



SOKOTO

JOURNAL OF GEOGRAPHY AND THE ENVIRONMENT (SJGE)

ISSN: 2705-3180

**A PUBLICATION OF THE DEPARTMENT OF GEOGRAPHY
USMANU DANFODIYO UNIVERSITY, SOKOTO**

Volume 2 December, 2020

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Two issues are published per year, in June and December by the Department of Geography, Usmanu Danfodiyo University, Sokoto, Nigeria. Annual subscriptions (2019): Nigeria ₦4,000 (individual); ₦7,000 (institution) including postage. The rest of Africa, and the World US \$35 (individual), US \$75 (institution). Single issue, Nigeria: ₦ 3,000 (individual), ₦5,000 (institution); rest of Africa and the World US \$50. For advertisement and other marketing details contact:

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PERCEPTION OF SOIL FERTILITY FOR AGRICULTURAL SUSTAINABILITY AMONG PEASANT FARMERS IN ASA LOCAL GOVERNMENT AREA, KWARA STATE NIGERIA

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Abstract

The inability of farmers to follow through with appropriate soil fertility management can affect agricultural sustainability in the area which will in turn lead to food shortage. The importance of indigenous knowledge has been realized in the design and implementation of sustainable development projects; however, little has been done to incorporate this into formal soil fertility management strategies. The study was carried out to analyze the perception of soil fertility for agricultural sustainability among peasant farmers in Asa local government area of Kwara State Nigeria. The specific objectives were to (1) determine the socio-economic characteristics of farmers in the study area; (2) identify farmers' indicators for soil fertility decline in the study area; (3) identify the indigenous knowledge system for soil fertility management employed by the farmers; (4) assess the impact of the application of indigenous knowledge system on farmers yield and agricultural sustainability; and (5) examine the constraints to the use of indigenous knowledge system for soil fertility management. A multi-stage sampling technique was used to select 85 farmers for the study. Descriptive statistics were used to describe socioeconomic and institutional characteristics, indicators for fertility decline and management practices employed by the farmers. Logit regression analysis was employed to analyze the socio-economic characteristics influencing the adoption of indigenous knowledge system for soil fertility management. The result revealed that 58.8 % of the farmers are between the ages of 50-60 years which implies that most farmers in the study area are still in their economically active age. Mixed cropping, application of organic manure, supplementation of organic fertilizer with inorganic fertilizers and crop residues were the frequently used indigenous methods of maintaining soil fertility in the study area. The impact of indigenous knowledge system for soil fertility management on the farmers' yield was statistically significant at 1% level of probability. The result further reveals that there were various constraints that prevent farmers from practicing indigenous knowledge systems for soil fertility management. The study recommends that for Indigenous knowledge system in soil fertility management to be preserved and transmitted to the younger generation, it must be practiced and be included in the education system as well as legislative policy that can help to integrate into current social system.

Keywords: Perception, Soil, Fertility, Agricultural sustainability, Peasant farmers, Indigenous Knowledge

Introduction

Provision of adequate food supply to satisfy the needs of its whole population has always been one pressing goal of every country's government. In Nigeria, one of the reasons for the failure of agricultural plans is underestimating the importance of soil status and therefore mismanagement of the nation's soil. The state of the soil of this is measured using the rate of productivity and can be classified into five different classes; very high productivity, high

productivity, medium productivity, low productivity and very low productivity. Under improved farming systems, the soil productivity could be improved (Luka and Yahaya, 2012)

The inability of farmers to follow through with appropriate soil fertility management in Asa Local Government Area can affect agricultural sustainability in the area which will in turn lead to food shortage. From previous studies of Ajibade (2002; 2008), it has been discovered that soil erosion is a major and perennial factor that affects the fertility of the soil in the study area. This has over the years resulted in a sharp decline in agricultural production in the area. If this trend continues unchecked, agricultural sustainability in the study area may become endangered. If this happens, it will not only affect the study area but also the catchment areas especially where the farm produce is supplied to. Barrera-Bassols et al., (2009) as cited in Buthelezi et al., (2013) emphasize the importance and relevance of soil information in land use planning and land management. It is, however, evident that rural communities' local knowledge about land, in terms of soil and land characteristics, still remains largely unknown to the scientific community (Ingram, 2008 as cited in Buthelezi et al., 2013). The importance of indigenous knowledge has been realized in the design and implementation of sustainable development projects; however, little has been done to incorporate this into formal soil fertility management strategies (Ajibade, 2008).

