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JOURNAL OF CONTEMPORARY RESEARCH (JOCRES)

RESEARCH ARTICLE VOL. 2 (2) ISSN:2814-2241

Date Accepted: 30th September, 2023

Pages 80 - 86

IMPACT AND ADOPTION OF SUSTAINABLE AGRICULTURAL PRACTICES ON CASSAVA YIELDS AND INCOMES OF RURAL FARMERS IN C.R.S.

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Abstract

This paper uses multivariate logistic estimation model and data from a sample of 180 cassava farmers to assess the determinants and impact of adoption of sustainable agriculture practices (SAPs) on cassava yields and incomes of rural farmers in cross river state. Harmful agricultural practices such as bush burning and mono-cropping are environmentally unfriendly and affect crop yield and incomes of farmers. It is expected that adoption of SAPs will scale up cassava production, reduce poverty and increase food safety net in Cross River State. Results reveal that adoption decisions are driven by households and plot level characteristics also, the adoption of a combination of SAPs packages raises both cassava yields and incomes of small scale farmers. Adoption of improved cassava alone increases cassava yield but profitability is limited due to cost of inputs. Greater household incomes are associated with adoption of SAP package such as cassava-legume rotation and improved cassava varieties.

Keywords: Adoption, SAPs, cassava yields, multivariate logistics model, incomes.

1. Introduction

Low soil fertility is one of the major constraints to cassava production and indeed agricultural productivity in Nigeria, (Usman M., Madu, v. and Alkali, G. 2005). Depleted and infertile soils as a result of continuous mono-cropping and insufficient recycling of organic matter couple with rainfall variability, constant and intensive farming practices and over-exploitation of ground water have resulted to low crop yields in Cross River State and accelerated poverty, food insecurity and child malnutrition.

Sustainable Agricultural Practices (SAPs) proffer potential solution to some of these problems by restoring and improving soil fertility, protecting the environment by conserving resources and reducing the quantity of waste generated, sequestering carbon for climate change mitigation and increasing crop yields and incomes. SAPs may include crop rotation, residue retention, cover-cropping, conservative tillage, intercropping with legumes, soil and stone bunds for soil water conservation. It also includes improved crop varieties and compositing. Using these methods, sustainable farmers can improve the soils ability to retain water, resist erosion, and produce more foods with fewer inputs (Jat, R., Sahrawat, K.and Kassam, A.2013). This paper focuses on two SAPs and a combination of them as it relates to cassava production as a major staple in cross river state: cassava-legume rotation and improved cassava varieties. Cassava-legume (groundnuts) rotation has enormous benefits for both farmers and the environment including soil improvement through nitrogen fixation by root nodules of legumes. It also increases soil-carbon content, which helps to mitigate the effect of climate change (Anderson *et al.*, 2014).

Although SAPs offer a number of benefits, there is limited empirical evidence on the determinants of their adoption and their impacts on small holder welfare and income. Recent studies on adoption of SAPs, uses unrelated multivariate probit regression models (kamau*etal*,2014) to assess the factors that affects adoption but do not analyse the impacts of (combination of) these

SAPs on crop yields and incomes of small holder cassava farmers. To my knowledge the only studies that assess the impact of SAPs in Nigeria are by Ireti E. *et al*, (2021) in south-western states, which is a different ecological zone. This study uses multivariate probit model to assess effects of agricultural programs and land ownership on the adoption of sustainable agricultural practices. Kassie et al (2013) also uses multivariate profit regression model to assess factors that affects adoption but do not analyse the impacts of (combination of) these SAPs on crop yields and incomes of smaller holder farmers.

This paper contributes to the emerging body of literature on SAPs by identifying the factors that affects the decision to adopt individual practices of cassava-legumes rotation, and improved cassava varieties as well as a combination of the two practices and their impact on small holder farmers' welfare in cross river state. The specific objective is to measure the economic and environmental advantages of adopting the use of SAPs over non-adopters.
The adoption of these practices are modelled as a multivariate selection process where the expected benefits of SAPs induce the adoption decisions. I specifically use a multivariate logistic model (Ireti *et al* 2021) to account for selection bias due to both observed and unobserved heterogeneity and to assess the differential impacts of the adoption of single and multiple SAPs.

