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Effects of Vetiver Grass Strips Technology (Vgt) Adoption on Poverty of Crop Farmers in Nigeria.

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ABSTRACT

Abia state faces severe soil erosion problem which affects agricultural production and poverty of crop farmers. The use of vetiver grass strips technology (Vgt) helps control soil erosion, enhance crop yield, increase farmers' income and reduce poverty. However, there is a dearth of information on the effect of adoption of Vgt. on poverty in Abia State. Therefore, the poverty status of crop farmers' adopters in Abia State was investigated. 250 farming households were randomly selected proportionate to the size of the cells. Data on socio-economics of the farmers, awareness and adoption of Vgt, inputs and outputs of crops, expenditure on food and non-food items were collected using a structured questionnaire. Data were analysed using descriptive statistics, Foster, Greer and Thorbecke model, and probit regression at α0.05. The results showed that the average age of the respondents was 48 years. The household size and farm-size were 6 members and 2ha. 59.2% of the respondents were aware of Vgt but 49.6% adopted. Most of the adopters of Vgt were females with farm size of 1.57 ha, and 42.7% of them had tertiary education. Adoption of Vgt reduced poverty incidence by 21.0% for the adopters. The study recommends effective extension services for farmers. Vgt being low-cost help to reduce the poverty level of the farmers and hence government should invest more resources on this technology. Further research should be on poverty reduction and involving of government intervention programme in the study area.

INTRODUCTION

The main objective of the study is to assess the effect of adoption of vetiver grass strips technology on the poverty of crop farmers in Abia State Nigeria. The specific objectives are to determine the adoption rate of vetiver grass strip technology, identify the determinants of adoption of vetiver grass strip technology and determine the poverty status of the crop farmers.

The improvement of agricultural crop yield is one of the resultant benefits of the effects of vetiver grass technology on soil and water conservation. This could be beneficial to farmers, especially those farming on sloppy lands that are usually prone to erosion. It was reported by National Research Council that vetiver grass improves crop harvest by reducing crop failure against the dry spell. They also reported that vetiver grass enhances soil moisture for plant use. In Nigeria, Babalola et al. (2003) reported an increase in crop yields by a range of 11–26% for cowpea and by about 50% for maize following the application of vetiver grass strips at 20-m intervals against non-vetiver plots on a 6% slope. They attributed the higher grain yield to higher nutrient use efficiency under vetiver grass strips relative to no vetiver strip.

Also, Oshunsanya et al. (2017) reported an increase in maize grain yield (13.5–26.6%), and cassava tuber weight (7.9–11.2%) in a maize/cassava intercrop under vetiver grass strips spaced at 5-, 10- and 20-m surface intervals. Another report by Babalola et al. (2007) showed that grain yields on plots treated with 4 and 6 t ha−1 vetiver grass mulch were 4 and 47.4% higher than plots treated with vetiver grass strips, respectively. In addition, Laing (1992) finally reported that the full potentials of vetiver grass could be harnessed by combining vetiver grass mulch with vetiver grass strips such that vetiver grass strips would reduce soil water erosion, while mulch materials would decompose to improve the nutrient status of the farmland.

There exist vast literatures on factors that determine agricultural technology adoption. According to Loevinsohn et al. (2012), farmers' decisions about whether and how to adopt new technology are conditioned by the dynamic interaction between characteristics of the technology itself and the array of conditions and circumstances.

Traditionally, economic analysis of technology adoption has sought to explain adoption behaviour in relation to personal characteristics and endowments, imperfect information, risk, uncertainty, institutional constraints, input availability, and infrastructure (Feder, 1995). A more recent strand of literature has included social networks and learning in the categories of factors determining adoption of technology. Some studies classify these factors into different categories. For example, Akudugu et al. (2012) grouped the determinants of agricultural technology adoption into three categories namely economic, social and institutional factors. Kebede et al. (2001) as cited by Lavison (2013) broadly categorized the factors that influence adoption of technologies into social, economic and physical categories.

