An Appraisal of Substantive Soil and Water Conservation Techniques Adopted on Different Farm Locations in Yola South LGA, Adamawa state, Nigeria.

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Abstract

The practice of soil and water conservation techniques by the peasant farmers received considerable attention on increasing food production in the tropic. However, some effective conservation techniques are not or less adopted on most farmlands by majority of the farmers particularly in Yola South LGA. Therefore, this study saddled in appraising substantive soil and water conservation techniques adopted on different farm locations in Yola south LGA, of Adamawa state, Nigeria. The study was quantitative in nature and had adopted survey approach, where five different farm locations (Mbamba, Bole, Namtari, Yolde pate and Wuro-chekke) were purposively selected and administeredrandomly well-defined and structured questionnairesto 30 farmers in each farm location culminating to 150 total respondents respectively. Data obtained were analyzed using descriptive statistics. It was revealed that tillage practices was the most adopted physical conservation techniques by 27 % of the respondents, while animalmanurig received 29 % respondents adopted as biological soil and water conservation techniques on most of the farm locations in the area. Similarly, multiple cropping as cultural techniques revealed to have largely adopted with 30 % of the respondents. From the result obtained. Soil and water conservation techniques were foundo have adopted by the farmers. However, some effective techniques are not or less adoptive by majority of the farmers due to lack of technical skills and knowledge application on other effective techniques. Therefore, farmers in the study area should properly trained on the modern techniques to be adopted on their farmlands by the extension workers and soil scientist for improving and conserving the soil nutrients and water content for optimum food production for the growing population.

Keywords: *Appraisal, Adopted, Conservation Soil, Techniques, Water and Yola South LGA.*

1. Introduction.

In recent years, intensive system of cultural soil conservation techniques have been developed by local farmers most especially those settling around the floodplains in the North central region of Nigeria, which improved their production and sustained the inherent fertility of the soil [1]. Thus, the scenario remains the same in the North-eastern region of the country particularly in Yola South LGA where small scale farmers engaged exhaustively in restoring the soil fertility decline on their farms through adoption of some conservation techniques which includes hillside terracing, organic manure, shifting cultivation, crop rotation, earth contouring, sand bag barriers, stone bunds, vegetative barriers, mulching, cover cropping, mixed cropping and bush fallowing. However, some of these practices appeared ineffective and less adopted on the farmlands in Yola South LGA most especially in recent years. Thus, Food security for an existing population is largely a problem of good soil management on existing cultivated lands and requires increased number of trained manpower (in conservation techniques) besides the capital intensive fertilization [2]. Recently, it was observed by [3]; [4]that intensive cultivation and cropping, coupled with less or no adoption of conservation techniques concerned the farmlands' nutrient status and eventually put most of their production less economical. Technically, it is a known facts that soil fertility degradation is an inevitable phenomenon not a disaster, but it might eventually turned in to disastrous scenario if no proper and timely conservation techniques adopted or employed with the aim of ameliorating the existing nutrients predicaments[5]. Hence, soil conservation techniques become an inevitable practice for restoring soil nutrient from degradation and nutrients lost in Yola South LGA, of Adamawa State.

It is highly imperative therefore, to assess the farmer's ability and level of soil and water conservation techniques adopted on their farmlands for realizing optimum food production for the growing population in the area as well as the region at large. Therefore, this study saddled with the specific objectives of appraising the most adopted techniques of conserving soil and water resources on some difference farm locations by the peasant farmers with the aim of identifying field challenges and providing practical workable suggestion for profitable and sustainable food production in the study area respectively.