2. Conceptual and economic framework

Agricultural technologies are most often introduced in packages that include several components. These inclusions may complement each other, or may be adopted independently (Feder*etal*,2016).In most cases, farmers adopt a combination of technologies to deal with a range of agricultural production constraints including low crop productivity, weeds, pest and disease. This study focuses on technology adoption as a choice over alternatives involving two SAPs (crop rotation and, improved cassava varieties), (i) No adoption (ii) Cassava-legume rotation only (iii)Improve cassava varieties only (iv)Cassava-legume rotation and improved cassava varieties only.

Economic Concept of utility assumes that a farmer aims to maximize their utility by comparing the utility provided by alternative varieties. A farmer will therefore choose any practice *j* over any alternative practices k if vij>vik, $k \neq j$
Cassava farmers often select into the adopter/non adopter categories and possible endogeneity problems may arise due to unobservable factors which may be correlated with the out come variables (yields and total household income). (Abdulai and Huffman, 2014) and failure to account for this may Overstate or understate the true impact of SAPs.

3. Materials and methods.

This study was carried out in cross river state. The state is geopolitically divided into three Senatorial Zones which spans from the mangrove of the south through the forest woodlands of the central to the guinea savannah of the northern senatorial district. It is bounded to the south by Atlantic Ocean and Akwa Ibom State, to the east by republic of Cameroon to the north by Benue state and to the west by Ebonyi state and Abia state in southwest. It lies between latitude $4^0 58^1 33^{11}$and longitude 6^0 $10^1 13^{11}$of the Greenwich meridian. The state is characterized by two distinct wet and dry seasons with annual rainfall of 1300 - 3000mm and average temperature of 15^0C – 30^0C. Cross River is naturally endowed with fertile soils which promote the growth of crops like oil palm, cassava, groundnuts, cocoa, yam and plantain. The major occupation is farming.

A multistage procedure was used. The first stage involved purposive selection of the three senatorial zones to strategically have good representation (Southern, Central and Northern senatorial zones). The second stage involves randomly selecting three local governments each from the three senatorial zones (Odukpani, Akamkpa, Biase, Abi, Obubra, Ikom, Ogoja, Yala and Obudu) making a total of nine local government councils. In the third stage, two villages each were selected from nine L.G.A on the basis of cassava production areas making a total of 18 villages. Finally, well-structured questionnaires were administered to 180 respondents.

Analytical techniques employed the use of multivariate logistic selection model to analyze economic and social factors that determine adoption of SAPS. The Ordinary Least Square (OLS) was used with selectivity correction to estimate the impact of SAPs on cassava yields and household income. In addition, the plot level information was exploited to deal with the issue of farmers' unobservable characteristics that are likely to affect the results.

4. Model Specification

Data analysis was done using the multivariate logistic regression model. The logistic model was preferred over the linear and probit model because according to Greene (2000), the logisticmodel ensures prediction of probability of choice in the range of 0 and 1.

In multivariate logistic technique, the probability of a farmer adopting innovation (SAPs) is defined in terms of an index or stimulus which is unobservable. The cumulative normal distribution with zero mean and unit variance is used in transforming the index to the probability range thus;

$$Pi = \frac{1}{\sqrt{2\pi}} \int_{\infty}^{Z*} \exp \frac{(-S^2)ds}{2} \ldots\ldots\ldots\ldots\ (2)$$

Where; z*=level of stimulus and

Pi =probability of observing response (adoption)

The unobservable z* is defined as a linear combination of observable explanatory variables. It is represented algebraically for the farmer as;

$$Z_i = B_o + B_1X_{1i} + B_2X_{2i} + \text{---}\ BnX_{ni} + e_i \ldots\ldots .(3)$$

I = 1, 2 … m(sample size)

Hence $z_i = F^1(p_i) = Bo + BX_i$

or $P_i = F\,(B_o + BX_i)$.