Although there are many categories for grouping determinants of technology adoption, there is no clear distinguishing feature between variables in each category. Categorization is done to suit the current technology being investigated, the location, and the researcher's

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preference, or even to suit client needs (Bonabana-Wabbi, 2002). For instance, the level of education of a farmer has been classified as a human capital by some researchers while others classify it as a household specific factor.

Vetiver is an effective hedge when grown on the contour because it significantly reduces the flow of sediment from eroding sites and reduces run off, both simultaneously, and at a low cost, compared to more traditional engineered practices. Vetiver grass has unique characteristics. Vetiver grass grows over a wide range of site conditions; is non-competitive with adjacent crops; is not a weed; is resistant to pests and diseases; is used as fodder for livestock; is used for stabilizing earth embankments, drainage lines, roads etc; is fire resistant and is known to repel rodents; and needs minimum maintenance. At a time when a great deal of attention is being paid to simple low-cost technology for sustainable agriculture, Vetiver grass provides one very good, widely and easily applicable technology that is practical, proven, effective, and profitable (Grimshaw,2012).

The vetiver grass technology, in its most common form, is simply the establishment of a narrow (less than one meter wide) live stiff grass barrier, in the form of a hedge, across the slope of the land (Oshunsanya, 2017). When applied correctly the technology is effective on slopes from less than 1 to over 100%. A well-established vetiver grass hedge will slow down rainfall run off, spreading it out evenly, and will trap runoff sediments to create natural terraces. All this is possible without the use of complex hydrological data and design, and without the aid of high-cost consultants and surveyors. It is truly a farmers' technology, created by farmers; one that went unobserved by most developers and scientists. Its uniqueness is in the characteristics of the plant. Vetiver (Vetiveria zizanioides) is a faster growing perennial grass that grows up to a metre or more. It grows in a wide range of areas from high lands to low lands in various soil conditions. It appears in a dense clump and grows fast through tillering. The clump diameter is about 30cm and the height is 50-150cm.The leaves are erect and rather stiff with 75cm of length and 8mm of width. Vetiver is a true miracle grass by its character of special massive long roots that anchoring and penetrating straight into the ground. In old days, it was commonly used for making thatch, handy crafts, perfumery, and employed in religious activities. Only few decades, were largely used at larger scale for soil and water conservation and agricultural practices. At present, the miracle grass was broadly modified for use for environmental protection and other non-agricultural applications and also on an industrial scale. Vetiver and its component parts have widely developed for other miscellaneous uses, i.e. as construction materials, forage for livestock, landscaping and ornamentals, mulch, compost, veneer, fiber board, ash for concrete work, and insecticide. The grass also was brought to get rid of heavy metals from industry sewage, leachate form garbage, and take part in various industrial, commercial products. The achievement of vetiver is considerable, it is expected that in future vetiver will be more important as a socio-economic tool for many countries and popularly used for making clean environment at the global concern. Vetiver is now being used in over 120 countries including the South east of Nigeria.

Poverty is an unacceptable deprivation in well-being. It exists when there is lack of the means to satisfy critical needs. Poor people live without fundamental freedoms of action and choice that the better off take for granted (World Bank, 2003). They often lack adequate food and shelter, education and health, deprivations that keep them from living the kind of life that everyone values. They also face extreme vulnerability to ill health, economic dislocation and natural disasters. And they are often exposed to ill treatment by institutions of the state and society and are powerless to influence key decisions affecting their lives. There are several dimensions of poverty (World Bank, 2001). Nigeria ranks 152 out of 188 countries and territories on the Human Development Index (HDI) with a HDI of 0.514 in 2014 and 18th on the Global Hunger Index (GHI) of 81 countries with a GHI of 15.5 indicating a serious hunger situation (UNDP, 2011). In 2016, Nigeria□s poverty incidence stood at 54.4%, implying that approximately 69 million Nigerians lived in poverty but increased to 69% (or 112.5 million Nigerians) in 2016 (NBS, 2012). Poverty is endemic to rural areas where the main occupation is farming (World Bank, 2008). According to the Nigeria Bureau of Statistics (NBS, 2012), 73.2 percent of the rural population are described as poor compared to 61.8 percent in the urban area.

