Assessment of Farmers' Soil Management Practices in Guinea Savannah Agro- Ecological Zone of Nigeria

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Abstract **– The study assessed farmers' soil management practices in Karu LGA of Nasarawa State. A total of 112 questionnaires were distributed to farmers' in the study area to ascertain the prevailing soil management practices and crop yields in the study area. The study reveals that most of the farmers' in the study area practice tillage soil management practice (107) and zero tillage (102), compost (55) and mono cropping (9) are the least soil management practices in the study area, the correlation analysis shows a positive and significant relationship between crop yield ($r = 0.905$; $p \leq 0.05$) and farmers' soil management practice. The study therefore, recommends that farmers' should practice retention of crop residues on the farms especially with respect to guinea corn and maize cropping, also more natural vegetation should be encouraged where trees like Faidherbia albida (apple ring accaia) an ideal agroforestry specie that can grow among field crops without shading them during the wet season can be planted.**

Keywords**: Farmers', Soil, Management, Karu**

I. INTRODUCTION

Soil management concerns all operations, practices and treatments used to protect soil and enhance its performance (Oloyede, Muhammed, Ayinde and Omotesho, 2015). They are practices that affect soil quality which includes controlling traffic on soil surface, the use of cover crop and crop rotation, nutrient management and conservation tillage. The goal of soil management is to protect soil and enhance its performance, to farm profitably and preserve environmental quality for decades to come.

This implies, the management of agricultural soils would maintain the soils productivity in an ecologically, economically and culturally sustainable system of soil management. Bationo, Das, and Krenzer, (2004) regarded the strategy that helps low resource farmers mitigate many problems and the characteristics of poverty and food insecurity by improving the quantity and quality of food, income and resilience of soil productive capacity as Integrated Soil Fertility Management (ISFM). This is said to involve the utilization of available organic and inorganic sources of plant nutrients in an efficient manner to improve on nutrient use efficiency by the growing crops.

According to Adeyemo, Oladoja, Famakinwa, and Alabi, (2017), the main issue in the Nigerian agriculture is that of low productivity. The greatest threat to sustaining agricultural productivity in the Nigerian farming communities is the declining productivity of soil caused by the loss of soil fertility through the erosion of top-soil brought about by inappropriate land use practices and the loss of soil water content, soil structure and porosity due to persistent laterisation of the top soil as a result of continuous exposure to sun by man and animals (Alemayehu, Amede, Bohme and Peters, 2013).

This transformation of natural resource not only brings the affected land under nature's degradation regime but also accelerates the process. Inherent poor fertility of the soil and low use of organic and inorganic fertilizers have been identified as some of the greatest constraints to increasing agricultural productivity in Nigeria. Also with the population growth, demand for land has increased resulting in intense cultivation with little or no fallow periods and the reliance on continuous cropping rather than conservation cropping systems (Assefa & Hans-Rudolf, 2016).

Human activities have either direct or indirect effects on the sustainability of natural resources like land, thereby threatening its continuous productivity (Tesfaye, 2017). This consequently, affects agricultural production. Also, ever increasing population in the developing countries which result in continually rising of demand for agricultural produce is contributing to the intensification of land use and adoption of technologies that would enhance constant supply of agricultural produce (Onwudike, Uzoho, Ihem, Ahukaemere, Nkwopara, Irokwe, and Echeanyanwu, 2016). Attempt by man to meet his food, wood and other resources requirements have destroyed the biodiversity and in order to expand agriculture and forestry, over cropping of some crops has resulted more often, to adoption of appropriate technologies and farm practices which further worsen sustainable land use among farmers (Mauricio, Cassio, and Douglas, *2017*). Loss of biodiversity, climate change and land degradation due to population pressure in developing countries, poverty and poor performance of extensive agriculture are such factors that make farmers to have problems in sustainable production activities (Hossen, Mozumder, and Islam, 2013). Soil is therefore managed in order to conserve agricultural land, biodiversity and food security for the country. Sustaining soil fertility and food security cannot be separated. In addition, it is sometimes noted that some farmers have little or no

knowledge about soil management, hence they abandon certain farmland when found unproductive due to some factors which can be controlled provided they are well equipped with knowledge on soil fertility.

