ranked it as medium where as 20 % of the respondents rated the level very high and 10 % of them revealed to have no erosion menace in the area respectively. Methods of erosion control were depicted in table 6, it was revealed that contour ridging is the most common measures adopted by the respondent (26 %) in controlling soil erosion on their farms and use of vegetative barriers was perceived by 18 % of them and 16 % had employed water ways construction where agroforestry received less responses (9 %) from the respondents in controlling erosion in the area due to absence of forest cover consequence to intensive deforestation activities in the area.

6.2 Mbamba farm location

The area is located at the eastern part of Yola south LGA characterized by few tall trees and grasses (Table 1). The farmers engaged dominantly in arable farming where rice and maize been the major crop grown for about 5-35 years conservation experience [14]. Result on table 2 shows that water erosion had perceived to be the major types of water erosion in the area with 33 % of the respondents. However, tillage erosion received 27 % responses from the respondents as major type of soil erosion in the area consequence to excessive deep tillage practices than any other farm location in the study area. Thus, Tillage erosion is the direct down-slope movement of soil by tillage implements where particles only redistribute within a field [17]. Also, channel erosion observed by 23% of the farmers in the area and for wind erosion was only 10 % of the respondents identified and the remaining 7 % revealed to have experienced no erosion menace on their farmlands accordingly. Moreover, the major identified cause of soil erosion in the area was due to nature of steep slope with 25 % respondents (Table 3) then 21 % of them attributed it to heavy rainfall. This is because erosion is slight from soil well covered by dense grasses or forest, but is enormous from steep, poorly covered soil that are exposed to heavy rainfall or strong winds. Likewise, [20] explained that with steep terrain and excessive rainfall, Taiwan is affected by severe soil erosion caused by summer typhoons and storms bring intensive rainfall and rapid flows. Excessive tillage received 20 % of the farmers' perception as the major cause of soil erosion. However, tillage erosion may significantly reduce crop productivity on convexities and near upslope field or terrace borders [17]. Poor management received fewer responses (6 %) from the farmers to have led to soil erosion in the area. Results on erosion variability in the areas was depicted on table 4, where gully erosion was found to be widely variable on the farmlands in Mbamba area having 28 % responses from the farmers while others (25 %) identified rill-gully erosion variability dispersed in the area and splash erosion was identified as less with only 4 % respondents respectively. The variability of gully and rill-gully erosion in Mbamba farm location than other location was connected to steep sided of the area. Thus, Yola south LGA is experiencing rapid development of extended gully erosion from its all farmland axis which carries organic soil from the top soil and sediment on farmlands [15]. Gully formations can be difficult to control if remedial measures are not designed and properly constructed. Operations with farm machinery adjacent to gullies can be quite hazardous when cropping or attempting to reclaim lost land [9]. Similarly, in the area 30 % of the respondents had agreed that erodibility level of soil erosion was very high affecting hundreds hectares of farmlands as shown in table 5, while 24 % of them rated as high. This ranking of high to very high erodibility level in the area is a function of combined factors identified such slope steepness, heavy down pour, deep tillage practices and developed gully erosions along the farm banks. Medium level was ranked with 23 % and only 14 % of the farmers perceived the level of erodibility as low in the area. From table 6 above, contour ridging was revealed to be the most common soil erosion control methods adopted by most of the farmers (28 %) in the area. Similarly, cover cropping was also revealed to receive 19 %, of the farmers to have adopted as techniques of erosion control. Reference [17] reported that hilly croplands under conventional agriculture and orchards without additional soil cover in temperate climate zones are subject to erosion rates up to 10-20 tonnes ha-1 yr-1 , while average rates are often < 10 tonnes ha-1 yr-1. In the area, vegetative barriers perceived 15 % of them and agroforestry received less (6%) adoptive as method of erosion control by the farmers respectively.