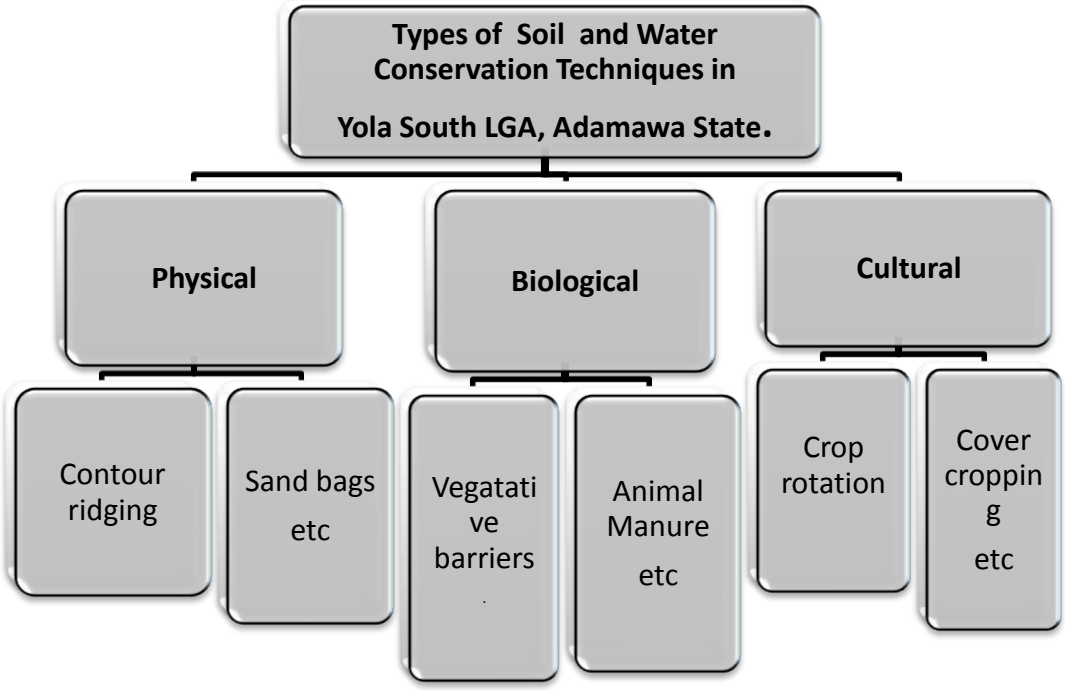

Fig 1. Shows the overview of some types of soil conservation techniques on farmlands adopted by the farmers in Yola South LGA, Adamawa State, (on field observation)

2. Study Area

The 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%. [6].

