Farmers' Sustained Adoption Decision Behaviors of Maize/Cassava Intercrop Technology in Imo State: Lessons for Extension Policy Development

Fidelia N Nnadi [1], Chidi Nnadi [2]

[1] Department of Agricultural Extension, Federal University of Technology, Owerri, Imo State PMB1526, Nigeria
[2] Department of Agricultural Economics and Rural Sociology, Niger Delta University, Bayelsa, Imo State PMB1538, Nigeria
dr_charleso@yahoo.com

Abstract: Various variables influence farmers' sustained adoption decision behaviors. Thus the rate of sustained adoption of maize/cassava intercrop technology, reasons for the sustenance and the determinants were empirically investigated in Orlu zone of Imo State with a view to drawing lessons for extension policy development. Data were collected from 115 randomly selected crop farmers using structured questionnaire. These were analyzed with percentage counts, frequency tables and logit regression model at 0.05 level of significance. The farmers' sustained the adoption of the technology by 88.7% with reasons ranging from environmental friendliness to full utilization/maximization of agricultural land. The farmers' age, family size, education, farming experience, social organization membership, farm size, and annual farm income as well as number of technological information sources used determined their sustained adoption decision behaviors. It was recommended that extension education sensitization campaign be intensified using multi-media as well as extension intervention strategies being guided by the socio – economic attributes of the farmers.
[World Rural Observations 2009; 1(2):87-92]. ISSN: 1944-6543 (print); ISSN: 1944-6551 (online)

Key words: sustained adoption; decision behaviors; intercrop technology

1. Introduction

In Imo State, household food security is of major concern. Increasing population and alterative demands for land has exacerbated this. As a panacea, innovative technologies that favour farm level production from research stations are disseminated by the State Agricultural Development Programme (ADP) to farmers for use. One of such technologies is maize/cassava intercrop.

The maize/cassava intercrop technology is the growing of maize and cassava in proximity as their period of overlap is long enough to include the vegetative stages (Gowez and Gowez, 1983). The technology is a risk management strategy that attempts to hedge against the vagaries of market, rainfall \and pest attack (Mutsaers *et al* 1993; Vandermeer, 1989). Here, cassava, a semi - perennial crop is associated with an early maturing crop, maize in such a way that the maize is harvested 3-4 months and the cassava harvest may start 9 months after planting. The bulk of the cassava is harvested after 12-35 months (Mutsaers et al, 1993). There is reduction in pest attack as a non-host plant is included in the field (Dessimond and Hindorf, 1990; Vandermeer, 1989).

The maize/cassava intercrop technology is of paramount importance in the state. First, maize and cassava are the most commonly cultivated carbohydrate staples of cereal and root/tuber crops origin respectively. Both are food security crops and there are no cultural barriers in their consumption. According to Ngoka (1997) maize is grown in almost all the states of the federation and about one million tones of it are produced annually. It is consumed boiled, roasted, fried or processed into flakes, pap, flour, etc. It is used in producing industrial starch, livestock feed, alcohol and for making hay and silage. Cassava on the other hand is a valuable source of 40 percent of the calorie consumed in Africa (Nwajiuba, 1995) and 70 percent of the daily calorie intake of more than 50million Nigerians (Ugwu et al, 1989). It is consumed as fou-fou, garri, flour, tapioca, cake, wet-extract starch, etc. It is a raw material in the livestock feed industry, industrial starch production and brewing industry. The leaves serve as forage and vegetable.

It is however unfortunate that in spite of the contributions of the crops to household food security and livelihood and the obvious advantages of the technology, empirical data on the sustained adoption decision behaviors of the technology does not exist. There are no data on the rate at which the technology is sustained. There is no information on the dynamics of the farmers' sustained adoption decision behaviours. Also the reasons behind the sustained adoption decision behaviours are unknown. Previous studies have treated maize/cassava intercrop as one of the technologies meant for farmers' adoption without in depth analyses of the farmers' sustenance of the technology (Nnadi and Akwiwu, 2005).

It was against the background that this study set out to assess the sustained adoption decision behaviors of maize/cassava intercrop in Imo State with a view to drawing lessons for extension policy development.