6.3 Bole farm location

The riverine area is sited on steeply (of about 20-22%) slope gradient with well rejuvenated rill to gully erosion having considerable devastation on farmlands. The vegetation is characterized by tall grasses, tall trees and shrubs dominated with arable farming with about 5-20 years conservation experience mostly maize, groundnut and cowpea along the hilly areas while rice is cultivated at swampy syncline (Table 1), [14]. From the result depicted on table 2, it was revealed that 27 % of the respondents have perceived that water erosion is a major type of soil erosion affecting the area, tillage erosion agreed with 27 % of the farmers while channel erosion recorded 21 % responses from the respondents and wind erosion was perceived by only 13 % of them respectively. Wind erosion occurs when dry, loose, bare soil is subjected to strong winds. Wind erosion is common in semiarid areas where strong winds can easily mobilize soil particles, especially during dry spells. [17] Conversely, in Bole farm location unlike in most locations of the study area deforestation practices perceived by most of the farmers (26%) as the major cause of soil erosion (Table 3). This might be inflicted to increase in population which leads to competition on marginal land around the area leading to intensive indiscriminate cutting down of trees and for other economic purposes. Reference [15] also assessed deforestation among the main factor of soil degradation in the area, subsequently subjecting the area in to desert

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encroachment zone .Thus, In Nigeria desertification is fast becoming a threat in the northern parts especially the states in the Sahel and Sudan Savannna areas [21]. Heavy rainfall also recorded 24 % of the respondents as agent of soil erosion. Despite the climatic region of Yola South with relatively low amount of annual rainfall, the area however from the last decade (2008-2018) was experienced an increase in total amount of rainfall of more than 800 mm with more than 60 days number of rainy days as shown in the figure 1 and 2 below respectively.

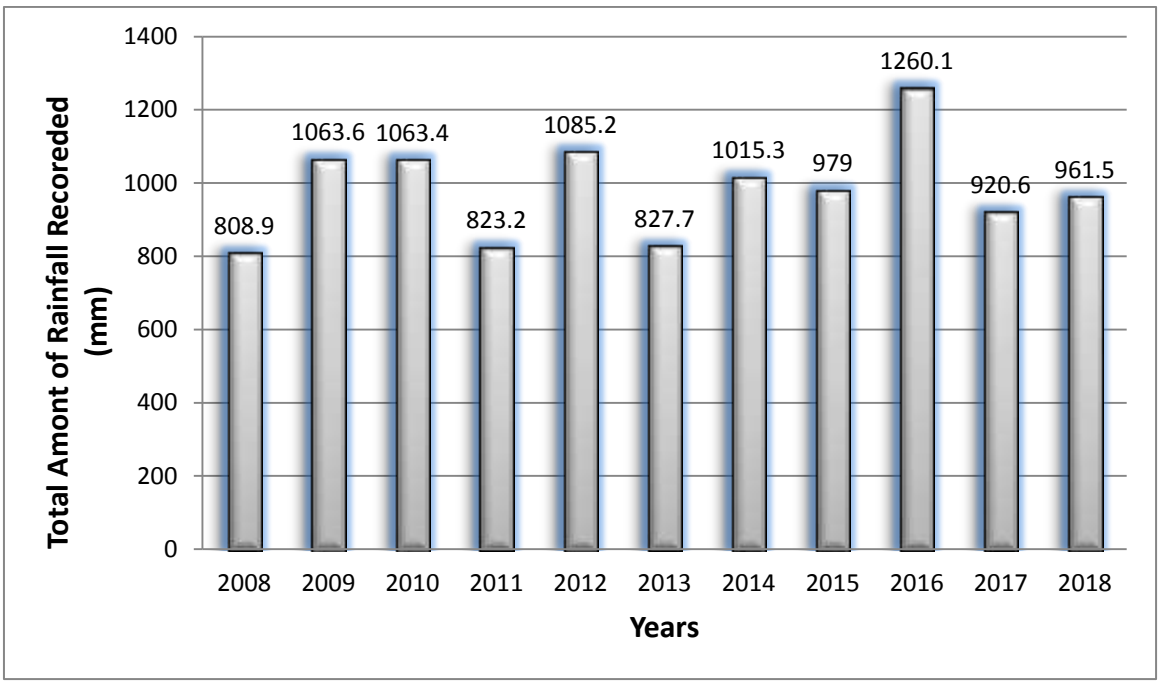

Fig 1. Shows the total amount of rainfall for a recent decade (from 2008-2018) of Yola South [15]