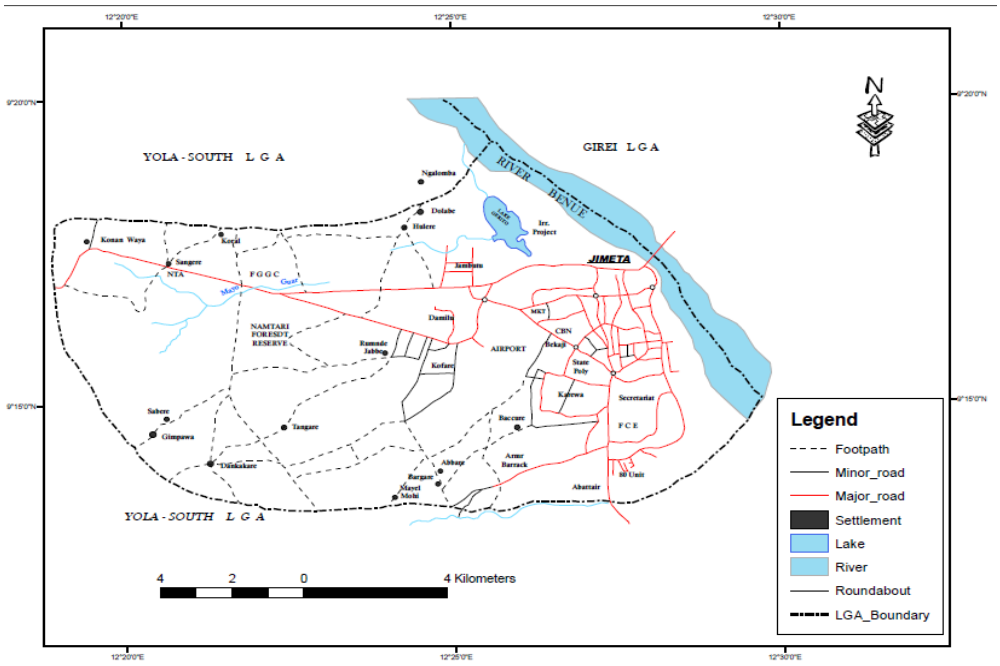

Fig 2.Shows the map of the study area (Adopted from [7])

3. Materials and Method

This study was quantitative in nature which largely based on data collection where total number of 150 sampled farmers who engaged in soil and water conservation practice in the study area were selected randomly as the respondents. The research adopted face-to-face approach using well defined and structured questionnaires that consisted of four parts: field parameters, physical, biological and cultural, soil and water conservation techniquesadopted on farmlands and were randomly administered to the sampled farmers. 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 Discussion

5.1 RESUTLS

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 andOrchards	Tall grasses, trees and shrubs	Maize, groundnut, beans and rice	Rill to gully	Steep
Yoldepate	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****; [8]*

Table 2.Appraisal of Physical Soil and Water Conservation Techniques

TECHNIQUES	Mbamba N= 30 P=(%) 100	Namatri N= 30 P=(%) 100	Bole N= 30 P= (%) 100	Yolde pate N= 30 P=(%) 100	wurochekke N= 30 P=(%) 100
Contour	7 (23)	6 (20)	6 (20)	10 (34)	6 (21)
Hill terracing	3 (10)	6 (21)	8 (27)	3 (11)	4 (12)
Sands	4 (14)	3 (10)	4 (12)	4 (14)	9 (30)
Stone	5 (17)	6 (19)	6 (20)	6 (19)	4 (13)
Tillage	11 (36)	9 (30)	6 (21)	7 (22)	7 (24)
Total N and P (%)	30 (100)	30(100)	30 (100)	30(100)	30 (100)

N= Total respondents in each farm location P= percentage of the responses. Source; [8]

Table 3.Appraisal of Biological Soil and Water Conservation Techniques

TECHNIQUES	Mbamba N= 30 P=(%) 100	Namatri N= 30 P=(%) 100	Bole N= 30 P= (%) 100	Yolde pate N= 30 P=(%) 100	Wurochekke N= 30 P=(%) 100
Use of compost	7 (24)	7 (23)	6 (20)	7 (23)	6 (21)
Vegetative barriers	4 (12)	6 (19)	7 (24)	2 (8)	9 (30)
Cover cropping	5(18)	5 (17)	5 (15)	6 (19)	4 (14)
Agroforestry	3(10)	2 (8)	6 (20)	5 (16)	4 (12)
Animal manure	11 (36)	10 (33)	6 (21)	10 (34)	7 (23)
Total N and P (%)	30 (100)	30(100)	30 (100)	30(100)	30 (100)

N= Total respondents in each farm location P= percentage of the responses.Source;[8]

Table 4.Appraisal of Cultural Soil and Water Conservation Techniques

TECHNIQUES	Mbamba N= 30 P=(%) 100	Namatri N= 30 P=(%) 100	Bole N= 30 P= (%) 100	Yolde pate N= 30 P=(%) 100	wurochekke N= 30 P=(%) 100
Mulching	4 (14)	7 (23)	4 (12)	6 (20)	7(23)
Crop rotation	7 (22)	5 (17)	9 (30)	10 (32)	5(17)
Recycling of crop residues	5 (15)	5(15)	3 (10)	6 (20)	9(31)
Shifting cultivation	3 (11)	2 (8)	2(8)	4 (14)	2(7)
Multiple cropping	11 (38)	11 (37)	12(40)	4 (14)	7 (22)
Total N and P (%)	30 (100)	30(100)	30 (100)	30(100)	30 (100)

*N= Total respondents in each farm location P= percentage of the responses**Source [8]***

5.2 DISCUSSIONS ON INDIVIDUAL FARM LOCATION OF THE STUDY AREA

Results on field parameters and commonly adopted indigenous soil and water conservation techniques on each farmland by the farmers on their farmlands were presented on table 1,2,3 and 4 while the overall result on the techniques adopted were also assessed from the cumulative result on an individual farmland were depicted in Fig 3, 4 and 5 respectively.