Indigenous knowledge needs to be recorded and can be of good use to devise innovative research for agricultural researchers, extension workers, development practitioners, and environmentalists for sustainable agriculture development and management of soil fertility. Understanding Indigenous Knowledge in agriculture helps to ensure that farming practices will not cause so much plant genetic erosion and environmental erosion. In fact, it should cater for sustainable food security and conservation of the variety and variability of animals, plants and very vital soil properties such as physical, biological and chemical properties. Soil fertility management depends on human beings and their interaction with the environment which is very much related to the Indigenous knowledge that has been communicated and passed down from generation to generation through family members and communities (Amos, 2013).

Although research is gradually recognizing the importance of indigenous knowledge in developmental studies, the value of indigenous knowledge system in soil fertility management has received little attention. Farmers all over the country, especially in rural areas, have always been faced with the annual deterioration and reduction in soil fertility, but unfortunately, it appears as if they are helpless in proffering a lasting solution to the problem (Olatunji, 2012). This is largely as a result of the fact that there is a great limitation to effectiveness and efficiency of the indigenous methods of addressing loss of soil fertility as applied by these farmers. In most rural areas, effects and consequences of soil fertility loss are evident in the distortions in the structure of land and most importantly a continuous decline in crop yield (FAO, 2017).

Apart from the above, decline in crop yield due to soil fertility loss, thereby reducing income of the rural farmers, discourages young farmers and promotes rural-urban migration. This negatively impacts on food security and sustainability not only in the rural areas but ultimately in urban centers which depend on these rural farmers for the supply of food (Liliane and Charles, 2020). More than ever before, the need to achieve sustainable agriculture in developing countries is more pressing especially considering the growth in population in most developing countries. It is therefore very important to improve indigenous method of soil fertility assessment with the view to achieve sustainable agriculture which can cater not only for the needs of the present generation but also provide for the incoming generations (Uziak and Lorenkowicz, 2017). Therefore, this study seeks to examine the perception of peasant farmers on soil fertility for agricultural sustainability in the study area by determining the socio-economic characteristics of farmers, identifying farmers' indicators for soil fertility decline, identifying the indigenous knowledge system for soil fertility management employed by the farmers, assessing the impact of the application of indigenous knowledge system on farmer's

yield and agricultural sustainability and examining the constraints to the use of indigenous knowledge system for soil fertility management.

Materials and Methods

Study Area

The study area lies between latitudes $8^{\circ}10'$ and $8^{\circ}40'$ N of the equator and between $4^{\circ}12'$ and $4^{\circ}40'$ E. It has an area extent of 1,286kmsq (Ajibade, 2008). It has three districts which are Onire, Owode and Afon is the Local Government Headquarters. Olawepo (2010) noted that the area stretches from the peri-urban fringes of the city of Ilorin to the Northern boundary of Oyo State. It shares boundary with Oyun and Ifelodun Local Government Areas in the Eastern part and Moro Local Government Area towards the North. According to Ajibade (2008), Asa Local Government is characterized by tropical wet and dry seasons with the monthly average temperature of 30.15°C . The month of March has the highest temperature of 30.15°C while August has the lowest average temperature of 27.3°C .

Topography of the area is an undulating plain with very broad and gentle slope, lying at an altitude of between 265 and 480 meters above sea level. The soil is derived mainly from the basement complex and is probably the most important group of soils in Nigeria because it covers the greater portion of the country. Soils in Asa are ferruginous tropical soil. Asa Local Government Area is a forest savannah mosaic and dry forest belt soil. Iroye (1993) and Awoeyo (2007) also observed that the zone is characterized by low density of trees and the annual bush burning in this area causes degradation of the vegetation into derived savannah in which fire tender trees are progressively being eliminated leaving only fire tolerant ones. These fire tolerant trees are intermingled with tall trees of the guinea savannah type. The study area has a projected population of 168,300 as at 2016 (National Bureau of Statistics, 2018). The people are mainly farmers who produce food crops both at the subsistence and commercial levels.