LITERATURE REVIEW

As a result of an early initiative by the World Bank, vetiver grass technology package was introduced to development projects in India as a lower cost vegetative system for soil and water conservation (Grimshaw,2012). Vetiver is now being used in over 120 countries including the South east of Nigeria. There are scanty studies on vetiver grass technology in Nigeria. Although it grows in Nigeria, its potential for soil and water conservation on improved crop yield has not been realized let alone quantified. Among the few authors that worked on vetiver grass technology adoption in Nigeria included Ejiogu & Offor (2008) who looked at adoption of vetiver grass technology in Imo-State using the regression analysis. He discovered that some socio-economic characteristics such as farm-size, sex, and income affected the farmer's use of vetiver grass in sheet erosion management in the study area. Nzeribe & Nwachukwu (2008) also using multiple regression to analyze the adoption of vetiver grass technology in the control of soil erosion in Anambra State observed that the adoption of the technology was below average. He also discovered that the adoption of vetiver grass increased with educational level, household and membership of cooperatives and decreased with farming experience. Babalola et al (2003) studied the use of vetiver grass in Oyo-State and discovered that the yield

of cowpea was increased by 26% and 50% for maize under vetiver management. Furthermore, there was a 70% reduction of soil loss and there was enhancement of Nitrogen use efficiency (NUE) up to 40%. Oshunsanya (2017) in his study on the use of vetiver grass technology using randomized complete block design found out that more soil moisture content increased significantly ($P<0.05$) under vetiver grass technology than the control plot. Maize grain also increased by a range of 13.5% to 26.6% while cassava tubers increased by 7.9 -11.2% and cowpea grain yield by the range of 11.0-33.5% over the control. Vetiver is an effective hedge when grown on the contour because it significantly reduces the flow of sediment from eroding sites and reduces run off, both simultaneously, and at a low cost, compared to more traditional engineered practices. Vetiver grass has unique characteristics. Vetiver grass grows over a wide range of site conditions; is non-competitive with adjacent crops; is not a weed; is resistant to pests and diseases; is used as fodder for livestock; is used for stabilizing earth embankments, drainage lines, roads etc; is fire resistant and is known to repel rodents; and needs minimum maintenance. At a time when a great deal of attention is being paid to simple lower cost technology for sustainable agriculture, vetiver grass provides one very good, widely and easily applicable technology that is practical, proven, effective, and profitable (Grimshaw,2012).

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MATERIALS AND METHODS

Abia State is rank one of the highest states in term of active gully sites. Abia State is located in south eastern region of Nigeria. Abia State lies within approximately 4041 and 60141 North and longitudes 70101 and 80 East. The State shares common boundaries to the North with Ebonyi state, to the South and Southwest with Rivers State, and to the East and South East with Cross Rivers and Akwa Ibom states respectively. To the West is Imo State, and to the Northwest is Anambra State. The State has a human population of about 2,833,999 (NBS, 2012) and covers an area of about 5,243.7sq.km which is approximately 5.8 percent of the total land area of Nigeria. With its capital in Umuahia it has seventeen local government areas namely Aba North, Aba South, Arochukwu, Bende, Ikwuano, Isiala-Ngwa North, Isiala-Ngwa South, Ukwa East, Ukwa West, Umuahia North, Umuahia South, Umu-Nnochi, Isuikwato, Obingwa, Ohafia, Osisioma, Ugwanagbo.Agriculture is the major occupation of the people of Abia State. This is induced by the rich land which stretches from the northern to the southern parts of the State. Subsistence farming is prevalent and about 70 percent of the population is engaged in it. The main food crops grown are yam, cassava, rice, cocoyam and maize while the cash crops include oil palm, rubber, cocoa, banana and various types of fruits.

The data for the study was obtained from both primary and secondary sources respectively. Information collected included socio-economic and institutional characteristics e.g farming systems, level of inputs used and output of crops. Information on prices of crops produced were also collected. The primary data were collected through the means of well-structured questionnaires. The secondary data on soil erosion, soil conservation practices in the State were collected from Ministry of Agriculture, Agricultural Development Projects (ADPs), National Bureau of Statistics, and governmental agencies. The data included information on the causes of erosion in the area and assessment of the rate of erosion.