5.2.1 Mbamba farm location

The area is located at the eastern part of Yola south LGA characterized by few tall trees and grasses. The farmers engaged dominantly in arable farming where rice and maize been the major crop grown for about 5-35 years conservation experience (Table1). Tillage practices revealed to had common physical soil and water conservation techniques adopted by the farmers in the area (36 %) respondents(Table 2).Contour ridging perceived to be the second techniques mostly adopted by 23 % of them. This might due to type the major crop grown (rice) in the area which requires adequate soil moisture for proper growth and development and also due to the rejuvenated gully erosion which received considerable devastation on farmlands consequence to the steepness of slope in the area. Similarly, for biological soil and conservation techniques, the use of animal manure is largely adopted with 36 % respondents and 24 % of them employed the use of compost manure (Table 3). This might have attributed to high impact perception of organic manures in conserving soil nutrients and improving soil structure so as to retain moisture content of the soil. Thus, organic manures check erosion, leaching of nutrients, evaporation losses and remain longer in soil and releases nutrients slowly making it available to plants ([9],[10], [11]). Also, use of organic fertilizer may go a long way in providing solution to low crop yield as a result of lack of inorganic fertilizers [12].Interns of cultural techniques adopted in table 4, multiple cropping was the common techniques (38 %) of the respondents. Reference

[13] explained that mixed cropping or multiple cropping helps to prevent soil erosion, controls spread of soil-borne plant diseases and pest, improve soil structure and soil fertility. Crop rotation was also adopted by 22 % of them. Shifting cultivation was less adopted (8%) of respondents, might due to the agricultural intensification coupled with limited agricultural land in the area as a result of rapid urbanization on the available marginal farmlands. This finding is in conformity with the conclusion drawn by [14] that the savannahs are less efficient soil fertility regenerators, as it may require between 10 and 20 years of fallow period before its next cultivation. Shifting cultivation is an oldest farming system in existence and is still practiced in some parts of Africa. However, the fallow system can no longer support the ever-increasing population of the Sub-Saharan Africa. Thus, achieving sustainable soil fertility by such systems that can't support the ever increasing human population has made such practices to be highly questionable. Hence, [13] also concluded that this type of farming techniques is only suited to areas of low population density, and where land is abundant. Crop residues are not recycle for restoring soil nutrient in the area as cultural method rather were feed to animals. Similar findings was revealed by [5] that in Mubi region, most farmers usually gather crop residues on their farms and sell them to pastoralists as a source of income without minding its negative implications or even understand the need to recycle such crop residues as sources of soil fertility enrichment on their farmlands.

5.2.2Namtari 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). In the area, tillage practice also revealed to have been the common physical soil and water conservation techniques adopted by most of the farmers (30 %) with the aim of increasing yield per unit area. A similar observation was reported by [15] when he found that the organic carbon of tropical soils decreased less when no tillage practices were used than when the soils were ploughed. While contour ridging and sand bags perceived as less adopted (Table2). This might be due to the moderate to steep nature of the topography with less rill erosion that received less or no effects on their farmlands. For biological techniques adopted were depicted in table 3. The trend remains the same as in Mbamba location where application of animal manure and compost manures were largely adopted by (33 % and 23 %) of the respondents. Thus, animal grazing is predominant in the area while agroforestry received less adopted (8 %) of them. Thus, application of organic matter to the soil ensures good tilt and improves water holding capacity [16]. In addition, multiple cropping still remains the common adopted cultural techniques as shown in table 4 which received 37 % of the respondents followed by mulching 23 % of them respectively.