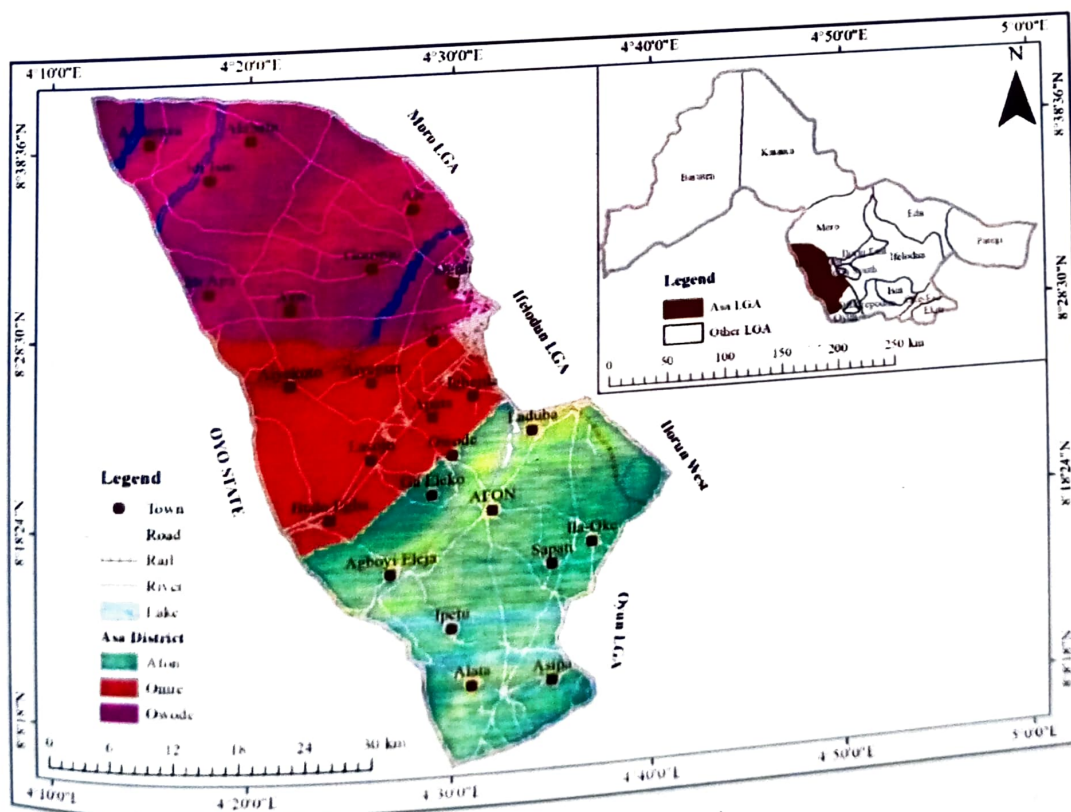


Figure 1: Asa Local Government Area (Inset: Kwara State)

Source: Kwara State Ministry of Land and Survey (2014)

Methods

The data used for this study were derived from both primary and secondary sources. While the primary data was gathered through the administration of questionnaire designed for a preliminary survey of the study area and Focused Group Discussion (FGD), the secondary data was gathered from maps, books, internet sources among others. To understand farmers' knowledge of soil fertility management, this study employed questionnaire for data collection.

According to the Kwara State Agricultural Development Programme (KWADP, 2019), the population of registered farmers in Asa Local Government Area is about 450. The target population for the study is made up of arable farmers who have at least 10 years of farming experience. Using the formular $\{S = N/1 + N(e)^2\}$, where S = sample size, N is the total population and e is the margin of error (0.07), 85 (18%) respondents of the population of farmers were selected from the three districts in the study area. Using purposive sampling technique, 28 (6%) respondents were interviewed from each district. The whole 85 respondents interviewed were all males. This is because the questionnaire administration sampling technique is purposive sampling and also because traditionally, agriculture as practiced in Asa local government is predominantly a male-dominated occupation.

Descriptive statistics such as frequency distribution, mean and percentage were used to achieve objectives i, ii, and v of the study. Logit regression analysis was used to achieve objective iii. Studies with a binary dependent variable (i.e. one or zero) can employ models, such as Linear Probability Model (LPM), Probit and Logit models to see the relationship between the dummy response variable and the explanatory variables. Following Gujarati (2003), the logistic distribution function for the decision to use the farmer's indigenous knowledge can be specified as:

$$P^{(1)} = \frac{1}{1 + e^{-Z(1)}} \dots\dots\dots 1$$

Where $P^{(1)}$ is the probability of a household that practiced any form of indigenous knowledge in managing soil fertility at the time of the survey and $Z(i)$ is a function of an explanatory variable (x_i).