1.1 Objective of the study

The broad objective of the study is to assess rural farmers' sustained adoption decision behaviours of maize/cassava intercrop technology in Imo State with a view to proffering policy recommendations. The specific objectives include: (1) to determine the rate at which the farmers sustained the adoption of maize/cassava intercrop technology; (2) to ascertain reasons for the sustained adoption decision behaviours; (3) to analyze the determinants of the sustained adoption decision behaviours.

1.2 Hypothesis

The farmers' socio – economic factors do not determine their sustained adoption decision behaviours of maize-cassava intercrop technology.

2. Methodology

The study was conducted in Orlu agricultural zone of Imo State, Nigeria between December 2006 and April 2007. Orlu agricultural zone is one of the three agricultural zones in Imo State. It is made up of 10 Local government areas. The major economic activity of the people is farming. The crops cultivated include cassava, yam, maize, cocoyam, oil palm, pineapple, banana, plantain and different types of vegetables. The animals reared include poultry, goat, sheep, pig, cattle, snail, grass cutter and fishery. There are two major seasons, rainy and diry, which range from April to October and November to March respectively. The rainfall ranges from 1500 to 2000mm (Onu, 2005) while the temperature is between 26 and 28^0C with relative humidity of 80-90 % (Ugwu and Lekwa, 1988).

Three local government areas were randomly sampled for the study-Oru East, Orsu and Ideato South. Two communities were randomly sampled from each local government area. From each community, 25 farmers were randomly sampled. These provided data for the study.

The instrument used for data collection was semi-structured questionnaire validated by experts and professionals in Agricultural extension and Rural sociology. The questions revolved around the objectives and hypothesis. These were tested for internal consistency using 25 farmers from Oru West L.G.A. with test – re – test method. A coefficient 'r' of 0.75 was got at 0.05 level of significance. A set of 150 copies of the questionnaire was administered while 115 copies were valid for use on retrieval.

The analytical tools comprised descriptive and inferential tools. For objectives 1 and 2, percentage counts were used while objective 3 and the hypothesis utilized logit regression model

$$Y = Ln\,(P/1\text{-}P) \quad (1)$$

$$Ln\,(P/1\text{-}P) = b_o + b_1 x_1 + b_2 x_2 \ldots b_{12}\, x_{12} + e \quad (2)$$

Where:

Y = Dependent binary variable (Sustained the adoption = 1, Did not sustain the adoption = 0)

P = Probability of sustaining the adoption

Ln = Natural logarithm function

bo = constant

$b_1 – b_{12}$ = Regression coefficients

$x_1 – x_{12}$ = Explanatory variables, x_1 –Age, (years) x_2 – Sex (Male = 1, female = 0), x_3 Education (number of years of formal schooling), x_4 – Marital status (married=1, single = 0), x_5 – Family size (number of persons' in a household), x_6 – Nature of Farming (fulltime = 1, part time = 0) x_7 = Farming experience (number of years of farming), x_8 – Social organization membership (member = 1, non number = 0)

x_9 – Farm size (hectare), x_{10} Credit opportunity (obtained credit = 1, has not obtained credit = 0)

x_{11} – Annual farm income (Naira), x_{12}- Number of technology information sources

(P/1-P)- Odd ratio (odds in favour of sustained adoption)

Chi – square was used in place of R^2 to measure goodness of fit (Gujarati, 1988):

$$\sum_{i=1}^{m} \frac{Ni\,(p_1^{0} - p^*)^2}{P_1^*(-p_1^*)} \quad (3)$$

Where:
N = Number of observations in ith cell
P_1^{o} = Actual probability of event occurring
P_1^* = estimated probability
M = Number of Cells

For the large sample size, the Chi – square was distributed according to the chi-squre distribution with M – K degree of freedom, where K is the number in the estimating model (K<M).

