Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development
Vol. 17, Issue 3, 2017
PRINT ISSN 2284-7995, E-ISSN 2285-3952

IMPACT OF SUSTAINABLE SOIL MANAGEMENT TECHNIQUES ON POVERTY LEVELS OF ARABLE CROP FARMERS IN IMO STATE, NIGERIA

Nnamdi Chukwuemeka EHIRIM[1], Emeka Emmanuel OSUJI[2]

[1]Federal University of Technology Owerri, Department of Agricultural Economics, P.M.B, 1526, Imo State, Nigeria. Phone; +2347038446724, ehinadykus@yahoo.com
[2]Michael Okpara University of Agriculture Umudike, Department of Agricultural Economics, P.M.B, 5267, Abia State, Nigeria. Phone; +2348037351597, osujiemeka2@yahoo.com

Corresponding author: osujiemeka2@yahoo.com

Abstract

Efficient use of sustainable soil management techniques has proven to be a panacea for poverty reduction among farmers. Hence this study examined the Impact of sustainable soil management techniques on poverty levels of arable crop farmers in Imo State, Nigeria. Multi-stage sampling technique was used to select 209 arable crop farmers. Information on the objectives of this study was elicited from the sampled respondents through a well structured questionnaire. Data were analyzed using descriptive statistical tools, poverty index, average treatment effect (ATE) and local average treatment effect (LATE) models. Results showed that the mean per capita consumption expenditure among the farm households was ₦360.30 ($1.81) while the poverty line was ₦240.20 ($1.21) per person, per day. Over 70% of the respondents accounted for the number of poor in the area, while 21.5% accounted for the non-poor people. The result further showed that the use of sustainable soil management techniques reduced the poverty level of the farmers by 13.1 percent and 18.9 percent from WALD and IV estimators. Hence, appropriate government policies should be directed towards encouraging the rural farmers to embrace the use of improved farming techniques for increased output and poverty reduction.

Key words: *impact, sustainable soil, management techniques, poverty levels, crop farmers*

INTRODUCTION

Sustainable soil management technique is the application of soil management techniques that support plant growth without degrading the soil for further use [16]. It involves the application of soil management practices that sustain food crop production without posing any adverse effect either immediately or in future.

The relevance of sustainable soil management to agriculture includes the maintenance of soil productivity and economic viability over time without being depleted while maintaining and meeting the food demands of the present and future generations [14]. It is the adoption of land use and crop management strategies that enable soil users to maximize the economic and social benefits of the soil, enhance ecological support and maintain a balanced soil ecosystem [4]. Managing our soils sustainably is very crucial for agricultural production and ecosystems. Methods of protecting and enhancing the productivity of the soil include the use crop rotation, organic manure, minimum tillage, erosion control, avoiding traffic on wet soils and maintaining soil cover with plants and/or mulches [5].

This requires the combination of soil fertility treatment (perhaps including application of organic fertilizers) with soil and water conservation measures, implementation of agronomic principles, soil management and physical measures such as contour ridging, terracing, tied ridges or providing ground cover through mulching, use of leguminous plants and crop residues [6].

According to [11] poverty can be reduce through the application of sustainable soil management techniques which build up soils using products and by products from own property or a local source that is added directly to the soil for long term benefit. Poverty on its own, depicts lack of basic necessities of life [1] intensified by insecurity, deprivation of well-being assests and vulnerability to shocks of climate change and food price fluctuations [26].

It is pervasive and manifests through social and pyschological deprivation from access to speech, decision making or accessement of cultural values, rights and freedom as well as the lack of dignity, self respect, security and justice [20] which engenders variant soil practices.

The poor adapts to shocks by using some copping strategies that are concomitant to soil degredation that reduced efforts of sustainable environmental management [2].

Hence the quick spread of land degredation. Poverty is often associated with low income [27] and low standard of living.

The incidence of poverty has plagued the rural farming households in Nigeria. Over 70% of the farmers cannot afford some modernfarming techniques [22].

Majority of the farmers still engage in the use of crude implements which is sine-qua-non to drudgery, low productivity and poor income. Consequently, poverty leads to low agricultural productivity and which further reinforced poverty incidence of the farmers. Most rural farmers in Imo State are resource-poor owing to the fact that they lack the ability to buy high yielding seeds, fertilizers, irrigation equipments and other tools needed to increase soil nutrients and land productivity [23].