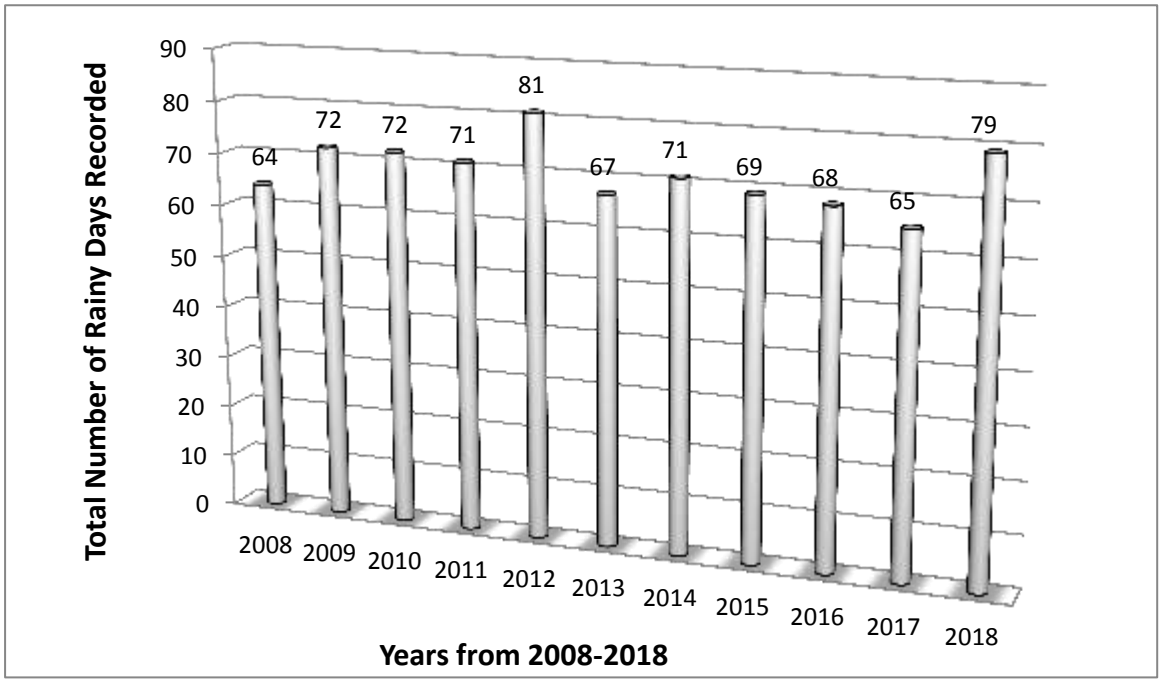

Fig 2. Shows the total number of rainy days for a recent decade (from 2008-2018) of Yola South. Adopted from [15]

Steep slope was identified also as causative agent with 18 % of the respondents and 2 % of the farmers attributed it to poor management of the farm. In terms of erosion variability, rill-gully erosion was mostly distributed on farmlands as conceived with 27 % of the respondents as depicted on table 4. Gully erosion recognized variably distributed with 22 % of them and rill erosion was identified highly dispersed on farmlands with 18 % of them. Similarly, in Bole area soil erosion was regarded high with 27 % of the respondents (Table 5) which may be connected to deforestation and heavy rainfall factors coupled with hilly nature of the area. Thus, erosion rates on hilly croplands in tropical and subtropical areas may reach values up to 50-100 tonnes ha $^{-1}$ yr^{-1} average rates and soil erosion by water is problematic in much of the hilly areas that are used as croplands on all continents [17]. While 24 % of the farmers ranked it as medium and 20 % of them rated very high level of erodibility of soil on the farmlands.

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Thus, the area is located at upper course of river chochi of more hilly terrain with resistant bedrock to erosion compared with other farm locations in the study area. Majority of the farmers (21 %) in Bole area adopted water ways to convey the water to the chochi tributaries as Mother River without flooding on the farmlands. Likewise, vegetative barriers as methods of erosion control was perceived with 21 % of the respondent while contour ridging perceived 16 % of them and agroforestry as well as sand-stone bags each recorded 13 % of the respondents, mulching identified to be less adopted by only (4 %) of the farmers as portrayed on table 6 respectviely.