Land sustainability is very vital to farmers' means of sustenance that any constraint to land use is affecting subsistence farmers in many ways as observed by Akpoka (2004) cited in Raufu and Adetunji (2012) that subsistent farmers are faced with a lot of constraints for integrating different farm management practices as well, this has affected the sustainability of crop yields. Kong (2014) and Global Environmental Facility (GEF, 2016) however, attributed these constraints to many factors which include insufficient capital, poverty, lack of knowledge or confidence to make a change, lack of financial incentives, land tenure dichotomy, labour constraint and poor infrastructures, low educational level of farmers, limited knowledge of inputs, poor fertility status of soil and unsustainability of some practices. The understanding of these constraints would boost farmers' morale to involve in applying different farm management practices in areas of inadequacy that need improvement in order to sustain crop productions.

Breman, (2008) opined that if some of the currently used soil management practices are continued, groundwater and food contamination will increase and jeopardize the sustainability of the current land use systems. Sustaining soil fertility has become a major issue for agricultural research and development in rural areas of Africa (Mapfumo, Campbell, Mpepereki, and Mafongoya, 2001). Sustaining soil fertility is an essential component in achieving food and livelihood security for the present and future generations (Abebe, Eyasu, and Gezaghegn, 2017).

In the past, most research efforts focused on trials to determine the appropriate amount and types of fertilizers needed to obtain the best yields for particular soil types and specific agro-ecological locations (Bello, 2008). This approach emphasized the use of external inputs and expensive technologies, and often disregarded farmers' knowledge and the resources at their disposal. Since then, research has gradually shifted towards an approach based on Integrated Soil Fertility Management (ISFM), which combines various existing soil fertility management techniques with external inputs. This combination is based on a thorough scientific understanding of the underlying biological processes of ISFM and aims to promote options that make the best of locally available inputs, and that are tailored to suit local agro-ecological conditions, and farmers' resources and interests (Teklu, 2011).

Thus, to achieve sustainable crop production and future food security in Karu in particular, a good knowledge of farmers' soil management practices is needed. Therefore, this study assesses farmers' soil management practices in Karu LGA of Nasararwa State, Nigeria with a view to establish the factors influencing the farmers choice of different farm management practices that facilitate sustainable crop production in the study area.

II. MATERIAL AND METHODS

Karu Local Government Area is located within latitude a latitude 8° 59' 46''N and longitude 7° 34' 32'' E and longitude 9^0 25' N and 8^0 00'E. Karu Local Government Area is one of the local Government areas of Nasarawa State Nigeria. It shares its western boundary with the Federal Capital Territory of Nigeria, its eastern boundary with Keffi Local Government of Nasarawa State, its southern boundary with Nasarawa Local Government Area and its northern boundary with Kaduna State. It has approximately land cover of 2,640km^2. Karu L.G.A has its headquarters in new Karu town. The L.G.A is made up of two development area which are Panda and Karshi Development Area and various settlements.

