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Analysis of factors influencing adoption of sustainable soil conservation practices as a good practice among farmers in Adamawa State, Nigeria

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ABSTRACT

The study analyzed factors influencing adoption of sustainable soil conservation practices as a good practice among farmers in Adamawa State, Nigeria. A total of 180 farmers were selected for the study, using multi-stage random sampling technique. Pre-tested and validated structured questionnaires were administered by means of interview schedule in generating the data analyzed. Both descriptive (frequencies and percentages) and inferential (Probit Regression) statistics were employed to analyze the data. Results of the Probit Regression indicated that age and farming experience of the farmers were positive and significant at 1% level of significance, whereas sex, family size, income, level of education and marital status were all positive and significant at 5% level of significance. This implies that these socio-economic characteristics contribute to the farmers' probability of agreeing that sustainable soil conservation practice is a good practice for small-scale farmers. It was concluded that farmers have perceived the overall importance of sustainable soil conservation in agriculture. It was recommended, among others, that: extension workers should organize educational trainings, short courses, workshops and symposia, for farmers on the importance of and need to adopt conservation agriculture; farmers should be advised to focus their attention on long term benefits of conservation agriculture.

Key words: Analysis, Adoption, Sustainable, Soil Conservation practices, Good Practice.

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INTRODUCTION

Background of the Study

In many regions of sub-Saharan Africa, continuous cropping and use of inappropriate farming practices have had massive negative environmental impacts. These negative impacts are characterized by declining soil fertility, soil erosion and degradation of vast expanses of arable land thus, further causing of low yields, food insecurity and perennial starvation (Guto et al., 2011). These problems are particularly intense in poor developing countries, where more than 80% of the populations of subsistence farmers still rely on simple traditional technologies and tools.

Land scarcity, increasing population pressure, poorly targeted agricultural policies and agricultural management strategies exacerbate the problem.

However, society has created nature conservation and environmental programs to counter these negative trends for example, the agro-environmental schemes within the European Union (Guto et al., 2011). These programs compensate farmers for the production of common goods and services by introducing and adopting environmentally friendly production strategies.

There are various methods or approaches to agricultural production which differ with places, availability of resources or otherwise as well as many other factors. There are also many other crop cultivation approaches which aimed at reducing the deterioration of cultivable lands. Sustainable soil conservation in agriculture is one of these approaches. It is a way to achieve sustainable agriculture and also to improve the livelihoods of rural people. It aims to produce high crop yields while reducing production costs, maintaining the soil fertility and conserving water. Dumanski et al. (2006) also defined Sustainable soil conservation practices in agriculture as the application of modern agricultural technologies to improve production while concurrently protecting and enhancing the land resources on which production depends. Permanent cover crops and non-removal of residue protect the soil from erosion and weeds. Varied crop rotation helps in weed control and boosting soil fertility. Conservation agriculture is therefore, a part of sustainable agriculture combining best practices with discontinuation of production systems associated with negative environmental externalities created by conventional agriculture (D'Souza et al., 1993).

Desperch (2005) reported that zero-tillage, which is the mainstay of conservation agriculture, is now applied on more than 95 million hectares worldwide, primarily in North and South America. He further reported that approximately 47% of the zero-tillage technology is practiced in South America, 39% is practiced in the United States and Canada, 9% in Australia and about 3.9% in the rest of the world, including Europe, Africa and Asia. Zero-tillage and other soil conservation practices are the corner stone of conservation agriculture. The application of conservation agriculture promotes the concepts of optimizing yields and profits while ensuring provision of local and global environmental benefits and services. The term "conservation agriculture" was adopted during the first World Congress on Conservation Agriculture Federation.

International Institute for Rural Reconstruction (IIRR) and African Conservation Tillage network (ACT) (2005) reported that in the 1930s, soil erosion in the United States reached crisis proportions. The problem was particularly severe in the Midwest, where millions of top soil were blown away by the wind or washed into rivers, in what came to be known as the "Great Dust Bowl" supported by the government. Thus, American farmers started abandoning their traditional practices of ploughing. Instead, they left the crop residue on the soil surface and planted the next crop directly into the stubble. Faced with similar problems, the farmers in South America also took up conservation agriculture. Because of the benefits of the farming strategy, knowledge passed quickly from farmer to farmer. It is against this background that the need to conduct this study in other parts of Africa was born in order to investigate its acceptability and practice in recent times.