The explicit logit model is expressed as:

$$Y = \beta_0 + \beta_1 \ln x_1 + \beta_2 \ln x_2 + \beta_3 \ln x_3 + \beta_4 \ln x_4 + \beta_5 \ln x_5 + \beta_6 \ln x_6 + \beta_7 \ln x_7 + U \dots\dots\dots 2$$

Where:

$y = 1$ = applicators and 0 = non applicators of any of the indigenous knowledge system identified for this study

x_1 = Age (years)

x_2 = Level of education (years spent in schooling)

x_3 = Household size (no. of people under the care of the household head)

x_4 = Farming experience (years spent in farming)

x_5 = Farm size (hectares of land for production)

x_6 = Extension contact (no. of visits either by extension agents or the farmers)

x_7 = Cooperative societies (of years spent in cooperative societies)

β_0 = Constant

$\beta_1 - \beta_7$ = the parameters to be estimated

U = Error term

Where β_0 is the intercept and β_1 is the slopes parameter in the model. The slopes tell how the log-odds of indigenous knowledge in managing soil fertility changes as the independent variables change by a unit. The stimulus index Z_i also referred to as the log of the odds ratio in favour of a farmer that practiced any form of indigenous knowledge in managing soil fertility at the time of the survey. The odds ratio is defined as the ratio of the probability that a farmer practiced any form of indigenous knowledge in managing soil fertility (P_i) to the probability that he/she is not ($1 - P_i$).

$$\text{But } (1 - P_i) = \frac{1}{1 + e^{Z(i)}} \dots\dots\dots 3$$

$$\text{Therefore, } \frac{P_i}{1 - P_i} = \frac{1 + e^{Z(i)}}{1 + e^{-Z(i)}} \dots\dots\dots 4$$

$$\text{and } = = + \dots\dots\dots 5$$

Taking the natural logarithms of the odds ratio of equation (4) will result in what is known as the logit model as indicated below.

$$\ln = \ln = Z(i) \dots\dots\dots 6$$

If the disturbance term U_i is taken in to account, the logit model becomes:

$$Z(i) = \beta_0 + U_i \dots\dots\dots 7$$

T-statistic was employed to achieve objective iv of the study. T-test was carried out to evaluate the impact of indigenous knowledge systems in soil fertility management among the farmers in the study area. This is in order to determine if there is real difference in their mean yields using a

0.05 level of significance.

T-test statistic for H_0 : Yield of adopters = Yield of non-adopters

$$t = \dots\dots\dots 8$$

Where:

= Mean of yield for applicators of indigenous knowledge system for soil fertility management.

= Mean of yield for non-applicators of indigenous knowledge system for soil fertility management

and = variance of yield for applicators and non-applicators

= sample size of applicators

= sample size of non-applicators

Results and Discussion

Socio-economic Characteristics of Respondents on Soil Fertility Perception

Table 2 shows that 58.8 % of the farmers are between the ages of 50-60 years which implies that most farmers in the study area are still in their economically active age. This implies a positive contribution to agricultural production. This supports the findings of Otitoju and Arene (2010) that age of farming household heads has a direct relationship with soil fertility management. They argued that this was understandable since it was expected that as a farming household head becomes older, he/she tend to have higher indigenous technical knowledge than the younger ones. Age is an important determinant of social –economic status of a population since people wear in energy as they advance in age. Although experience is gained with age, farming needs not be dominated with aged populations in any region as this could have negative implications on the future of food production (Onojah, Aduba and Oladunni 2013).

From Table 2, 54.1 percent of the respondents have secondary school education. This shows that the educational level of the farmers has no influence on farmer's decision to apply indigenous knowledge system for soil fertility management. This implies that a large number of the farmers are knowledgeable about scientific knowledge. An increase in education level of the farmers may decrease the probability of applying the indigenous knowledge system for soil fertility management. This may be due to the fact that farmers who engage more in off-farm employment have less commitment to the farm and hence, they do not view the economic impacts of soil fertility depletion as being significant factor to justify undertaking soil conservation activities. This contradicts the findings of Luka and Yahaya (2012) that formal education can give an unparalleled advantage to the people of an area in terms of quick understanding of scientific principles underlying the use of indigenous soil management

practices. However, Mawere (2015) reported otherwise that the coming together of the indigenous and scientific knowledge acquired through formal education can be used to promote innovative thinking as it provides the basis for problem-solving strategies for local communities particularly with regards soil fertility management.