In the second stage, the impact of adopting SAP bundle was assessed on two outcome variables; the natural logarithm of cassava yields and total household income per capita. The expected outcome equation is formulated as:

$$E(yi/di, xi, Li) = xi \quad \beta + \sum Yj\, dy + \sum \lambda j1ij \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots.(1)$$

in this equation yi is the welfare outcome for a household *i*: specifically, coefficients yj estimates the effects of SAPS on the welfare of farm households. Although in principle the parameters of the model can be estimated using the maximum- likelihood Estimation (MLE). The use of MLE guarantees that all the parameter estimates are asymptotically normal, such that the test of significance analogous to the regression t-test can be performed. The error term which represent the unobservable household and farm level characteristics of surveyed farmers, is assumed to be independently distributed over the survey period.

5. Results and Discussion

5.1 Factors influencing adoption of SAPs.

Table I presents results of estimates of multivariate logistic model. The baselines or dependent variable is non-adoption against which results are regressed. The wald test shows that R^2= 74.89 with p- value of 0.000 This implies that the null hypothesis that the regression coefficients are jointly equal to zero is rejected.

The results of table 1 also shows that, the coefficient of age is negative implying that adoption of most SAP packages decreases as a farmer advances in age. Ageing farmers may find it difficult to apply novel technology in their farms.

Education level plays a significant role in technology adoption. Hence the coefficients are positive and significantly associated with most of the SAPs. This is consistent with the work of Ersado et al., (2004).

The result also shows that female-headed household are less likely to adopt SAP packages. This implies that women have less resources and information on improved agricultural technologies. Membership of association is positive and significant at 5% (0.27) implying that it is easier for a group to adopt new technology than individuals. The result on extension contacts revealed that the contacts period had negative coefficients. This also indicates an inverse relationship. It implies that cassava farmers in the study area do not come in contact with extension services as required.

The size of farm according to table 1 revealed that household that have larger sizes of farm are more likely to adopt SAPs than those with small farms. This results is consistent with the work of Kassie et al., (2013) Shehu, et al., (2009)

Farm experience is significant and positive. This implies that as farming experience increase, the possibility of adopting SAP package increases. It means farmers who are experience are more likely to adopt SAP packages than less experienced farmers.

Farm households that do not trust formal financial sources are more likely to adopt SAP and diversity practices believing that formal sources of finance may not guarantee household food diversity need (kassieetal 2013). This is evident in the negative coefficients for financial sources, consistent with the work of Adegbola and hardebrook, (2007)

Land ownership is important in technology adoption. Result shows that, household that have larger parcels of land are more likely to adopt SAP packages than those with less land. This result is consistent with the work of Teklewold et al., (2013) who asset that land ownership has a significant effect on adoption decisions.

5.2 Impact of SAPs on Cassava Yield and Income.

Results displayed on table 2 reveals impact of SAPs on cassava yield and incomes of households. It shows that adoption of cassava-legume rotation alone is significant at 5%for both yields and incomes of household. This is so because not much is invested into inputs like fertilizer as legume provide nitrates into the soil. This is consistent with the work of Eze et al., (1999). Adoption of improved cassava alone increase cassava yields by 80% and income by 46% than non- adopters. Increase in yield is more than increase in income because of the high cost of input such as fertilizers. This is consistent with the work of Ali, N.C. (2005)

The table equally reveals that adoption of SAP package in combination of other packages such as cassava-legumes rotation and improved cassava increases both yield and household income by 52% and 75% respectively than non-adopters and is significant at 1% level. This is also consistent with the work of Tiku et al., (2015). Implying that adopting a more comprehensive SAP package translate to increase yield and household incomes of farmers.

6. Conclusion

The purpose of this study was to examine the impact and adoption of sustainable agricultural practices (SAPs) on cassava yield and incomes of rural farmers in Cross River State.

Results shows that household and farm level characteristics such as age, education level, membership of association, farm size and experience, land ownership and extension contact significantly influence Adoption decisions of cassava farmers.

It also shows that SAP packages give better results when adopted in combination of other packages such as cassava-legumes rotation and improved cassava varieties. The combination of these SAP packages has a significant effect as it increases yield and household incomes of farmers up to 75% more than non-adopters.