Statement of the problem

Agricultural experts, researchers, national and rural development agencies have been making concerted efforts in order to improve agricultural production and farming systems all over the globe for quite a long time now. This became necessary owing to the fact that conventional agricultural production practices have been associated with progressive soil degradation, erosion, soil nutrient content depletion and deforestation, to mention a few. This scenario is accompanied with poor nutrition and health, insecure livelihoods and the general poor living conditions of farmers. In view of this, different agricultural production systems, methods, practices and other similar intervention approaches were introduced over time (IIRR and ACT 2005).

Desperch (2005) reported that the utilization of conservation agriculture has been widely spread in many parts of the world. He reported that the area under zero-tillage in the world has grown from 45 million/ha in 1999 to about 111 million/ha in 2009. According to him, although conservation agriculture has shown a great adaptability to all kinds of bio-physical environments, its development in Africa has been limited. For instance, the area under zero-tillage on the African continent represents only 0.3% of the area worldwide.

Conservation agriculture has a great potential in Africa because of its ability to control erosion, produce stable yields and reduce labour needs. However, despite the advantages and potential benefits accruable to farmers from the practices of conservation agriculture, research findings and other literature have shown that it is not widely adopted in Africa. For instance, Desperch (2005) reported that only 3.9% of zero-tillage is practiced in Europe, Africa and Asia put together as against 47%, 39% and 9% in South America, United States and Canada, and Australia respectively. This poses a great challenge for agricultural researchers and African farmers, where conservation agriculture is not widely adopted. Thus, since African countries, including Nigeria, have such a very low percentage (0.3%) in the practices of conservation agriculture, there is a need to investigate farmer's perception, awareness and adoption on its practices in Nigeria. Therefore, this study analyzed factors influencing farmers' adoption of sustainable soil conservation practices as a good practice in Adamawa

State, Nigeria.

Objectives of the Study

The main objective of the study was to analyze farmers' perception and on conservation agriculture practices in Adamawa State, Nigeria. The specific objectives were to:
i.) Identify the socio-economic characteristics of the respondents.
ii.) Identify the types of conservation agriculture practices adopted by the respondents.
iii.) Determine the relationship between farmers' perception on conservation agriculture and their socio-economic characteristics.
iv.) Identify the constraints encountered in practicing conservation among the respondents.

METHODOLOGY

The Study Area

This study was conducted in Adamawa State of Nigeria, which is located in the northeast part of the country. The state is divided into four Agricultural Development Programme (ADP) Zones, namely, Mubi, Gombi, Mayo-Belwa and Guyuk as Zones I, II, III and IV, respectively. This division is principally for administrative convenience because the state has similar agricultural and geographical features.
Adamawa State lies between latitudes 70^0 28'' and 10^0 55'' North and longitude 11 $1/2^0$ 20'' and 13 $3/4^0$ 40'' East. The state capital, Yola, lies on latitude 9^0 14'' North and longitude 12^0 28'' East. The state has a total land area of 42,159 square kilometers. The National Population Commission Census Report of 2006 gave the population of the state as 1,606,123 (males), 1,561,978 (females) giving a total of 3,168,101.

Sources Data and Methods of Data Collection

The study used the primary data generated from the structured questionnaires which were used to obtain information from the respondents. Secondary information were obtained from journals and records kept in some agriculture-related organizations (Examples are Adamawa Agricultural Development Programme, Community and Social Development Agency, etc.), the internet and textbooks. A total of 21 extension staff were trained and employed to assist in the administration of questionnaires during the process of data collection.

Sampling Procedure and Sample Size

Multi-stage random sampling technique was employed for the selection of the local government areas, villages and the respondents who were involved in the study. In the first stage, three (3) local government areas were selected from each of the four existing zones, giving a total of twelve (12) local government areas. In the second stage, five (5) villages were selected from each of the selected local government areas using simple random sampling technique. This gave a total of sixty (60) villages. In the final stage, three (3) respondents were selected from each of the selected villages. Thus, the sample size of respondents involved in the study was hundred (180).