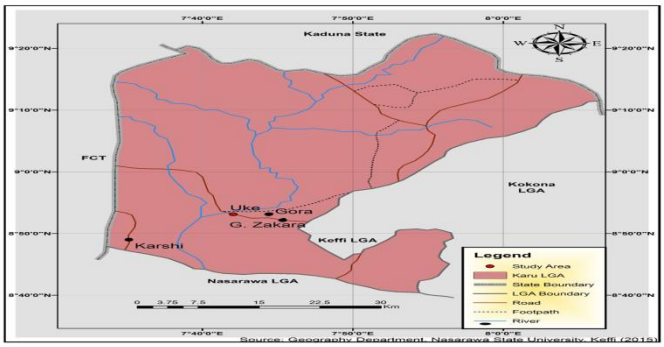

Figure 1: Map of Karu Showing Study Area

Karu Local Government Area of Nasarawa state like other parts of Northern Nigeria has climate that correlates with that of savanna belt. It is under the influence of inter-tropical convergence zone (ITCZ). The area has a distinct wet and dry season. The wet season starts from about the beginning of May and ends in October and the dry season is experienced between November and April. Annual rainfall ranges from about 1100mm to about 1200mm (Bimbol, 2007). About 90% of the rain falls between May and September. The temperature is generally high during the day particularly between the months of March and April. The mean monthly temperature is in the range of 20^0C to 34^0C with the hottest month being March and April and the coolest month being December and January (Bimbol, 2007).

The vegetation on the hilly parts of the area are composed mainly of grasses and isolated trees. Trees of economic value including locust beans (Parkia biglobosa), Shea butter (Vitellaria paradoxa), Neem (Azadirachta indica), Mango (Mangifera indica), Citrus (Citrus X sinensis) and Banana (Musa acuminaia), are scattered across the area, particularly in the lowland areas and the southern part of the study area. (Aboki, Mailafiya and Osaba, 2007).

The geology of the study area is made up basement complex rocks cover about 70% of the total superficial area of the state while the remaining 30% is made up of sedimentary rocks of the middle Benue trough. The younger granites intrude the basement complex and therefore do not occupy any separate landmass of their own. Of the basement complex, migmatite –geisses along with the older granites account for about 70% while rocks of the schistose lithology and other metasedimentary series amount for the remaining 30% (schist, quartzite, marble, ironstone). (Obaje, Lar, Nzegbuna, Moumouni, Chaanda, and Goki, 2007).

The area lies between 300-100 meters above the sea level except the hilly areas of Kajari and Gitata whose elevation reached 2154 meters in Kajari and 2760 meters in Gitata respectively. The Uke River is another major river in the state that flows through the northwestern corner of Karu hills to the southwest Kugwaru forest. The river takes it source from the North-Central Highlands and flows through towns like Panda and Nasarawa Benue east of Umaish. Its major tributaries are rivers Ado, Obi and Antau (Samaila and Bimbol, 2007).

Two stage sampling techniques were adopted for the selection of respondents in the study area. The study area comprises of six (6) management practices in the study area. However, only six of these sites were functional. Purposively, the six (6) functional sites were selected. The total number of registered farmers in each of the sites was 560. Proportionate sampling procedure was used to select 20% of the farmers that are practicing the prevailing soil management practices in the study area to get a total of 112 farmers for sampled of the study. Quantitative data were collected using well-structured and validated interview schedule.

III. RESULTS AND DISCUSSION

Prevailing Soil Management Practices and Socio-Economic Factors in Study Area

The results in figure 2: show majority (93%) of the respondents were male with (7%) female. The findings showed that male dominate arable crop production in the study area. This is expected because traditionally, farming work is known to be male gender specific due to drudgery and risk involved in it.