6.4 Wuro-chekke farm location

The flood plain area is situated along river Benue basin at western part of the study area dominated with tall grasses and few trees, practicing arable farming, irrigation and orchards farming. The area has noticeable rill to gully erosion with notable steep topography having sediments and depositional materials spread over the low lying adjacent areas. Rice and cocoyam were the major crops grown in the area for over 5-15 years conservation farming experience (Table 1) [14]. Results on table 2 above revealed that water erosion and channel erosion (27 % and 26 % respondents) were the major types of soil erosion dominated the area then tillage erosion perceived with 23 % of the farmers and the remaining 14 % of them described wind erosion as most prevalent in the area. Although, wind erosion in the area was also not glaring as in other farm locations with that however perceived to be most affecting the soil resources in the study area. Generally the effects of wind erosion in the study area occur in two periods; during the onset of rainy season which is more severe where all lands are dry and soil structure and compaction are loose consequence to overgrazing which might ease the detachment of humus and other soil particles and transported for varying distance resulting into onsite and offsite effects. While the second period was at the offset of the rainy season respectively. Reference [17] also reported wind erosion is common in semi-arid areas where strong winds can easily mobilize soil particles, especially during dry spells and estimates of the total amount of dust that is yearly mobilized on land place an upper limit on dust mobilization by wind erosion on arable land at ca. 2Gt yr^{-1}. Approximately 430 million ha of dry lands, which comprise 40 percent of the Earth's surface are susceptible to wind erosion ([22] [23]). Similarly, steep slope was revealed as major cause of soil erosion in Wuro-chekke area by most of the farmers (24 %) .[sadiq and sadiqa et al 2019] in their recent research report it was revealed that, 22 % of the respondents conceded that nature of the slope in the area causes the soil to degraded, because some farmlands in the study area is suited in steeply sloping (20-22 %) ground most especially those along Benue riverine areas. The sloppy nature of the farmland increases the rate of erosion and is the most serious soil loss agent devastating the area. It was reported by [10] in West Africa, soil erosion gulps about 10-21 tons of top soils per ha on nearly gentle slopes of 0.4 - 0.8% and up to 30 - 35 tons on 1-2% slopes respectively. Deforestation received 21 % of the respondents to have cause erosion in Wuro-chekke area due to inadequate or low vegetation cover protecting the soil surface as shown in table 3. Hence, lack of permanent vegetation cover in some locations has resulted in extensive erosion by wind. Moreover, 17 % of the farmers attributed it to heavy rainfall on some farmlands, only 9 % had contributed to soil type. The area was recognized to have affected mainly with gully erosion as perceived with 27 % of the respondents and 26 % of them agreed that rill-gully erosion was more variable on farm lands while sheet-rill and splash-sheet identified to have widely dispersed on farmlands with 14 % and 13 % of the respondents as presented in table 4 respectively. Equally, erodibiliy level of the soil was apprehended by majority of the farmers (28%) as high. This finding is in line with result of [2] explained that erodibility factors of Ohi, Orogwe and Amakohia-Ubi communities were found to be high which is due to the presence of high quantity of sandy soils in these areas. Sandy soils are known to have low cohesive force and therefore are more prone to detachment and transportation by water and wind. Furthermore, high sandy soil content encourages high rate of permeability of water into the soil, which induces landslide and erosion. Moreover, result from table 5 described that 25 % of respondents identified the level as medium while 23 % of the respondents conceived it to very high, 11 % agree to have no erodibilty effects on their farmlands respectively. Planting of vegetative barriers along the erosive zones was majorly adopted by most of the farmers (27 %) in the area as methods of controlling the widely spread gully erosion with high level of erodibility. This practice helps a lot in averting the menace in the area. Plates 3 below described the planting of vegetative plants along the erosion farm site by the farmers to reduce the erosion threats. Water ways is another identified alternative method employed by the farmers (22 %) and 14 % of them adopted sand-stone bags techniques while agroforestry practice was revealed less employed by the farmers (5 %) as presented in table 6.This perhaps is connected to absence of forested land in the area.

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P[ates 3. The use of vegetative plants as barriers to control soil erosion in Wuro-chekke farm location.