5.2.3Bole 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). The most adopted techniques for physical soil and water conservation (Table 2) was found to be hill terracing (27%) of the respondents while contour ridging and stone bunds received 20 % each of the respondents. This has attributed to presence of rill to gully erosion which prompted the farmers to mitigate such menace in the area. Moreover, adoption of vegetative barriers as biological techniques was found to be most employed (24 %) of them as depicted in table 3. This technique adopted by the farmers might be as a result of excessive run-off generated from tributaries on river Chochi. Hence, the area is located at the middle course of river chochi where lateral gully erosion was severe due high rate of transportation. However, cover cropping as conservation techniques had less adopted (5%) of the respondents. Agro forestry was adopted by 20 % of them due to the presence of tall trees in the area for sustainable food production. Hence, agroforestry is an important component of farming systems in humid tropics not only in terms of nutrient recycling and soil conservation but also in supplying food and firewood to the small farmers and ensuring overall sustainability of production [17]. Similarly, multiple cropping appeared to be most employed by (40 %) of the respondents among the cultural conservation techniques then followed by crop rotation (32 %) of them respectively (Table 4). This is because both of the techniques have economic yield impact over the other techniques. The less adopted cultural techniques in the area was shifting cultivation (8%) respondents due to unavailability of agricultural caused by rapid urbanization in all axis of the study area. This result is in conformity with the findings of [18] revealed that in Yola South LGA, inadequate land for farming due to rapid urbanization and industrialization prompted farmers in the area to shift in to the floodplains area of river Benue in the study area for farming.

5.2 4 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. Few tress, grasses and shrubs made the vegetation of the area (Table 1). Farmers have in the area largely adopted contour ridging as physical measures of soil and water strategies to ensure optimum and sustainable food production with the idea of catching and retaining the runoff water and allowing it to infiltrate slowly into the soil. (Table 2). Contour ridging are small bunds usually 20-45 cm high built along the contour [14]. Due to lack of hills in the area terracing of hills appeared less employed (11%) of the respondents. For biological conservation measures presented in table 3, application of animal and compost manures (34 % and 23 %) received most

practiced by the farmers in the areas. These had attributed to their glaring economic effects on profitable food production and are simple to adopt. Thus, [19] earlier reported that the application of 5% poultry manure proved more effective in improving the productivity of an Ultisol in Nigeria, than with combination of 120, 30 and 120 kg/ha of N, P and K, respectively. Also [20] earlier reported that poultry manure, compost manure, rice husk and saw dust used as soil amendments at the rate of 5% were more effective than a combination of high doses of N, P, K and Mg fertilizers in improving the productivity of Acrisols in Nigeria. Similarly, crop rotation manifest more employed (32 %) of the respondents followed by mulching and recycling of crop residues 20 % each of the respondents. Conversely, shifting cultivation and multiple cropping were less adopted with 14% each as shown in table 4 respectively.

5.2.5 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). Sand bags revealed to had mostly adopted physical soil and water conservation techniques (30 %) of the respondents (table 2). This practiced was adopted to reduce the layering of deposited materials (sandy loams, levees etc) on farmlands and to reduce the rate of water run-off out of the farms. Similarly, tillage practices received 24 % of them to conserved soil and water as physical measures. Thus, the purpose of tillage is to create a soil environment favourable to plant growth. [14]. Biological conservation techniques were also adopted in the area, where planting of vegetative barriers along farmlands boarder was dominantly employed by 30 % of the respondents with the aim of controlling and reducing rate of water run-off and soil lost on the farm lands. 23 % of them agreed to have mostly adopted the use of animal manure to enhance maximum yield (Table 3). Culturally, majority of the farmers in the area (31 %) had adopted crop residues recycling techniques as a means of conserving soil and water on their farmlands then followed by mulching practices (23 %) of them (Table 4). The farmers' attitude on selling crop residues o the herdsmen is less due to absence of pastoral animals compared with the other farm locations in the study area.