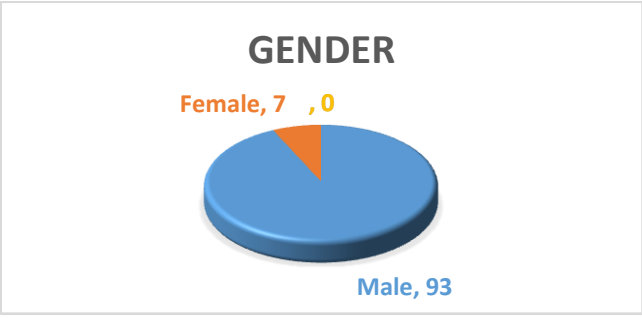

Figure 2: Gender Distribution of Respondent in the Study Area

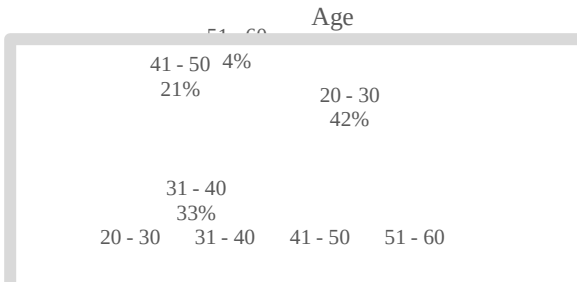

Figure 3: Age Distribution among the Respondents in the Study Area

Also, figure 3: revealed that about two-thirds (61.2%) were within the age bracket of 20-40 years with the mean age of 37.5 years. This implies that majority of the respondents were in their active and productive age during which, they could withstand the rigor required for farming operations. This implies that both young and old farmers have higher probability for adopting the farm management practices in the region. This is probably due to the benefits accrued from these management practices. Muhammad, Kemi, Olabisi, and Dayo. (2014) observed that there were both positive and negative correlation between age of farmers and adoption of conservation farming practices.

This result is in line with the findings of (Oladoja, Akinbile, Adisa, and Akinsanya 2006), and (Jibowo, 2006) who both asserted that people in their active ages tend to perform their tasks effectively and efficiently as they endure the stress and rigors of exerting and fatigue laden work. The ecological implication is that the respondents had potential to adopt and utilize new methods of soil management practices which are sustainable as they were expected to be less risk averted.

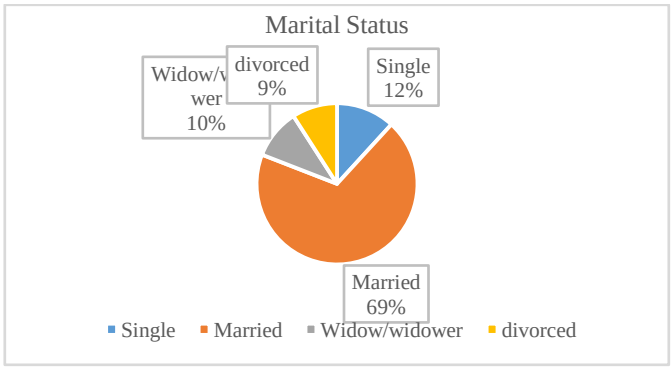

Figure 4: Marital Status of Respondents in the Study Area

The result in figure 4: shows that majority (69.1%) were married. This implies that married people were more involved in farming in the study area. This could be since this category of people have more responsibilities than the unmarried, so the need to involve in income generating activities becomes necessary to meet up with the challenges of meeting the family needs. Adeyomo, *et al* (2017) observed the same trend in their studies in Ogun State (79.1%).

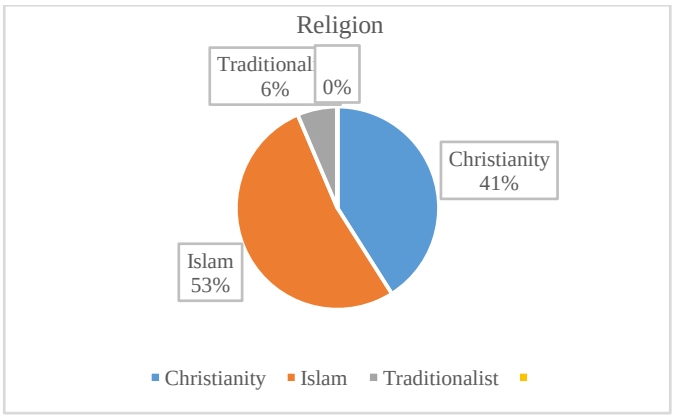

Figure 5: Religion Distribution among the Respondents in the Study Area

The result in figure 5 shows that majority (53%) were Muslims, (41%) were Christians and only very few (6%) were traditional worshipers. This implies that Christianity and Islam were the dominant religions in the study area.