[7] noted that apart from poverty incidence, the farmers' decision on the techniques of farming and tools to use especially in land preparation affect the bio-physical quality of the soil and the speed of soil depletion. Therefore, persistent use of some unsustainable soil management techniques by food crop farmers that dominate the crop production of the state could be the reason for the poor performance on food crop production, increased poverty and declining agricultural productivity in the State [9].

However, the extent to which the use of sustainable soil management techniques (SSMT) by arable crop farmers to reduce poverty especially in Imo State has not been documented, hence the need for this study.

MATERIALS AND METHODS

This research was conducted in Imo State of Nigeria, which is located in the South Eastern part of Nigeria with a land area of 5,530 sqkm. The State lies between latitudes $4^0 45^I$N and $7^0 15^I$N and Longitudes $6^0 50^I$E and $7^0 25^I$E. The State shares boundaries with Abia and Cross Rivers State to the East, Delta State to the West, Rivers State to the South and Enugu and Anambra State to the North [10]. The State has Owerri as its capital and made up of 27 (twenty-seven) Local Government Areas which are grouped into three agricultural zones namely Owerri, Orlu and Okigwe. Farming is the predominant occupation of the rural inhabitants. Multi-stage sampling technique was used for this study. In the first stage, two local government areas (LGAs) were purposively selected from each of the three agricultural zones of the State namely (Owerri, Okigwe and Orlu). The selection of these LGAs was based on their predominant agricultural activities and use of sustainable soil management techniques (SSMT). The LGAs selected were Ngor-Okpala and Ohaji-Egbema from Owerri zone, Nwangele and Isu from Orlu zone while Isi-ala Mbano and Obowo were selected from Okigwe zone respectively. A total of six (6) local government areas were used for this study. The second stage involved a random sample selection of arable crop farmers from the list of registered arable crop farmers using SSMT, kept with the zonal ADP's in each of the selected LGAs from the various zones of the State. Owerri zone has 122 registered arable crop farmers while Orlu and Okigwe zones have 130 and 109 arable crop farmers. This shows that there are unequal numbers of arable crop farmers across the three zones, hence an equal representation of sample was made from a proportion of 70 percent of the total population from each zone. This gave a sample size of 85 for Owerri zone, 91 for Orlu zone and 76 for Okigwe zone giving a total of 252 arable crop farmers across the six LGAs. However, the study eventually used only 209 valid questionnaires for analysis. Data were analyzed using descriptive statistical tools, poverty index model, average treatment effect (ATE) and local average treatment effect (LATE) models following [8] and adapted by [24].

Poverty index model is stated as follows:

MPCE = $\frac{THCE}{HHSZ}\frac{THCE}{HHSZ}$ (1)

Where poverty line or threshold is the minimum level of income deemed necessary to achieve adequate standard of living in a given society [21]. This is shown as the mean per capita consumption expenditure (MPCE), which becomes a relative standard for poverty line usually measured as two-third of the MPCE of the household in the population under study. It is estimated using the total household consumption expenditure (THCE) which is an aggregate total expenditure on utility, service, food and durable assets of the household relative to the household size (HHSZ).

Average Treatment Effect models were specified thus:

ATE = $\frac{1}{n}\sum_{i=1}^{n} - \frac{(d_i - p(X_i)y_i}{p\,(X_i)(1-p(X_i)}$ (2)

ATE1 = $\frac{1}{n1}\sum_{i=1}^{n} - \frac{(d_i - p(X_i)y_i}{(1-p)(X_i)}$ ---------------- (3)

ATE0 = $\frac{1}{1-n1}\sum_{i=1}^{n} - \frac{(d_i - p(X_i)y_i}{p(X_i)}$ --- -----------(4)

Where n is the sample size, $n_i = \sum_{i=1}^{n} d_i$ is the number of treated (i.e. number of SSMT users)

P(X_i) represents the PSM evaluated at X_i

ATE = Average treatment effect

ATE0 = Average treatment effect on the untreated

ATE1 = Average treatment effect on the treated

Y_i = Outcome variable,

d_i = Use status of the farmers.