5.3. GENERAL RESUTLTS AND DISCUSSIONSON THE STUDY AREA

From the result presented and discussed on an individual farm location in Yola South LGA, of Adamawa state. The cumulative result revealed that, tillage practices was found to be the most commonly physical soil and water conservation techniques adopted by the farmers with 27 % of the respondents out of 150 total respondents' Fig 2). This is to improve the soil compaction which aids aeration rate and moisture retention capacity. Reference [21] have reported that tillage operations may loosen, granulate, crush or even compact the soil, certain soil factors which influence plant growth such as bulk density, pore size distribution and the composition of soil air are generally influenced. Conversely, intensive tillage has been reported to lead to rapid oxidation of SOM especially in the tropics [22]. Therefore, excessive and intensive tillage may lead to severe loose in soil structure and endanger SOM, minimum tillage not exceeding plough layer(15 cm) is recommended for the less compacted soils in the tropics. Contour ridging appeared the second most adopted techniques with 35 respondents out of 150 (23 %) respondents. However, contour ridging helps to slow down the movement of water over the soil and is more effective when the land is newly cultivated as recommends by [14], but conversely it has the disadvantage of ridges breaking down which might leads to collapsing of the whole system resulting in to severe erosion damage on the farmlands. Therefore, it should not be adopted over a long period of time due to it ineffectiveness over time.

For biological soil and water conservation techniques animal manure had largely adopted by most of the farmers (29 %) of them then followed with the use of compost manures as depicted in Fig 3. According [23] observed that animal manure is a source of all plant nutrients including nitrogen, calcium, magnesium, potassium and sodium. However, despite the failing or higher quality of animal manures, they still compared favourably with compound fertilizer in terms of grains yield. They can be used as an alternative to the expensive chemical fertilizers [24]. Incorporation of crop residues and animal manures will improve the OM content of soils effectively ([25], [26], [27]).In Sub-Saharan Africa, it has been reported that the majority of soil fertility indicators were significantly higher in soils that received organic manure than in soils that did not [28]. The results confirmed that organic manure improves soil fertility. However, the extent to which manure can enhance soil nutrient content and soil physical properties depends on the source and quantity of organic matter added. Organic manure incorporation is an intensive practice that is commonly done under continuous cultivation on farmlands around homes and market places [14]. Thus, most of the farm locations in Yola South were around the homes due to urbanization trends.While agroforestry appeared less adopted with 13 % of them. However, despite the fact that agroforestry is partly achieved by the nutrients that are 'pumped up' from the deeper soil horizons [29], still received less attention in almost all of the farm locations in the study area, which is inflicted to lack of forested land in the area consequence to excessive deforestation with zero afforestation practices. Deforestation activities in the study area over the years are now triggering desert encroachment and extensive erosion. In recent research conducted by [30]in Yola South LGA, of Adamawa state have shown that 21% of the respondents assessed deforestation as the main factor of soil

degradation in the area, where trees (leaves, litters which decomposed in purification process of

organic matter in nitrogen cycle are indiscriminately cut down as fuel wood for cooking and economic purposes subsequently subjecting the area in to desert encroachment zone .Thus, in Nigeria desertification is fast becoming a threat in the northern parts especially the states in the Sahel and Sudansavannah areas [31].Similarly, [32] 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.