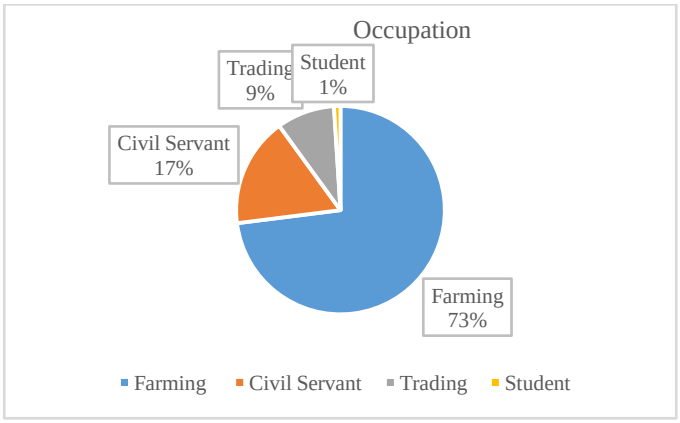

Figure 6: Occupation of Respondents in the Study Area

The result in figure 6 shows that (73%) had farming as their sole occupation while few (16%) were civil servants who also engaged in farming. The findings were in agreement with (Akinsaya, 2011) assertions that farming is the major occupation among the rural people.

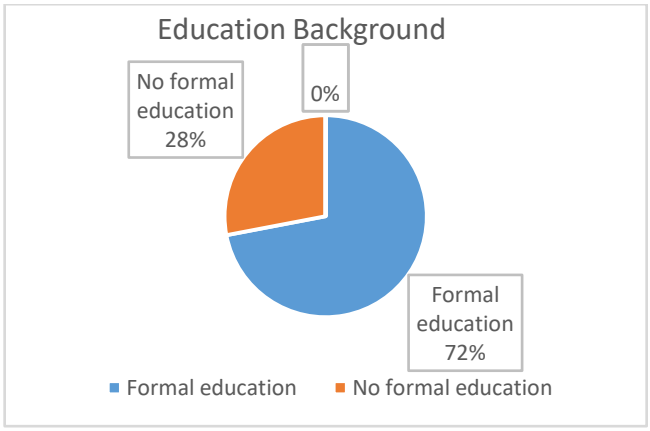

Figure 7: Education Background of the Respondents in the Study Area

The result in figure 7: shows that majority (72%) of the respondents had attained one form of formal education or the other while about (28%) had no formal education. This implies that majority of them were literate which could assist them to be more enlightened in utilization of innovations than illiterates. This result, however, is in agreement with the findings of (Adeyomo, *et al*, 2017, Jibowo, 2006, and (Brunello, 2004) who submitted that education and training improve the skill, attitude and knowledge of an individual thus sharpening their ability to comprehend and apply innovations with ease. Therefore, since majority of the respondents were educated, it is expected that they perform and operate more effectively, efficiently and know more about natural resources and environmental sustainability than those who had no formal education.

The result in figure 8: shows that about (60%) had farming experience of 11-15 years with the mean farming experience of 13 years. This means that majority of the respondents were experienced farmers, and this could influence their utilization of sustainable soil management practices.