About 77% percent of the farmers in the study area are married. This suggests that a large number of those farmers have the responsibility of providing food and other life necessities of life through farming. To this extent, it can therefore be inferred that soil fertility management will be a major concern to such farmers in order to sustain their families.

Table 1: Socio-Economic Characteristics of Respondent

Age Distribution	Frequency	Percent
30-40 years	8	9.4
40-50 years	13	15.3
50-60 years	50	58.8
60 years above	14	16.5
Total	85	100.0
Marital Status		
Married	65	76.5
Single	6	7.1
Widowed	10	11.8
Divorced	4	4.7
Total	85	100.0
Farming Experience		
5-10 years	3	3.5
10-15 years	9	10.6
15-20 years	5	5.9
20-25 years	24	28.2
30-35 years	21	24.7
35 years above	23	27.1
Total	85	100.0
Education Qualification		
No formal education	10	11.8
Primary	17	20.0
Secondary	46	54.1
Tertiary	12	14.1
Total	85	100.0

About 28.2 percent of the farmers have between 20 to 25 years farming experience (Table 1). This implies that an increase in farming experience of farmers may increase the probability of applying the indigenous knowledge system for soil fertility management. This is in tandem with the findings by Edeghon (2008) that farmers are usually more involved in practices that they are more familiar with or that they have experience on than others.

Farmer's Indigenous Knowledge System for Soil Fertility Management

Using farming experience as the independent variable and soil fertility decline, indigenous knowledge system, cropping practice and residue use as dependent variables, Table 2 indicates that indigenous knowledge system is the most significant ($P < 0.05$) of all the variables. Farming experience influence the soil fertility decline negatively with average value of 0.119 which is equivalent to 11.9%. Farming experience also influence Indigenous knowledge system with an average value of 0.718 which is equivalent to 71.8%. Farming experience also influence cropping practice with an average value of 0.247 which is equivalent to 24.7%, while farming experience influence residue use with an average value of 0.192 which is equivalent to 19.2%. The total variance explained from the result shows an average value of 29.6% for the considered independent variables while the remaining factors accounts for the rest with standard error of 1.38%, respectively. These results implicate that farming experience plays a significant role in soil fertility management and consequently agricultural sustainability. Farming experience also affects an effective cropping system that can ensure agricultural sustainability and food for all for our teeming population. Experienced farmers were discovered to have been able to effectively manage soil fertility and cropping practices in order to sustain continuous farming/cropping which of course will guarantee agricultural sustainability. There is therefore the need for a kind of mentorship by more experienced farmers to farmers that are relatively new in agricultural practices. This will go a long way to ensure a sustainable soil fertility management system.

Table 2: Soil Fertility Management Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	T	Sig.
	B	Std. Error	Beta		
1 (Constant)	5.133	0.692		7.416	0.000
Soil fertility decline	-0.119	0.107	-0.123	-1.113	0.269
Ik System	-0.718	0.329	-0.247	-2.181	0.032
Cropping practice	0.247	0.321	0.083	0.770	0.444
Residue use	0.192	0.374	0.058	0.513	0.609

a. Independent Variable: Farming Experience

$$FE = 5.133 + (-0.119)SFD + (-0.718)IKS + (0.247)CP + 0.192(RU) \dots\dots\dots \text{equ. i}$$

$$FE = 5.133 - 0.11SFD - 0.718IKS + 0.247CP + 0.192RU \dots\dots\dots \text{equ. ii}$$

$$R = 29.6\% ; SE = 1.38\%$$

Where FE= Farming Experience, SFD = Soil Fertility Decline, IKS = Indigenous Knowledge System, CP= cropping Practices, RU= Residue Use

Impact of the Application of Indigenous Knowledge System on Farmer's Yield and Agricultural Sustainability

From Table 3, the student's t-test table indicates t-values that range from 20.7 to 31.6 and P value < 0.05 (0.00) for the significant values. Since significant values of t were all less than 0.05,

the examined concepts show that there are significant differences between the means values. Also, the calculated values were all greater than the table values of the analyzed parameters. The results reveal that the correct application of indigenous knowledge of soil fertility management has a direct positive impact on farm yield and agricultural sustainability with in the study area respectively. The implication of this is that, when effectively deployed, indigenous knowledge of soil fertility management, has the capacity to increase crop yield and thereby lead to agricultural sustainability in the study area. This is not farfetched from the study by David et al., (2012) reporting that the role of Indigenous Knowledge on traditional farming system is positively supporting food security, evidence showed that the site which still practices Indigenous Knowledge tends to have the highest biodiversity related to agricultural produce