6.5 Namtari farm location

The area appears on moderately slopping (8-10%) interposed with shrubs, grasses and tress vegetation dominant by livestock production (cattle and steeps) and arable farming mainly rice, cassava and maize with about 10-45 farming experience (Table 1) [14]. In table, water erosion recorded 29 % of the respondents as major type of soil erosion devastating the nutrient status of the soil which in turn reducing the farm output significantly. Thus, water erosion is considered as the major erosion affecting the soil. The most likely range of global soil erosion by water is 20–30 Gt yr^{-1}. Soil erosion by water induces annual fluxes of 23-42 Mt (megaton) N and 14.6-26.4 Mt P of agricultural land. These nutrient losses need to be replaced [17]. Correspondingly, 26 % of the farmers described tillage erosion as the major type of erosion repositioning the soil particles on their farms. Global estimate made by [17] revealed that tillage erosion may amount to ca. 5 Gt yr^{-1} of soil particles loss of the earth. 21 % of the farmers attributed it to channel erosion and wind erosion recorded less (7 %) of the respondents in the farm location of the study area. Generally, wind erosion was found not be active on triggering soil erosion in Yola and environs due to its low annual average velocity throughout the year with less than 260 km/day compared with some state around the semi-arid region of the country coupled with clayey soil type of the study area as well . According to Reference [2] explained that communities with high clay content have low erodibility factor because of the higher binding and interbinding forces that help in resisting detachability of soil by wind and water. The average annual wind speeds from (2007-2017) of the study area are depicted in figure 3 below.

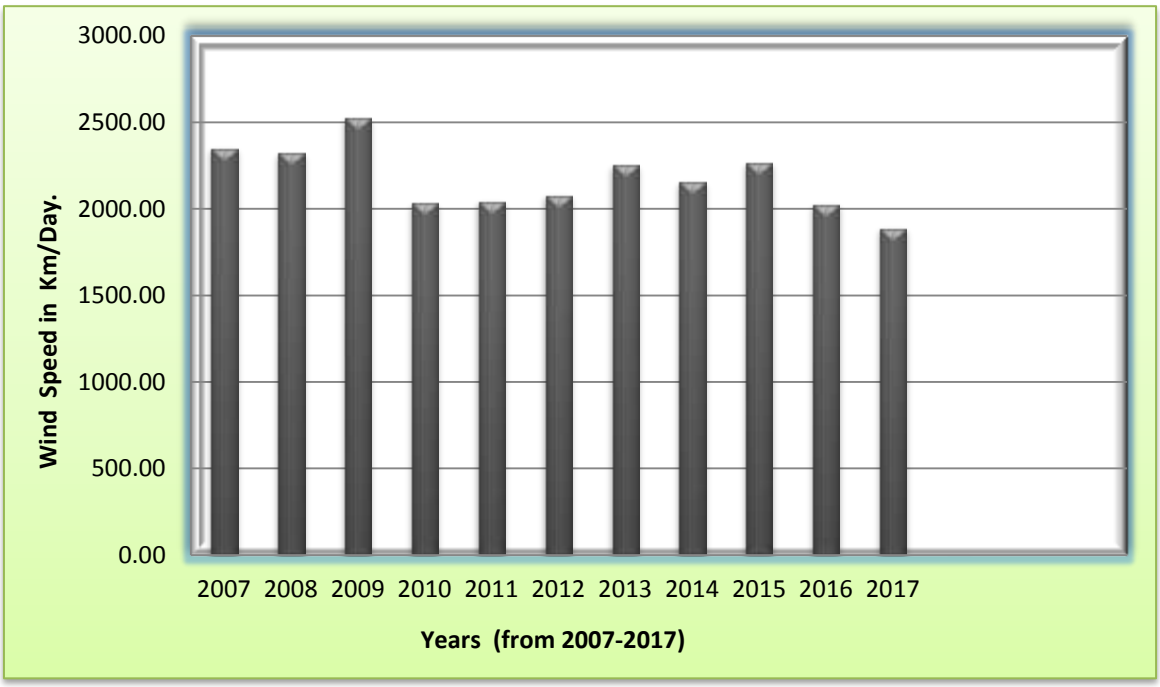

Fig.3. The average annual wind speed for a decade in the study area. Source; [13]

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In addition, Deforestation was the major cause of soil erosion with (20 %) of the respondents (Table 3). This is because the roots of trees and other plants hold the top soil in situ. Therefore, by clearing an area for either agricultural, industrialization or other purposes is exposing the soil more easily to washed away by water or wind leading to soil erosion subsequently to desertification. Reference [24] reported that in 1983, desertification was assessed to affect 90% of Africa's range lands, 80% of rain fed croplands and 30% of irrigated lands, which is indeed awful. Deforestation may lead to soil erosion, loss of soil nutrients, and decrease in transpiration and evaporation losses, which may consequently lead to desert encroachment. Historically, trees are cut down for timber, firewood and for other domestic or agricultural purposes around Mubi area of the state [3]. Thus, Yola is also inclusive. In Yola South LGA, recent report by [15] has shown that soil degradation is quite glaring and felt through deforestation practices which gradually manifest to desert encroachment evidently on the plates 4 below.