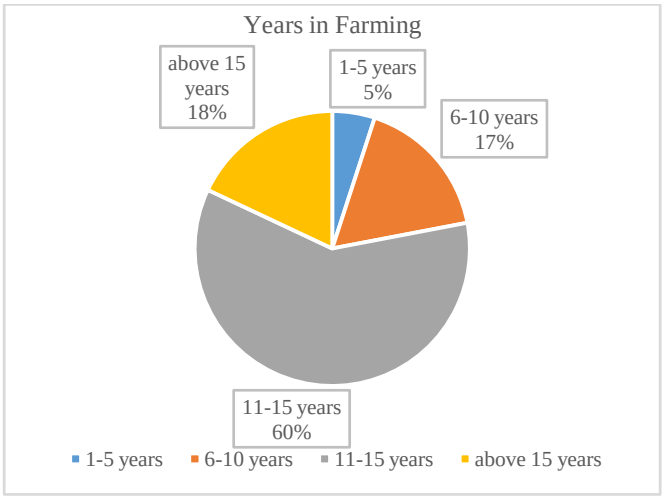

Figure 8: Farmer's experience in farming

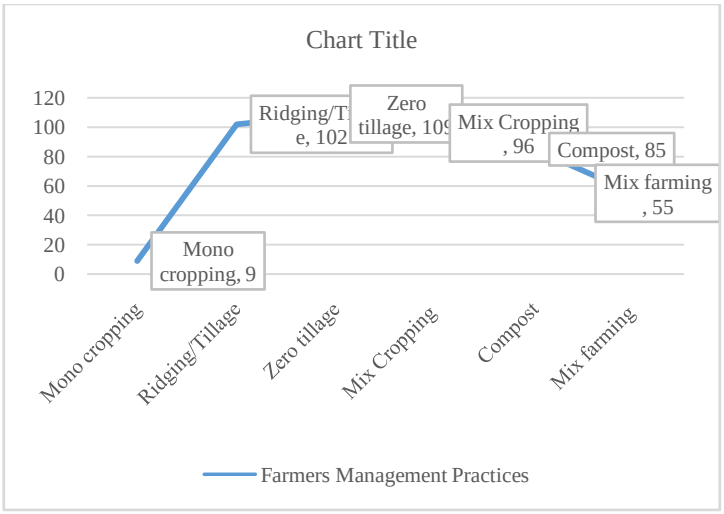

Figure 9: Farmer's Soil Management Practices

The result in figure 9: shows that (107) respondents practice zero tillage in the study area, the farmers' adopt the practice of zero tillage to reduce soil erosion in their farms, (Tillage 102), Mix cropping (96) the farmers adopt mix cropping in other to increase variety of crop grown and most have gone for the option of growing of cover crops to reduce the rate of run off in the farms. Babalola and Olayemi (2013) reported similar study that revealed high adoption of mixed cropping and minimum tillage/mulching in Ogun State, Nigeria. The high adoption rate of these practices were attributed to simplicity, moderate cost and effective stabilization of soil fertility. Compost (85) Mix farming (55), and Mono Cropping (9) were identified as the prevailing soil fertility management practices in the study area. On the other hand, mix farming and mono cropping (8.2%) were not popular in the study area. The respondents adopts multiple soil management practices since their farms are not large and have multiple farm land in the study area

This result is line with the report of (adeyemo, *et al*, 2017, Oloyede, Muhammad-Lawal, Ayinde, and, Omotesho, 2014) who identified ridging, tillage, mix cropping, zero tillage and compost as the sustainable soil management practices in their studies but contrary to the reports of (Adekunmi, Oyeyinka and Yusuf, 2014) and (Abera, 2004), which established compost, animal droppings and mixed cropping as the major sustainable soil management practiced among the farmers in the study area.

Relationship between Soil Management Practices and Crop Yield in the Study Area

The result in figure 10: shows farmers' yield based on the utilization of sustainable soil management practices in the study area, mix cropping recorded the highest (253.9 tons) crop yield despite being the third most utilized soil management, this is due to practicing of more than one crop in the soil, this was followed by zero tillage (180 tons), tillage (176.6 tons), compost (175 tons), mix farming (100.2 tons), and mono cropping (20 tons).

This result implies that the use of soil fertility management brings about increase in soil quality status in the study area, which in turn brings about high crop yields. This corroborates the findings of (Cooke, 1982), (Tarawali, 1998), (Edeoghon, 2008), and (Amanze, Eze, Eze, and Chidozie, 2010) which claimed that the use of soil fertility management like mix cropping, mix farming, compost, zero tillage, and organic manures increased soil fertility and farming productivity (crop yield).