The LATE Model is further expressed as follows:

$$E(y_1 - \frac{y_0}{d_1} = 1) = LATE = \frac{cov(y,z)}{cov\,(d,z)} \quad (5)$$

$$= \frac{E\left(\frac{y}{z}=1\right) - E(\frac{y}{z}=0)}{E\left(\frac{d}{z}=1\right) - E(\frac{d}{z}=0)} \text{ ----} \quad (6)$$

$$= \frac{E(y_i * (z - E(z_i)}{E(d_i * (z - E(z_i)} \text{ ----} \quad (7)$$

The right hand side of eqn. (7) can be estimated by its sample analogue:

$$\left(\frac{\sum_{i=1}^{n} y_i z_i}{\sum_{i=1}^{n} z_i} - \frac{\sum_{i=1}^{n} y_i(1-z_i)}{\sum_{i=1}^{n}(1-z_i)}\right) \text{ X } \left(\frac{\sum_{i=1}^{n} d_i z_i}{\sum_{i=1}^{n} z_i} - \frac{\sum_{i=1}^{n} d_i(1-z_i)}{\sum_{i=1}^{n}(1-z_i)}\right) \quad (8)$$

Where:

Z = binary outcome variable

y_1 = high users of SSMT

y_0 = low users of SSMT

d_i = use status of the farmers

E = mathematical function

This is well known as the Wald and IV estimators, which can be estimated using two-stage least squares. The framework was designed by [17] and [15] in treating a set of heterogeneous population like the use of sustainable soil management techniques that has two possible outcomes denoted by y_1 and y_0 as high and low use of SSMT. High using status is denoted as d_1, otherwise d_0. The causal effect of use of SSMT on observed outcome is the difference between the two potential outcomes (y_1-y_0). But the realization is mutually exclusive for individual farmers, hence making it impossible to obtain the individual effect of using SSMT on the population. [8] noted that the impact parameter that identifies the causal effect of SSMT users in the presence of non-compliance as well as remove both overt and hidden biases is the local average treatment effect (LATE) which remedy the shortcomings associated with the computation of the average treatment effect.

RESULTS AND DISCUSSIONS

Estimated Poverty Line in Imo State

The estimated poverty line of the arable crop farmers is presented in Table 1. The Table depicts the estimated poverty line of the arable crop farmers which was based on per person, per day. Results showed that the mean per capita consumption expenditure among the farm households was ₦360.30 ($1.81) while the poverty line was ₦240.20 ($1.21) per person, per day. This implies that the farm households were living on ₦240.20 ($1.21) per person, per day. This differs from the findings from [19] and [11] which reported different poverty lines across arable farm households. This amount could be too low to meet the daily needs of the entire farm household heads. Moreover, considering the poverty line obtained and the mean household size of 6 persons per household, these values ₦240.20 ($1.21) and ₦40.03 ($ 0.20) were lower than the international poverty threshold of ($1.25) per person, per day for people living in Sub-Saharan Africa and Asian countries as viewed by [25], [19] and [28]. The results tend to suggest problems of food insecurity among poor farm households. In other words these amounts may not be able to meet the minimum daily calorie in-take of 2,250 Kcal required per person per day. Hence, any household spending less than the amount obtained above on consumption is described as being poor while any other household spending exactly the stipulated amount or higher than that on consumption imply that the respondent is non-poor.

Table 1. Estimated Poverty Line

MPCE	**₦360.30 ($1.81)**
Poverty Line	₦240.20 ($1.21)
Mean Household Size (6 persons)	₦40.03 ($ 0.20)

Source: Computed from Field survey data, 2015
Note: The Dollars equivalents were given in parenthesis. The exchange rate was ₦199 per US Dollar in 2015.

Poverty Status of the Farmers with respect to Poverty Line

Table 2 shows that over 70% of the respondents accounted for the number of poor in the area, while 21.5% accounted for the number of the non-poor people in the study area implying that the percentage of the non-poor is too low compared to the percentage of poor people.

Table 2. Distribution of Farmers According to Poverty Status with Respect to Poverty Line

Poverty Status	Frequency	Percentage
Poor	164	78.5
Non-poor	45	21.5
Total	209	100

Source: Field Survey, 2015.

This further corroborates with the findings of [22] and [30] who reported that majority of the farmers in the State are resource poor which engenders the application of variant soil techniques.

According to the poverty line, anyone earning below ($1.21) per day is living in poverty and otherwise.

Impact of Sustainable Soil Management Techniques on Poverty Levels of Farmers

The impact of sustainable soil management techniques on poverty levels of arable crop farmers is shown in Table 3. Relative poverty line was used in this study to classify the respondent farmers as non-poor and otherwise poor. The proportion of poor or non-poor formed part of this estimate. This is different from [3] and [23] who adopted the per capita household consumption expenditure.