Table 3: Impact of the Application of Indigenous Knowledge System on Farmers Yield and Agricultural Sustainability

Test Value = 0						
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Indigenous system impact	24.529	84	.000	1.118	1.03	1.21
Positive or negative impact	20.739	84	.000	1.259	1.14	1.38
Impact example	20.312	84	.000	1.541	1.39	1.69
Agricultural sustainability impact	31.655	84	.000	1.047	.98	1.11

Constraints in Indigenous Technical Knowledge for Soil Fertility Management

There are various constraints that prevent farmers from practicing indigenous knowledge systems for soil fertility management. These problems differ based on the opinions and experiences of the farmers interviewed. Soil tillage, deforestation, climate change, cost and health implication were some measures mentioned as the constraints in using indigenous soil fertility management. Figure 2 clearly shows that about 50% of the farmers believe that cost implication is the major constraint to the application of soil fertility management whether indigenous or scientific. This is especially so for the scientific soil management techniques which the farmers believe are costly.

Close to that is climate change in which 32% of the farmers believe is another very significant constraint to soil fertility management. This is surprising especially when this is coming from traditional and low educated farmers who one may think lack the scientific knowledge or experience of what climate change is all about. It is really interesting to note that even the peasant farmers recognize the reality of climate change and its impact on agriculture and food sustainability.

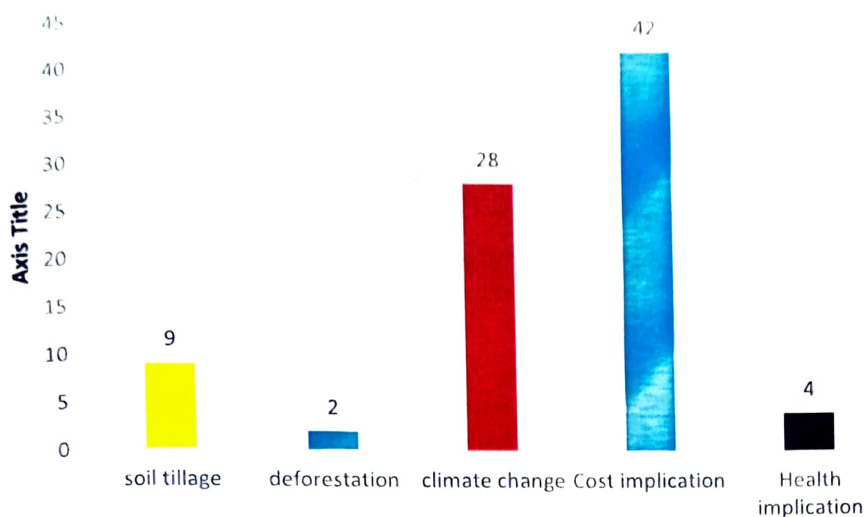


Figure 2: Soil Fertility Management Constraints

Source: Author's Data Analysis (2020)

Farmers in the study area are willing to adopt both indigenous and modern systems of soil fertility management if they can afford the cost. Also, the nagging impact of climate change poses a major challenge to soil fertility management and consequently agricultural sustainability. It therefore means, if the cost of soil fertility management systems can be reduced by government and relevant agencies, the chances are high that agricultural sustainability is attainable not only in the study area but also across the nation. Also very important, is the response of government and relevant bodies to the issue of climate change. Proactive measures should be taken to militate against the negative impacts of climate change to our soils and indeed agricultural sustainability.

Conclusion

The study shows that rural farmers use indigenous methods for maintaining soil fertility which include; organic manure, mixed cropping, crop rotation, crop residue management, mulching, and use of legumes. The study also showed that older farmers, more experienced farmers and farmers with relatively larger holdings have higher probability of applying indigenous knowledge system in soil fertility management. There is significant impact on farmer's yield with the application of indigenous knowledge system for soil fertility management. The study recommends the inclusion of indigenous knowledge system into the education system. This will encourage practicalizing, preservation and transmission to the younger generation. Also, the integration between indigenous and scientific approaches at the local level will enable a better understanding of soil management systems as applied by small-scale farmers and to ensure the protection of topsoil to maintain sustainable soil quality.

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