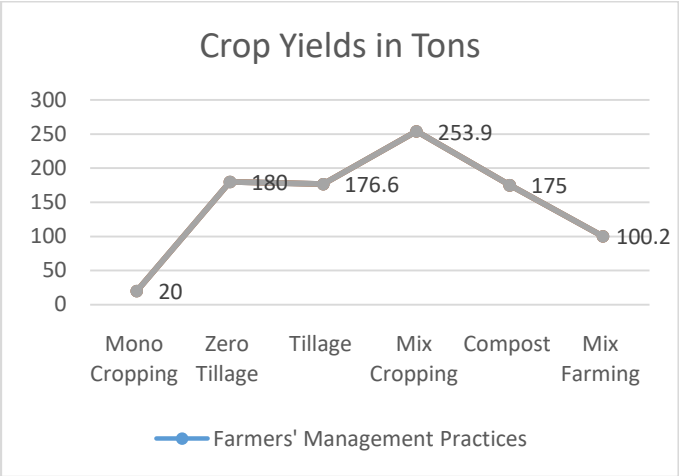

Figure 10 Crop Yields in the Study Area

The results shows that soil fertility management like tillage, zero tillage/ridging, mix cropping and mix farming were highly utilised by the respondents.

This may be since these soil fertility management helps to conserve soil water, control soil erosion, and enrich soil nutrients by the decay of crop residue and leaves (Olaitan, and Omomia, 2006).

The use of zero tillage mitigates soil against the release of CO_2 and N_2O caused by intensive tillage and burning and reduces destruction of soil structure (Dimelu, Ogbonna and Enwelu, 2013). On the other hand, mono cropping, was least utitilised by the arable crop farmers.

The use of mono cropping and mix farming ranked low probably because of greater dependency on the use of fertilizer and inadequacy of arable land for farmers. The result agrees with the finding of (Dimelu, *et al*,. 2013), that established that zero tillage, tillage/rigging, mix cropping, and mix compost were the most preferred and utilized soil conservative practices among arable crop farmers in Enugu State.

The result was also in colaboration with the reports of (Schoomaker-Freudenberger, 1994), and (Edeoghon, et al, 2008) assertion that the use of compost and mix farming were the least used soil fertility management among farmers. This could be due to their irritating odour, tediousness of preparation, bulkiness, and high cost of application.

Table 2: Results of Correlation Analysis of the Relationship between Crop Yield and Farmers' Utilization of Sustainable Soil Management Practices

Variable	Correlation coefficient (r)	p-value
Yield	0.905*	0.013

*correlation significant at 0.05 level of significance.

Source: Field survey, 2020.

The results in table 2: shows that there was a positive and significant relationship between crop yield ($r = 0.905$; $p \leq 0.05$) and farmers' utilisation of sustainable soil management

practices. The implication of this is that the higher the use of sustainable soil management practices among farmers the higher the crop yield. The results does not corroborates the findings of (Cooke, 1982), (Edeoghon, *et al*, 2008), and (Amanze, *et al*,. 2010) assertions' that farmers use fertilizers which is one of the major SMPs to boost soil productivity with the aim of increasing arable crop production.

IV. CONCLUSION

Current information on farmers' soil management practices is needed to develop appropriate integrated nutrient management packages for sustainable crop production within the area**.** Consequent upon the above results, the research also discovered some fundamental aspects associated with soil fertility management strategies across the study area. The study revealed that zero tillage is the most soil management practice in the study area with 107 of the respondent adopting this sustainable fertility management practice, followed by ridging/tillage 102 respondents, mix farming and mono cropping were the least soil fertility management practice in the study area, with a response of 55 and 9 respectively. The studies further revealed that 51% of the respondents rate their yield obtained from their crops as average and low while 49% rated theirs as very high and high. The result showed that there was a positive and significant relationship between crop yield ($r= 0.905$; $p \leq 0.05$). The study therefore, recommends that farmers' should practice retention of crop residue on the farms especially with respect to guinea corn and maize cropping. Also more natural vegetation should be encouraged where trees like Faidherbia albida (apple ring accaia) an ideal agroforestry specie that can grow among field crops without shading them during the wet season can be planted.

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