A four-stage random sampling technique was adopted for this study. The three Agricultural Development Project zones (ADPs): Aba, Umuahia and Ohafia in the state were considered. Thirteen blocks (representing 34.2%) were randomly selected from the thirty-eight blocks in the State. Thirty cells (representing 32.2%) of the

ninety-three cells in the selected blocks were randomly selected. Two hundred and fifty farming households were randomly selected proportionate to the size of the cells. Data on socio-economic characteristics of the farmers (gender, age, education, household size, farm-size), awareness and adoption of vetiver grass strip technology, quantity of inputs and outputs of crops, expenditure food and non-food items were collected using a structured questionnaire. The analytical tools include descriptive, adoption rate, probit model and Forster, Greer and Thorbecke. The descriptive statistics was used to analyse the socio-economic characteristics of vetiver grass adopters households. These include tables, means, standard deviation, frequencies, percentages. The adoption rate was estimated by computing an index with this formular (Feder,1995; Dontsop,2010)

$$\textbf{Adoption rate} = \frac{Area\ applied\ with\ Vetiver\ grass}{Total\ farm\ siz} \text{ ----------[1]}$$

The Probit model was used to analyze the determinants of the adoption of vetiver grass technology. The assumption is that the individual small holder farmer is considered either to adopt a particular soil conservation practice or not. The independent or explanatory variables include farmer's socio-economic characteristics, farm characteristics, farm and non-farm income. Others are the use of infrastructural facilities like access to credit, farmer's attitude toward risk and perception of the technology.The relationship between the probability of adoption variable , and its determinants, is given as

$$P_i = \beta_0 + \beta_i X_i + \varepsilon \text{ ----------[2]}$$

Xi is a vector of explanatory variables, β0 = intercept and βi is the vector of parameters. The probit model computes the maximum likelihood estimator of βi given the non-linear probability distribution of the random error . The dependent variable Pi is a dichotomous variable, which is one when a farmer adopts vetiver grass technology and zero if otherwise. Given the regressors , the goal is to describe P ( ) =1 |)

The explanatory variables are:

X1 = Gender of farmer (male = 1 and female = 0), X2 = Household size, X3 = Age of farmer in years, X4 = Years of formal education, X5 = Farm size (ha), X6 = Proximity to input market (km), X7 = Primary occupation (farming = 1, others = 0), X8 = Total income in N, X9 = Cooperative membership (member = 1, non – member = 0), X10 = Risk (risk averse = 1, non-risk averse = 0), X11 = Perception of technology (simple =1, complex = 0), X12 = Access to credit (access =1, no access = 0), X13 = Land Ownership Status (land owner =1, others = 0), X14 = Access to leisure (access = 1, none = 0), X15= Cost of Vetiver in N, X16 = Cost of Adoption is estimated as the Variable cost in N, X17 = Cost of labour in N, Ei= Random error.

Variables such as Risk (X10), Perception of technology (X11), and Leisure (X14) were determined using Likert Scale.

The Foster, Greer and Thorbecke (FGT) Model was used to analyze the poverty incidence of the respondents. The analysis of poverty incidence using FGT measure usually start with ranking of expenditures in ascending order Y1≤ Y2≤…….Yn

$$P\alpha = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{Z-Y}{Z}\right)\alpha \text{ ----------[3]}$$

Where,

α = Non-negative poverty aversion parameter, which can be 0 for poverty incidence,1 for poverty gap, and 2 for poverty severity.

Yi = The per capita expenditure of ith poor household

n = The total population

q = The number of people with expenditure below the poverty line.

Z = Poverty line.