3. Results and discussion

3.1 Rate of sustained adoption of maize – cassava intercrop technology

The rates of adoption of a technology and participation in a programme were measured as the percentage of the farmers' that adopted the technology or participated in the programme (Nnadi and Akwiwu, 2008; Nkonya et al, 1997). Following these, the percentage count of the farmers who sustained the adoption of maize – cassava intercrop was calculated in Table 1. The result shows that about 89 percent of the farmers sustained the adoption of maize – cassava intercrop technology while 11.30 percent did not. The high sustenance rating could be attributed to the superiority of the technology over the traditional, obvious gains from the use and concerted extension efforts. On further probing the farmers, 80.40 percent indicated sustaining the adoption for more than 5 years and 19.60 percent otherwise. On the technology attributes that favored the sustenance, 69.91 percent indicated that the technology is inexpensive, 73.53 percent favored specificity, 98. 04 percent indicated for profitability while 82.35 percent identified with simplicity. These underscore the relevance of technological attributes being wholesome for farmers to sustain adoption.

Table1. Farmers' classification by rate of sustained adoption of maize – cassava intercrop technology

Sustained doption	Frequency	Percentage
Yes	102	88.70
No	13	11.30
Total	115	100.00

Source: Field survey data, 2007.

3.2 Reasons for the farmers' sustained adoption decision behaviours:

Six reasons were adduced for the sustained adoption decision behaviours of the farmers (Table 2). The item, the land is fully used in a growing season ranked first with 56.52 percent while the item, the technology is similar to the existing traditional practice but for a few modifications had 54.78 percent to rank second. Whereas the item, the farmer does not lose all at the event of failure of one crop had 52.17 percent to rank third, the item, the technology is easy to apply had 44. 35 percent to rank fourth. The item, technology does not involve much money and the technology is friendly with the environment had 29.57 percent (5^{th}) and 21.74 percent (6^{th}) respectively.

Table 2. Farmers' distribution by reasons for sustaining the adoption of maize – cassava intercrop technology

Reasons	*Frequency	Percentage	Rank
The land is fully used in a growing season	65	56.52	1^{st}
The technology is similar to the existing traditional practice but for a few modifications	63	54.78	2^{nd}
The farmers do not lose all at the failure of one crop	60	52.17	3^{rd}
Technology is easy to apply	51	44.35	4^{th}
Technology does not involve much money	34	29.57	5^{th}
The technology is friendly with the environment	25	21.74	6^{th}

*Multiple responses
Field survey data, 2007.

The various reasons given by the farmers indicate proper understanding of the obvious advantages of the technology. These corroborated the objectives of the technology (Mutsaers *et al* 1995; Vandemeer, 1989). The reasons further laid credence to the need to consider the farmers' socio–economic situations for technological design and dissemination.

3.3 Socio – economic determinants of the farmers' sustained adoption decision behaviors of maize/cassava intercrop technology

The logistic regression equation had a chi-square of 61.2297. Eight variables (66.72) were statistically significant at 0.05 levels. These included age, education, family size, farming experience, social organization membership, farm size, annual farm income, and number of technological information, sources. There determined the farmers' sustained adoption decision behaviors:

Age (Xi) – The coefficient was – 0.0318 while the t-value was–3.074, significant at 0.05 level. The relationship was inverse. The result implies that a unit increase in age resulted to 3 percent reduction in sustenance of maize – cassava intercrop technology. This shows that young farmers sustained the adoption of the technology more than old farmers. Old age is associated with weakness and skepticism while youth hood is associated with virility and venturesome ness. The finding agrees with Nnadi and Akwiwu (2005) and disagrees with Matthews-Njoku (2005).

Education (X_2) – The coefficient of education was 0.1926 while the t-value was 2.5992. The positively significant relationship implies that a unit increase in years of formal schooling increased the probability of the sustained adoption decision behaviour by 19 percent. Educated farmers are analytical and observe easily the obvious advantages of new technologies. The studies of Nnadi and Akwiwu (2008) and Ohajianya and Onu (2005) associated education with increased participation/adoption of agricultural technologies.

Family size (X_5) – The coefficient and t – value of family size were – 0.0337 and – 2.9052 respectively. The inverse relationship implies that a unit increase in the family size resulted to about 3 percent reduction in the probability of the adoption decision behaviours of maize-cassava intercrop technology. This could be explained by the high social and food security responsibilities of large families that could derail the use of farm capital. The result contradicted Nnadi and Akwiwu (2006) that large families sizes predisposed adoption of innovations.

Farming experience (X_7) – The number of years put into farming had a coefficient of 0.0513 and t-value of 2.5909. The result implies that each additional year to the farmers experience resulted to 5 percent increase in the probability of sustained adoption decision behaviour of maize cassava intercrop technology.