7. Recommendations

Since education is important in adoption decision of SAPs, the result suggest that improvement in education should be one of the strategies to improve adoption of SAPs. It is also important to address the problem of lack of information on the part of extension agents. Extension agents should be motivated to work with rural farmers. Finally, policy makers and researchers should look for cheaper methods of increasing yield and incomes of cassava farmers by finding best combinations of SAPs packages for farmers to adopt.

Table 1: Multivariate logic model estimates of SAPs adoption

Variables	Cassava – legume rotation	Improved cassava variety only	Improved cassava variety and cassava – legume rotation
Gender	-0.83 (0.22)***	-0.63 (0.24)**	-0.06 (0.28)***
Age	-0.00 (0.02)	0.01 (0.01)*	-0.01 (0.01)
Education level	0.02 (0.04)***	0.13 (0.05)**	0.03 (0.02)***
Membership Of association	0.29 (0.30)	0.55 (0.31)	0.54 (0.27)**
Extension contacts	0.16 (0.28)*	-0.03 (0.01)	-0.02 (0.01)**
farm size	0.10 (0.01)***	0.12 (0.03)**	0.02 (0.09)*
farm expensive	0.06 (0.02)*	0.02 (0.12)	0.02 (0.01)**
financial sources	-0.73 (0.27)**	-0.91 (0.48)*	-0.03 (0.14)***
land ownership	0.14 (0.02)***	0.04 (0.03)*	0.18 (0.04)***
constant	2.21 (1.04)***	2.01 (1.10)*	4.00 (0.84)***
Wald test	R^2 = 74.89:P>R^2 = 0.000		

****,**,* represent significance level of p< 0.01, 0.05 and 0.10*

Robuststandard error in parenthesis

Table 2: Impact of SAPs on cassava yields and household incomes

Adoption package	Log cassava yield per ha	Log household income per capita
Cassava – legume Rotation	38% (0.15)***	50% (0.20)**
Improved cassava variety	80% (0.14)***	46% (0.12)**
Cassava – legume rotation and improve cassava variety	52 % (0.17) ***	75% (0.19)***

****,**,* represent significance at 10%, 5% and 1%. Baseline is farm household that did not adopt SAPs*

References

Abdulai, A and Huffman, W. (2014) the Adoption and Impact of soil and water Conservation Technology. An endogenous switching regression application: *Land Economics Vol 90: 26-43*

Ali, N. C. (2005) Profitability Analysis of Cassava Processing in Igbo-Eze South Local Government of Enugu State. Unpublished B. Agric project, Dept of Agric Econs. University of Nigeria Nsukka 23-267

Ersado, I, Amacher G. and Alwary, J. (2004) Production and Land enhancement technology in Northern Ethiopia: Health, Public investment and sequential adoption. *American Journal of Agricultural Economics, 86 (2): 321-331*

Eze C. and Madukwe O. (1999) Adoption Behaviour of farmers in South West Nigeria: The case of cassava farmers. *Bulgaria Central EU. Agric. 6(4):142-432*

Greene, W.H (2000) Econometric Analysis Fourth Edition, Prentice Hall Int'l Edition U. S. A

Ireti Emmanuel A, William N, miroslava B and Mustapha Y. M. (2021) Effects of Agriculture Programmes and Land Ownership on the Adoption of Sustainable Agriculture Practices in Nigeria. *Journal of Sustainability 13(13): 7249*

Kassie, M. Jauta, M, shiferaw, B, Mmbando, F and Makuria, M. (2013) Adoption of interrelated Sustainable Agricultural Practices in Small holder system: evidence from rural Tanzania. *Technological forecasting and social change Vol. 80: 523-540*

Teklewold, H., Kassie, M. and Shiferaw, B. (2013) adoption of multiple sustainable agricultural practices in rural Ethopia. *Journal of Agricultural Economics vol.64: 597-623*

Usman M., Madu V. U. and Alkali G. (2015): The combine use of organic and inorganic fertilizer for improving maize crop productivity in Nigeria. *International Journal of Science Research Pub 8 (10): 1-7*