In this study, poverty rate was calculated by comparing the total expenditure of every household with the corresponding poverty line. Suppose income x of an individual is a random variable with the distribution function F(x). Let z denote the poverty line, the threshold expenditure below which one is considered to be poor. Then F(z) is the proportion of individuals (or families) below the poverty line. The relative poverty line is estimated based on the expenditure profile of respondents on basic needs (food and non -food items) as shown in Table 2. However, the total household Per capita Expenditure (PCE) is used as proxy of standard of living.

$$\text{Mean PCE (MPCHHE)} = \frac{Total\ PCE}{Total\ number\ of\ Households} \text{ ----------[4]}$$

The non-poor threshold is the region greater than two-thirds of MPCHHE while the moderate poverty line ranges from one third to two-thirds of MPCHHE; and the core-poor threshold is the region less than one-third of MPCHHE. This study adopted Foster et al. (1984) approach to estimate the incidence, depth and severity of poverty in the study area. The FGT indices are calculated by taking the proportional shortfall in expenditure for each poor household and normalising the sum by the population size. The major question regarding poverty in this study is what effect does vetiver grass adoption have on farmer's poverty status?

RESULTS AND DISCUSSIONS

Table 1 shows the distribution of household's head in terms of gender. Majority of house head heads were males (51.2%) while females were 48.8%. This implies that males dominate headship and are likely to adopt vetiver grass because the technology is labour intensive. This finding agrees with Awoyemi (2000) in his gender analysis of economic efficiency who reported a positive coefficient for males in cassava-based farm holdings showing that males are more efficient in cassava production than women.

In addition, majority of the household heads were within the ages of 41-50 years (39.6%) while the least was reported for 31-40 years (16.8%). The mean age of house head's head was found to be 48±10.46 years. This means

that majority of the farmers fall into their physically and economically active age group respectively.

Furthermore, majority of the households had 6-10 members (50%) followed by those with 1-5 members (44.8%) while the least were those with greater than 10 members. The mean household size was 6±2 persons thus supporting the preponderance of large household size in Nigeria. A large household size will encourage the release of family labour for farm work. This agrees with both Tiamiyu (2008) who discovered that family size was positively related to economic efficiency and Adeoti & Adewusi (2005) who found out that increase in farm labour will increase the probability that the farmer would adopt non-traditional technologies.

With respect to educational attainment of the household head, about 35.6% have tertiary education, followed by those with secondary education (33.6%) while 18.4% had primary education and the least having no form of formal education (12.4%). Conclusively, we can infer that most of the household heads are literate which also encouraged adoption. Education helps to improve farmer's literacy which will afford the farmers the opportunity to understand and increase the probability of adoption (Adeoti & Adewusi, 2005). The table further shows that the farm size has a median of 1.5 hectares with majority of the farmers cultivating less than 1ha (94.8%) while the least of the farmers cultivate between 4-5ha (0.4%). The implication of this is that the farmers are mostly subsistent in production activities. The table also shows that about a quarter of the farmers (23.6%) have 21-30 years' experience in farming while only (5.6%) have experience of above 50years. The average experience is 18±11years, which means that majority of the farmers are experienced in farming. Majority of the respondents (59%) are non-members of co-operatives while (41%) are members of co-operatives.

In addition, table 1 shows that majority of the farmers do not have access to loans from banks (52.4%) while 47.6% have access to loans. Also, majority of the farmers do not have access to extension services (61.2%) while 38.8% do have access to extension agencies. Finally, majority of the farmers have access to leisure (53.2%) while (46.8%) do not have access to leisure.

Analysis of Poverty Profile of respondents.

The summary of households' expenditure on food and other basic needs are presented in table 2. The mean per capita household expenditure (MPCHHE) per month for the respondents stood at ₦15,330.35 while the two-thirds of the MPCHHE amounted to ₦10,271.33. Hence, households were classified as moderately poor if their mean per capita expenditure was below ₦15,330.35 for the month.

Poverty Profile by Adoption Status

Table 3 shows that 55% of the adopters were non-poor since they were above the poverty threshold while about 45% are currently poor and below the poverty threshold. The table also shows that 50% of the non-adopters were non-poor while 50% are poor. The overall total shows that 52.4% of the respondents were non-poor since they were above the poverty threshold while about 47.6% are currently poor and below the poverty threshold.

Table 1: Descriptive analysis of selected socio-economic characteristics.