Cultural soil and water conservation techniques in Yola South was glaring on farmlands, where multiple cropping was found to be dominant (30 %) of them, crop rotation received 24 % while shifting cultivation was not or less employed (8%)which was 13 respondents out of 150 total respondents as depicted in Fig 4. Crop residues recycling techniques received 19 % respondents (28 out of 150 respondents). It was revealed that in an interacting session with the farmers in the study area, the amount of crop residues after each harvest are extensively and immediately utilized for many purposes such as fencing, housing, fodder (hay), and fueling (fire wood) at the expense of soil surface coverage. Reference [33] mentioned that the role of crop residues in maintaining SOM under tropical and sub-tropical soil conditions needs no emphasis. The nutrient potentials of cereals were estimated to be 0.7, 0.8, and 2.1 million tons of N, P2O5 and K_2O, respectively. Farmers are advised to conserve these manure resources and suggest proper methods of utilizing crop residues [33]. Therefore, understanding the pivotal role of crop residues in soil improvement by the extension workers to the peasant farmers in Yola South LGA, area is indeed crucial.

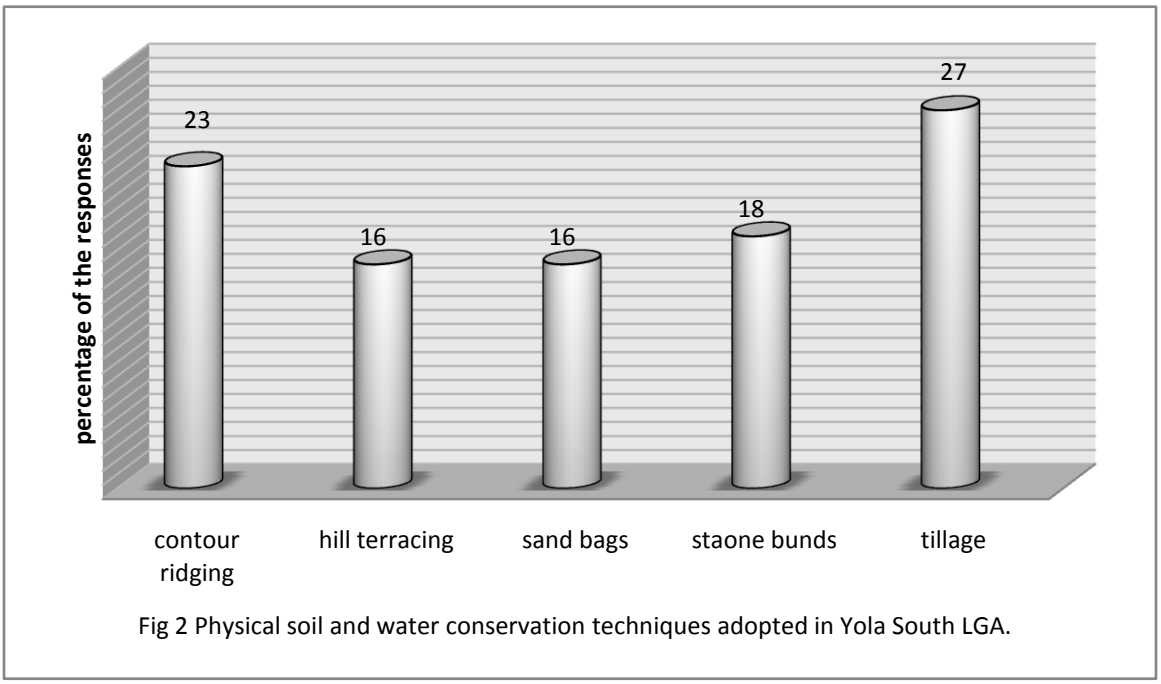

Fig 2 Physical soil and water conservation techniques adopted in Yola South LGA.