Analytical Techniques

Data were analyzed using descriptive and inferential statistics. Thus, percentages, frequencies and means were used as descriptive statistics, whereas the inferential statistical technique used was the probit regression. The model of the regression is specified in its implicit form as follows:

$Y = \beta X_i + e$

Where:
Y= perception (dependent variable) of the respondents
X_i= set of explanatory variables
e = Error term

The explicit form of the regression model is expressed as:

$Y = (\beta_i X_1 X_2 X_3 X_4 \ldots\ldots Xn_i e)$

Where:
Y= perception (dependent variable, measured by use of scores)

The explanatory variables considered in the study were:

X_1= Age (in years)
X_2= Sex (Male = 1, Female = 0)
X_3= Household size (number of people in the household)
X_4= Farming experience (number of years a farmer spent in farming)
X_5= Income (amount in naira value)
X_6= Level of education (number of years spent in school)
X_7= Marital status (Married = 1, Divorced or Widowed = 0)
β_1= Regression parameters or coefficient
e = Error term

RESULTS AND DISCUSSION

Results from Table 1 showed the distribution of the

Table 1: Distribution of the respondents based on socio-economic characteristics.

Variable	Frequency	Percentage (%)
Sex		
Male	126	70
Female	54	30
Age (Years)		
< 20	26	14.4
21-30	40	22.2
31-40	58	32.2
41-50	36	20.1
Above 50	20	11.1
Marital Status		
Single	54	30
Married	54	30
Widowed	54	30
Divorced	18	10
Educational Level		
Non-formal education	44	24.4
Primary education	38	21.1
Secondary education	60	33.3
Higher education	38	21.1
Farming Experience		
1-5	42	23.3
6-10	82	45.6
11-15	42	23.3
Above 15	14	07.8
Family Size		
< 2	10	05.6
2-4	82	45.6
5-7	66	36.7
8-10	22	12.2
Annual Income (₦)		
20,000 – 25,000	64	35.0
26,000 – 30,000	72	40.0
31,000 – 35,000	28	16.0
Above 35,000	16	09.0
Total	**180**	**100**

Source: Field Survey, 2015.

respondents based on their age. The table shows that 32% of the respondents were between 11 to 30 years, 47% were between 31 to 50 years, 17% were between 51 to 70 years and 4% were 71 years and above. This shows that many (47%) of the respondents were between 31 to 50 years. This might be because it is an economically active age range, and the respondents still have the energy for agricultural activities.

Table 1 also showed that the respondents with 71 years and above constituted the lowest percentage (4%). This could be as a result of their old age. Thus, the physical energy they need to perform much agricultural operations has declined and this probably accounts for why they constituted very low percentage. In addition, they may be depending on their children who, at this stage of their living, are grown up people that can provide for most of their parent's needs.

The respondents within the age range of 11 to 30 years constituted about 32%. This could be due to the fact that most of them are coming up and still have little or no responsibilities for other family members. Furthermore, the results show that the respondents within the ages of 51 to 70 years are 17%. This could be as a result of weakness and also by that time, their children must have grown and begun to fend for themselves.

Similarly, the results showed that 53% of the respondents were males and 47% were females. This shows that more than half of the respondents were males. The reason for this could be as a result of the fact that men are the heads of their respective families with a lot of responsibilities attached to them. Therefore, many of them were involved in agricultural production. From the results, women also have a high percentage (47%) although it is not up to that of their male counterparts.

Table 2: Probit regression results between respondents' perceptions on sustainable soil conservation practices and their socio-economic characteristics.

Y	Coefficient	Std. Error	P >
Age	0.0738665	0.0383047	1.93**
Sex	0.1302605	0.0511676	2.55***
Household Size	1.0409300	0.4102662	2.54***
Farming Experience	1.4176690	0.6177543	2.29**
Income	2.1797150	0.4834875	4.51***
Level of Education	2.1818470	0.5310540	4.11***
Marital Status	2.0322950	0.6728991	3.02***
Const.	.04165750	0.0204270	2.04**

This means that women also produce crops to meet up with their own little needs and those of their families.

Results in Table 1 also show the distribution of the respondents based on household size. The results indicate that 80% were with the household size range of 1 to 10, 18% were within the range of 11 to 20 and 2% fall within the range of 21 members and above. This shows that the range with the highest percentage (80%) is 1 to 10. However, the results showed that the range with the highest number of household members is 11 to 20 which constituted 18% and those with 21 members and above constituted the lowest percentage (2%).