The propensity score matching and inverse propensity score weighing were -0.1235 and -0.0586 respectively. The estimates are negative and not significant even at P≤0.1 critical level. However, it could be deduced from the result that increase in the use of SSMT will reduce poverty by 12.35% and 5.86% respectively using these estimators. It is important to note that while overt bias were removed from the farmers self selection problems, the hidden bias still exist within the problem hence, making such estimators an inconclusive estimation procedure as far as impact studies is concerned. The intension to treat effect may not have been corrected using PSM and IPSW as non-compliance problems may persist. The use of SSMT is endogenous hence, the removal of non-compliance cannot be possible with PSM, because of its limitations as it does not account for hidden / decision bias and does not have causal interpretation on our outcome of interest [18] and Javier and [13]. However, the local average treatment effect was used in this study to curb the limitations of PSM and IPSW. Hence, the LATE estimator using WALD or IV becomes very efficient in elimination of the hidden bias from self selection problem. The WALD estimator while accommodating the oversights of PSM and IPSW has its estimate as -0.1313. While, the LATE estimator using IV has its value as -0.1894 as shown in Table 3 below. Hence, these estimates differs from the one obtained by [23]. The estimates are negative and significantly different from zero at P≤0.01, hence, the inverse relationship of the sustainable soil management techniques with the poverty level of the farmers implies that the higher the use of sustainable soil management techniques, the lower the probability of the farmers being poor. The result further showed that the use of sustainable soil management techniques reduced the poverty level of the farmers by 13.1 percent and 18.9 percent from WALD and IV estimators respectively. Thus a unit increase in the use levels of sustainable soil management techniques would lead to a corresponding decrease in the poverty level of the farmers. This finding is consistent with *a priori* expectations and supports the findings from; [12], [15], [18], [23] and [29]. Furthermore, the finding also revealed that apart from the sustainable soil management techniques impact on farmer's net income, the use of SSMT also have significant impact on relative poverty levels of the farmers. Hence, the IV (Extension contacts) may have guided this finding. It therefore follows that the use of SSMT will not only increase farmer's net income; it can also reduce the poverty levels of arable crop farmers in the State.

Table 3. Impact of Sustainable Soil Management Techniques on Poverty Levels Arable Crop Farmers

LATE Estimators				
PARAMETER	LATE (WALD)	LATE (IV)	ATE (IPSW)	PSM
ATE	-0.1313	-0.1894	-0.0586	-0.1235
	-(15.16)***	-(21.04)***	-(0.16)	
ATE 1			-0.0748	
			-(2.26)**	
ATE 0			-0.0419	
			-(0.35)	

Source: Computed from field survey data, 2015
***; ** indicates statistical significance at 1 percent, and 5 percent respectively

CONCLUSIONS

Poverty induces farmers to employ variant soil management techniques that are quite unsustainable and this approach has adversely affected the productivity and income of the farmers.

The findings of the study reveal a poverty line of ₦240.20 ($1.21) per person, per day using the relative poverty approach. This implies that the farm households were living on this income per person, per day. Thus, this amount suggests problems of food insecurity among poor farm households as evidenced in the poverty status. The Late model was used to remove both overt and hidden biases associated with the use of sustainable soil management techniques which helped in increasing the income of the farmers and thus, reducing their poverty levels in the area. Therefore; appropriate government policies should be directed towards encouraging the rural farmers to embrace the use of improved farming techniques for increased output and poverty reduction.

REFERENCES

[1]Bamlaku, A., 2011, The impact of poverty, tenure security and risk on sustainable land management strategies in North-Central Ethiopia: Analysis across three agro-ecological zones. Journal Sustainable Development in Africa. 13(1): 11-13.
[2[Deaton, A., 2003, How to monitor poverty for the millennium development goals. Research program in development studies. Princeton University. 23-27.
[3]Diagne, A., Adekambi, S. A., Simtowe, F. P., Biaou, G., 2009, The impact of agricultural technology adoption on poverty: A contributed paper at the 27th Conference of the International Association of Agricultural Economics. August 16- 22. Beijing, China. 26-31
[4]FAO, 2005, Agricultural workers and their contributions to sustainable agriculture and rural development. FAO/Rome (Italy), 13-16.
[5]Gail, F. A., 2013, Sustainable agriculture research and education program. Agricultural Sustainability Institute, University of California, Davis, CA. 95616, (530): 752-756.