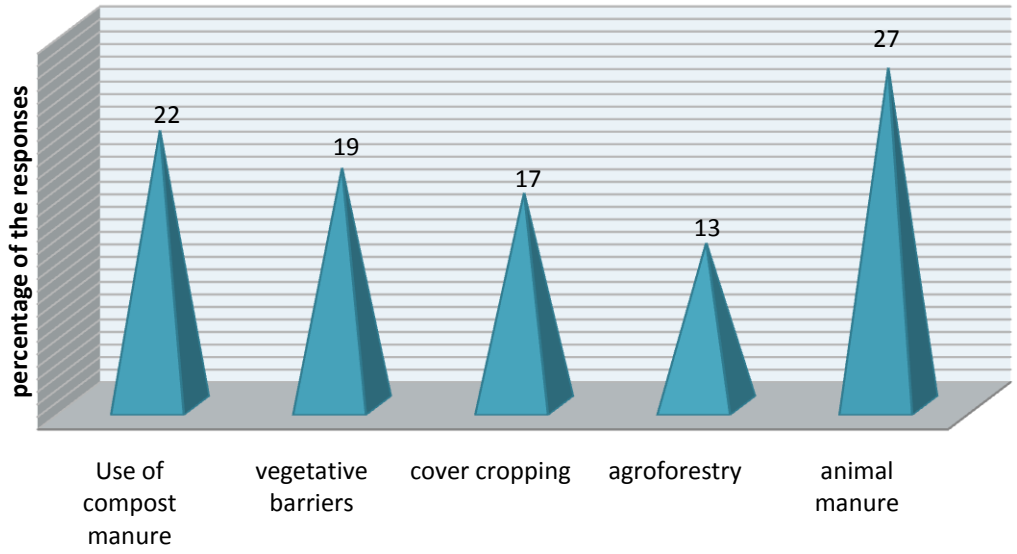

Fig 3.Bioloical soil and water conservation techniques adopted in Yola South LGA.

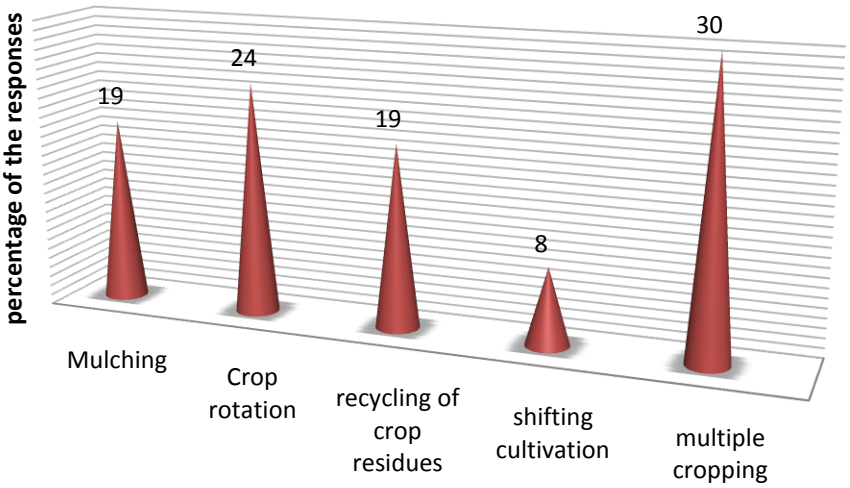

Fig 4. Cultural soil and water conservation techniques adopted in Yola South LGA.

6. Conclusion

Soil and water conservation techniques remains an evitable practices adopted by the farmers in the area for sustainable food production. Even though such practices are now receiving less priority and seen as primitive techniques on arable farmlands most especially on most farm locations in Yola south. The findings from this study revealedthat tillage practice, animal manuring and multiple cropping were the most physical, biological and cultural techniques adopted in the study area.This have attributed to glaring economic effects of such techniques, requires less labourand easier to adopt. However, among the less employed techniques by the farmers were hill terracing and sand bags, agroforestry and shifting

cultivation.Thus, might be consequence to absence of adequate forested land and limited agricultural land due to rapid urbanization on the marginal land in all axes of the study area. To ensure effective soil and water conservation techniques in the area, it is therefore recommends that, the less adopted techniques which are highly effective together with the new modern techniques should be incorporated on farmers through practical training, encouraging and educating the farmers to adopt them by the soil scientist and extension agents for profitable farming in the area.

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