Increased years of farming experience just like education furnished more knowledge that increased the farmers' rationality in the use of innovations. The work of Nnadi and Amaechi (2007) explained increased years of farming experience as a valuable asset in adoption decision-making.

Social organization membership (X_8): The coefficient and t-value of farmers' membership of social organization were 0.0847 and 3.3086 respectively. The result implies that a unit increase in farmers' membership of social organization increased the probability of sustained adoption of maize – cassava intercrop by 8 percent. Social organization membership provided the social needs of the farmers, enhanced diffusion and facilitated collective solutions to problems. The result is in consonance with Nnadi and Akwiwu (2006) in which women who belonged to social organizations adopted more soil management practices.

Farm size (X_9): Farm size had a coefficient of 0.0961 and a t-value of 3.0315. The result implies that a unit increase in hectare of farm size cultivated resulted in 9 percent increase in the probability of the sustained adoption decision behaviours. This could be explained by the fact that large farm size pre-supposes large farm asset. Thus, farmers who had more assets had more dispositions to sustain technologies than those who had less. A similar result was reported by Nkonya *et al* (1997).

Annual farm income (X_{11}) – The coefficient and t-value of annual farm income were 0.0219 and 3.3692 respectively. The result implies that a unit increase in Naira from annual farm income resulted to 2 percent increase in the probability of the sustained adoption decision behaviour of maize/cassava intercrop. Increased annual farm income increased a farmer's capital base. This predisposed to sourcing agricultural information, purchasing farm input, employing farm staff and paying wages. The result is in consonance with that of Karki and Bauer (2004).

Number of technology information source (X_{12}):

The number of technology information sources available to a farmer had coefficient of 0.0856 and t-value of 3.0681. The result implies that a unit increase in the sources of information available sustained adoption decision behaviours by about 9 percent. More sources of information furnished more facts, cleared doubts and clarified misconceptions. The study of Nnadi (2007) revealed positive relationship between the number of information source available to farmers and their adoption of improved poultry technologies in urban and peri-urban areas of Imo State.

The variables: sex, marital status, nature of farming and credit opportunity were not significant. They do not determine the farmers' sustained adoption decision behaviours and as such should not be considered in designing extension intervention strategies.

Table 3 Logistic regression determinants of farmers' sustained adoption of maize/cassava intercrops technology.

Explanatory variables	Coefficients	T-values
Age	-0.0318	-3.0874*
Sex	-0.714	1.1609
Education	0.1926	2.5992*
Marital status	0.0841	1.1169
Family size	-0.0337	-2.9052*
Nature of farming	0.1167	0.9419
Farming experience	0.0513	2.5909*
Social organization membership	0.0847	3.3086*
Farm size	0.0961	3.0315*
Credit opportunity	0.1022	0.8989
Annual farm income	0.0219	3.3692*
Number of technology information source	0.0856	3.0681*

Constant	-18.3266
N	115
Degree of freedom	58
Model Chi-square	61.2297

*Significant at 0.05 levels

Source: Field survey data, 2007

4. Conclusion and policy implications

The adoption of maize – cassava intercrop technology was sustained by 88.7 percent of the farmers. The reasons ranged from the technology being friendly with the environment to the land being fully used in a growing season. The determinants of the farmers' sustained use decision behaviours include age, education, family size, farm size, annual farm income and number of information sources available. These underscore the importance of the farmers' socio-economic factors, technological attributes and communication related variables in designing extension intervention strategies:

Participatory approaches like the farmer field school should be utilized in designing and disseminating technologies so as to incorporate farmers' socio-economic conditions and expectations for sustained adoption.

Extension education campaign should utilize multi-media for increased awareness, clarification and reinforcement of extension agents' efforts.

Extension enlightenment campaign by the state Agricultural Development. Programme should be intensified to sensitize and motivate farmers towards enlisting in farmers' co-operative societies.

Farmers' socio-economic factors should be considered fundamental in designing extension intervention strategies.

Correspondence to:
Fidelia N Nnadi

Department of Agricultural Extension
Federal University of Technology
Owerri, Imo State PMB1526, Nigeria
dr_charleso@yahoo.com

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9/18/2009