[6]Garrity, D. P., 2004, Agroforestry and the achievement of the millennium development goals. Agroforestry System. 61:5-17.
[7]Ibeawuchi, I. K., 2007, Intercropping a food production strategy for resource-poor farmers, Nature and Science, 5(1): 46-49.
[8]Imbens, G. W., Angrist, J. D., 1994, Identification and estimation of local average treatment effects. Econometrica 62(14): 467-476.
[9]Imoh, A.N., Ajaero, J.P., 2007, Rural women involvement in dry season vegetable production and marketing in Ezinihitte Local Government Area of Imo State, Nigeria. GAEP. 3(12): 9-12.
[10]ISSYB, 2004, Imo State Statistical Year Book publications of Imo State Government.
[11]James, A.N., Patience, G., Glory, A. A., Barnabas, T. M., 2014, Assessment of fish farmers' livelihood and poverty status in Delta State, Nigeria. Journal of Agriculture, Forestry and Fisheries; 3(5): 427-433
[12]Janvry, A., Sadoulet, E., 2002, World poverty and the role of agricultural technology. Direct and indirect effects. Journal of Development Studies, 38(4): 1-26.
[13]Javier, B., Awudu, A., 2010, The impact of improved maize varieties on poverty in Mexico: propensity score matching approach. World Development, 38(7):1024-103
[14]Kate-Robert, W., 2010, Readings in sustainability science and technology. an introduction to the key literatures of sustainability science. CID Working Paper, No. 213, Centre for International Development. Harvard University, Cambridge. 24-28.
[15]Lee, M. J., 2005, Micro-econometrics for policy, program and treatment effects. Advanced text in econometrics. Oxford University Press. 36-39.
[16]Manning, S., Booms, F. O., Von-Hagen, Reinecke, J., 2011, National contexts matter: The co-evolution of sustainability standards in global value chains. Ecological Economics. 49(1): 104-109.
[17]Mendola, M., 2007, Agricultural technology adoption and poverty reduction: A propensity- score matching analysis for Rural Bangladesh. Food policy 32: 372-393.
[18]Mendola, M., 2005, Agricultural technology adoption and poverty reduction: A propensity- score matching analysis for rural Bangladesh. Food policy. 32: 372-393.
[19]Ogbonna, M.C., Onyenweaku, C.E., Nwaru, J. C., 2012, Determinants of rural poverty in Africa: The case of yam farm households in Southeastern Nigeria. Int'l Journal of Agric. and Rural Dev. 15(2): 1129 – 1137
[20]Okojie, C.E.E., Anyanwu, J.C., Ogwumike, P.O. 2000, Poverty in Nigeria: An analysis of gender issues, access to social service and the labour markets. A draft report to the African Economic Research Consortium (AERC), Nairobi, Kenya. 20-26.
[21]Olaniyan, O., Bankole, A. S., 2005, Human capital, capability and poverty in rural Nigeria. Journal of Social Sciences. 3(2): 34-40.
[22]Onweremmadu, E.U., Onyia, V.N. Anikwe, M.A.N., 2008, Geospatial distribution of organic matter in soils of Imo and Abia Areas, Southeastern Nigeria. Journal of Environmental Science and Pollution Research, 2(1): 46-53.
[23]Osuji, E.E., Ohajianya, D.O., Ehirim, N.C., Eze, E.U., 2012, Effect of land use patterns on agricultural productivity in Imo State, Nigeria. International Journal of Food and Agricultural Research. 9(1): 81-89.
[24]Paul, M.D.N., 2010, Impact of new rice for Africa (NERICAS) varieties adoption on rice farmers' households' welfare in Nigeria. Unpublished Ph.D Thesis, Department of Agricultural Economics, University of Ibadan, Ibadan.
[25]Ravallion, M., 2005, Evaluating anti-poverty programs. World Bank policy research working paper 36: 55-61. The World Bank, Washington, D.C.
[26]Ravallion, M., Shaohua, C., Sangraula, P., 2009, "Dollar a day revisited". World Bank Economic Review 23(2): 163-184.
[27]Stephen J. I., James, O. A., 2015, Analysis of the impact of community based poverty reduction project on farming communities in Kogi State, Nigeria. Journal of Economics and Sustainable Development, 6(4):19-23.
[28]United Nations, 2003, World reports, on poverty and its devastating effects on the populace, 23-31.
[29]WorldBank, 2000, World development report: Attacking poverty. Oxford university press, Washington, D.C. 21-22.
[30]WorldBank, 2015, WorldBank development report, Washington, D. C. 221-226.