Results in Table 1 also show the distribution of the respondents based on household size. The table shows that 46% of respondents have farming experience of 1 to 10 years, 31% have the farming experience of 11 to 20 years, 15% have 21 to 30 years and 8% have 31 years and above. The results showed that the respondents with the lowest percentage (8%) were those within the range of 31 years and above. This may be attributed to the fact that for a farmer to have experience of up to or above 31 years, he is likely to be very old and not many of such people are found in a given society. On the other hand, those with the highest percentage (46%) were the ones that fall within the range of 1 to 10 years. This may be due to the fact that youths engage in agricultural production in order to achieve their ambitions, such as buying clothes, preparing for marriage and also, for some of them, to sponsor themselves.

The table also presents a distribution of the annual income of the respondents. The results indicate that 48% of them have ₦20,000-₦100,000, 36% have ₦101,000-₦300 and 16% have ₦301,000 and above. From the distribution, the respondents within the highest annual income range are few, constituting only 16%. This may be because most people with capital prefer to invest in other businesses other than farming, since in Africa most farmers are small scale holders. The table shows that 48% of the respondents earn ₦20,000-₦100,000.This may be because of the fact that farmers produce food just enough to feed their nuclear families.

Giller et al. (2009) stated that farmers' involvement in conservation agriculture tends to be done mainly by more wealthy farmers, which could be attributed to the fact that in most cases, wealthier households are more likely to join most governmental and non-governmental interventions projects. The table shows that 15% of the respondents have no formal education, 32% have attended primary school, 22% have attended secondary school and 31% have post-secondary education. This shows that only few of the respondents have no formal education. There may be some of the older respondents who were born at the time that schools were not found in villages. The table also presents a distribution of the marital status of the respondents. The distribution shows that 78% of the respondents are married and 22% are single. The reason why majority (78%) of the respondents are married may be attributed to the fact that married people have responsibilities more than those who are not and so they need to cultivate crops in order to provide food for their family members. On the contrary, the reason why there are only few of the single in the study may be attributed to the assertion that they have fewer responsibilities to bother about. In spite of this, a good number of them may be engaged in agricultural production probably in order to take care of some of their needs or to sell their produce and marry to begin their nuclear families or to settle other personal problems (Oluwatayo, 2009).

Results of Probit Regression Analysis

The study determined the relationship between the respondents' perception on sustainable soil conservation practices and their socio-economic characteristics. The results are presented in Table 2. The results indicated that age was positive and significant at 5% level of significance. This implies that when the age of a farmer increases by one year, the probability of the respondent to accept the statement that sustainable soil conservation is a good farming system to be practiced by small-scale farmers is 0.07. The results also indicated that sex was positive and significant at 1% level of significance. This implies that for a respondent to be a male, he has 0.13 chances of accepting that sustainable soil conservation is

Table 3: Distribution of the respondents based on the types of sustainable soil conservation practices adopted.

Sustainable Soil Conservation Practices	Frequency	Percentage (%)
Zero tillage	8	1.9
Planting of cover crops	47	11.4
Crop rotation	61	14.7
Application of chemicals in balance with crop requirements	100	24.0
Use of compost manures and organic soil amendments	81	19.5
Promoting legumes fallows	39	9.4
Mulching	3	0.7
Practicing of precision placement of inputs to prevent damage	77	18.5
Total	**416**	**100**

Source: Field Survey, 2015. *Multiple adoption of soil conservation practices were observed.

a good practice for small-scale farmers.

The results on the table show that household size was positive and significant at 1% level of significance. This implies that for the household size to increase by one member, the respondent has 1.04 chances of accepting that sustainable soil conservation is a good practice for small-scale farmers. The analysis shows that farming experience has a positive and significant relationship with the respondent's perception at 5% level of significance. This implies if the farming experience of an individual increases by one year, the respondent has 1.41 chances of accepting sustainable soil conservation as good practice for small-scale farmers. The analysis also indicated that income has a positive and significant (at 1%) relationship with the respondents' perception on sustainable soil conservation. This means that if a respondent's income increases, he/she has 2.17 chances of accepting that sustainable soil conservation is a good practice for small-scale farmers. Findings of the study further indicated that level of education is positive and significant at 1% level of significance. This implies that if the level of education of the respondent increases, he/she has 2.18 chances of accepting that sustainable soil conservation is a good practice for small-scale farmers. The results also revealed that marital status is positive and significant at 1% level of significance. The implication of this is that, if a respondent is married, he has 2.03 chances of accepting that sustainable soil conservation is a good practice for small-scale farmers. Though the results indicated that all the socio-economic characteristics are positive and significant, the findings indicated that any increase in farming experience, level of education and the married respondents have the highest chances (>2) of agreeing that conservation agriculture is a good practice for small-scale farmers, followed by household size and farming experience, both of which have high chances (>1) to concur to the statement. This infers that the respondents' average annual income, level of education, household size, farming experience and marital status do all contribute much to their perception on the statement that sustainable soil conservation is a good practice for small-scale farmers.