Variable	Frequency	Percentage (%)
Gender		
Female	122	48.8
Male	128	51.2
Age(years)		
31-40	42	16.8
41-50	99	39.6
51-60	60	24.0
61 and above	49	19.6
Household size		
1-5	112	44.8
6-10	125	50.0
Above 10	13	5.2
Educational level		
No education	31	12.4
Primary education	46	18.4
Secondary education	84	33.6
Tertiary education	89	35.6
Farm Characteristics		
Farm size (Ha)		
0-1	237	94.8
2-3	12	4.8
4-5	1	0.4
Experience (years)		
1-10	21	8.4
11-20	65	26.0
21-30	59	23.6
31-40	33	13.2
41-50	58	23.2
Above 50	14	5.6
Member of Cooperative		
Yes	102	40.8
No	148	59.2
Access to credit		
No	131	52.4
Yes	119	47.6
Access to Extension Services		
Yes	97	38.8
No	153	61.2
Access to leisure		
Not at all	117	46.8
To a very great extent	133	53.2

Table 2: Average monthly expenditure of Farm Households on Food and Some Basic Needs

Item	Average Monthly Expenditure (₦)	Share in Total Expenditure (%)
Food	22,882.98	28.1
Clothing and Footwear	5,986	7.4
Rent	3,107	3.8
Health care	6,450	7.9
Education	16,075	19.8
Transportation	4,673	5.7
Electricity	2,298	2.8
Fuel	2,277	2.8
Water	1,385	1.7
Savings	8,414	10.3
Ceremonies	2,538	3.2
Association	2,107	2.6
Gifts	3,152	3.9
Total (Non- Food)	58,462	
Total Expenditure (Food+Non-Food)	81,344.98	
Mean per capita Household Expenditure	15,330.35	
2/3MPCHHE (Poverty line)	10,271.33	

Table 3: Distribution of Farmers by their Poverty Profile and Adoption Status

Poverty Status	Adopters(N=124)		Non-adopters (N=126)		Total (N=250)	
	Frequency	(%)	Frequency	%	Frequency	%
Poor	56	45	63	50	119	47.6
Non-poor	68	55	63	50	131	52.4
Total	124	100	126	100	250	100

CONCLUSION

Many rural parts of world prone to erosion are not aware of vetiver cultivation and its application still due to poor infrastructure, communication and financial issues. Such areas should be identified in order to introduce vetiver conservation projects through social improvement fund in collaboration with developed countries.

The study assessed the effect of adoption of vetiver grass strip technology on the poverty status of crop farming households in Abia State. The data were collected with a structured questionnaire through a multistage sampling technique for the selection of agricultural zones, blocks, cells and households. A sample of 250 households were selected comprising the Vetiver grass adopters and non-adopters. The data were analyzed using descriptive statistics, Probit Regression Model and Foster-Greer-Thorbecke weighted poverty index. The results revealed that the adoption rate of Vetiver grass strip adopters was 0.496%.This implies that almost half of the respondents adopted Vetiver grass strip while half did not. This result is still encouraging compared with other adoption studies on soil conservation practices where the adoption level was below average. Certain socio-economic and demographic factors that significantly influence adoption level of Vetiver grass strip were: gender, level of education, age, risks, perception of technology, farm-size and cost of labour.

Respondents age was 48.5±10.5 years, and more were male farmers (51.2%). The household size and farm-size were 6.0±2.2 members and 2.0±1.9 hectares, respectively. About 36% of them had tertiary education, while majority (59.2%) were aware of vetiver grass strips technology but 49.6% adopted it. Most of the adopters of vetiver grass strips technology were female (53.2%), with farm size of 1.57±1.46 hectares, and 42.7% of them (28) had tertiary education. From the results of the analysis, the study makes the following recommendations.

Since education, sex, and age were the major factors affecting the adoption and income of vetiver grass farmers. Effective education services should be put in place to give some level of training to farmers especially women by organizing programs such as farmer's day in rural areas. The agricultural extension services rendered by Abia State Agricultural Development Program which is moribund should be resuscitated and well facilitated in terms of human, natural and financial capital by the government.

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