Plates 4. Shows gradual development of desertification in Yola South LGA. Adopted from [15]

19 % of the farmers have linked it heavy rainfall while overgrazing received 14 % of the respondents. However, Namtari farm location received considerable responses from the farmers on effects of overgrazing on soil properties than the other farm locations of the study area. This is because majority of the people in the area are Fulani herdsmen coupled with some easily accessible route and less or no conflicting issues between the farmers and the herdsmen compared with other farm locations. This finding is in conformity with what [18] concluded in Mubi area the extensive nature of the production system, nomadic people therefore move their herds in and out of the area in accordance with seasonal changes as a consequence predisposing the soil to loss of organic matter, of texture, structure and compaction which are premises of nutrients availability. Similar report was made by [17] on soil relict in the Jadan basin, Ecuador area where overgrazing led to excessive erosion and the soil has been completely stripped from most of the landscape in less than 200 years, exposing the highly weathered bedrock. Furthermore, soil erosion variability on farmlands was dominantly rill erosion with 23 % of the respondents and rill-gully erosion also received 21 % of the farmers' perception while gully erosion perceived to be variable on farmlands with 19 % of them as shown in table 4 respectively. Result on table 5 revealed that soil erodibility level was medium and high (28 % and 25 % respondents) and 19 % of the farmers perception defined it as very high and remaining 10 % of them had none erodibiity effects on their farmlands. It was also revealed from table 6 contour ridging and mulching practices were the major techniques adopted by the farmers in control the level of erosion in the area with 23 % and 17 % respondents. Similar result was obtained of recent by [14] which show that contour ridging in Namtari area was adopted by 20 % of the farmers as physical techniques of soil and water conservation with the aim of increasing yield per unit area. Also, water ways was practiced with 16 % of the farmers whereas agroforestry was considered less adopted with only 7 % of the respondent respectively

7. CONCLUSION

Soil erosion still remains the major problem to farmers affecting their farmlands thereby causing poor or low production output most especially in the tropical countries particularly in Nigeria. Furthermore, In Yola South LGA, farmers are faced with severe effects of soil erosion on their farmlands which led to eroding of soil surface where the available nutrients to the plants are concentrated. However, many farmers have already made significant progress in dealing with soil erosion problems on their arable farms. Conversely, because of continued advances in soil management and crop production technology that have maintained or

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increased yields in spite of soil erosion, others have not been aware of the increasing problem on farmland on the perspective of its causes, distribution and effective control measures. The study therefore, empirically identified perceptions of farmers on the existing menace on their different farm locations in Yola. It was concluded that the farmers' perceived water and tillage erosions are the main types affecting the soil resources which are connected to heavy rainfall, steepness slope of some farms and deforestation practices in search of marginal land for farming and urbanization. These factors have contributed to the variable distribution of gully and rill erosions with high to very high erodibility level on the arable lands. Control measures are considered to tackle the threat by most of the farmers' adopting different techniques of which contour ridging and vegetative barriers are most common in the area. To realize optimum food production for the growing population in Yola area and beyond, soil resources most be free from eroding effects which can only be achieve through effective understanding on the causes, distribution and suitable control measures to be employed that will sustain and improve the soil resources for profitable farming practices.

8. RECOMMENDATIONS

Based on the research findings from this study, it is therefore recommends the following;

1. Farmers in the study area should be well trained and equipped with modern techniques of erosion control measures by the extension workers and soil scientist
2. Afforestation programs and agroforestry farming should be implemented in all the areas to reduce erosions resulted from deforestation
3. There should be strong linkage between research and other organizations (Government and NGOs) to transfer better experiences and technologies in soil erosion agenda
4. Government should developed a comprehensive erosion control system that will overlook any erosion related problems on different farm locations with the aim of sustaining the inherent soil resources for maximum food production in the area and the state at large.

CONFLICT OF INTEREST STATEMENT

The authors declared no conflict of interest on the research work.

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