Types of Sustainable Soil Conservation Practices Adopted

The results on the types of sustainable soil conservation practices adopted are presented in Table 3. The results show that 24.04% of the respondents have adopted the application of fertilizer, pesticides and fungicides in balance with crop requirements. The practices adopted by fewer respondents are zero tillage and mulching constituting 1.92% and 0.72% respectively. The table also shows that 11.39%, 14.66%, 19.47% and 18.51% of the respondents have respectively adopted the planting of cover crops, crop rotation, use of compost, manures and organic soil amendments and practicing of precision placements of inputs to prevent environmental damage. This implies that the respondents have adopted the practice of sustainable soil conservation in the study area. The application of green manure and inter-cropping of legumes is another important practice for biological farming systems and the reduction of leaching of nutrients and soil erosion (Friedman, 2007).

Constraints in Practicing Conservation Agriculture

The results presented in Table 4 shows that 29.35% of the respondents indicated that inappropriate transportation is a major constraint to adoption of sustainable soil conservation practices. More than half (18.09%) of the respondents show that mulching is more difficult than slash and burn. Those who argued that the very long period of time it takes for them to see the benefits of adopting sustainable soil conservation practices is a serious problem constituted 14.33%. With this result, it is apparent that the respondents have only few constraints to the practice of sustainable soil conservation. Inappropriate transportation infrastructure is also another bottle neck to conservation agriculture (Cramb, 2000; Despsch 2005; Friedrich et al., 2009).

Table 4: Constraints in adoption of sustainable soil conservation practices.

Constraints	Frequency	Percentage (%)
Limited access to input	8	2.7
Insufficient resources to grow cover crops	17	5.8
Lack of sufficient equipment for planting	13	4.4
Lack of relevant skills and knowledge	11	3.8
Lack of adequate extension services	16	5.5
Inadequate farm size	21	7.2
Insufficient human capital	19	6.5
Absence of Mechanization	7	2.4
Inappropriate transportation infrastructure	86	29.4
Mulching is more difficult than slash and burn	53	18.1
It takes longer period to see benefits	42	14.3
Total	**293**	**100**

Source: Field Survey, 2015.
*Multiple responses were observed.

Conclusion

Most of the farmers in Adamawa State are fully aware of sustainable soil conservation practices and have accepted most of its practices. In spite of this, many of them can still be categorized as either late adopters or even laggards since they are yet to adopt the sustainable soil conservation practices fully. Each of the respondents practices only some aspects of conservation agriculture but not in its totality. This shows that the extension workers, who are supposed to convince farmers to the point of adoption, did not do enough of their work. The Adamawa State and Hong Local Government have not assisted the farmers in terms of the materials and inputs needed to facilitate the adoption of sustainable soil conservation practices among farmers. The farmers on their part do not look at sustainable soil conservation practices from the perspective of long term benefits, but they are more concerned with immediate results and benefits.

The farmers' socio-economic characteristics have played a very important role on their perception of conservation agriculture, which indicated there is a significant relationships between their socio-economic characteristics and their perceptions on sustainable soil conservation practices.

RECOMMENDATIONS

Based on the results of this study, some recommendations were made:

i.) Government should provide the rural areas with good transportation infrastructure.

ii.) Government should empower farmers through provision of loans and credits in order to enable them acquire the equipment and facilities needed for the adoption of sustainable soil conservation practices.

iii.) Extension workers should intensify their efforts in organizing educational trainings, workshops and symposia for farmers on the need for the adoption of sustainable soil conservation practices. They should try to change the farmers' focus on short term benefits to long term results of conservation agriculture.

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