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ANALYSIS OF THE FACTORS INFLUENCING FARMERS' ADOPTION OF ALLEY FARMING TECHNOLOGY UNDER INTENSIFIED AGRICULTURE IN IMO STATE, NIGERIA; USING A QUALITATIVE CHOICE MODEL

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ABSTRACT

This study analyzed factors that influence farmers' alley farming technology adoption behaviours in the intensified land use systems of Imo State, Nigeria. A logit econometric model was used to quantify and analyze data obtained from 480 randomly selected farm households from 12 agriculturally intensified autonomous communities in Imo State. The results show that younger farmers between the ages of 18 and 44 years, cultivating at least 0.7 hectares of land, which they have control over its allocation and usage had higher probabilities of adopting alley-farming technology than their older counterparts. Adoption decisions increased with increased contacts of farmers with extension agents working on the agro-forestry technology, farmers' level of formal education, ownership and control over cultivated lands, length of land lease, membership and participation in the activities of farmers' associations, and farm sizes above the sample mean farm size of 0.7 hectares. Adoption rates are lower among female farmers than males, and decreased with increased family sizes and population induced land scarcity conditions. The study confirms the importance of recognizing the heterogeneity of the farming population not only in terms of differences in the biophysical conditions of their farms but also in the socio-economic and demographic conditions under which they operate, in targeting agro-forestry extension programs for maximum impacts. The results show that qualitative choice modelling using farmers' socio-economic and demographic variables can lead to more precision in

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targeting farmer categories for the achievement of accelerated alley farming technology adoption rates.

1. INTRODUCTION

In Southeast Nigeria generally and in Imo State specifically, farmers for long relied solely on shifting cultivation and bush fallowing characterized by the traditional 'slash-and-burn' techniques for maintaining the fertility of their arable lands and ensuring the balance between their socio-economic and agro-ecological environments. Studies of these traditional – cultivation fallow systems in this agro-ecological zone show that farmers typically clear a plot of land, cultivate the plot for 1 to 3 years, and then abandon it to lie fallow for up to 25 years (Onus, *et al*, 1998; Freeman, 1994; Lagemann, 1977 and Nwosu, 1974). During the fallow period, there is forest or bush re-growth. The ground cover protects the soil from erosion and controls undesirable weeds. The gradual accumulation of nutrients supplied by the decay of organic matter from secondary growth of natural vegetation regenerates soil fertility (IITA, 1992; Sanchez, 1976).

Unlike the present times, farmland was then relatively more abundant and the traditional land management system, which rotates cultivation periods with long fallow periods, was able to develop stable ecosystems that are biologically efficient and sustainable (Spencer & Swift, 1992). However, there are currently few communities in Southeast Nigeria where fallow periods are long enough to fully regenerate soil fertility without tangible decline in crop productivity, due to the rapidly increasing population pressures. Population pressures on land are particularly pronounced in Imo State, where population densities are highest and land per capita and arable land: farmer ratios are the least compared with other parts of rural Africa (Eboh & Lemchi, 1994, Lagemann, 1977 and Nwosu, 1974). The rapidly increasing population growth rates and densities have created land scarcities, leading to shortening fallow lengths and land use intensification in the State (FAO, 1985; Lagemann, 1977 and Nwosu, 1974). In many communities in the State, farmers have reduced their fallow periods below levels necessary to restore soil fertility and maintain the ecological balance under shifting cultivation. In some cases, the fallow system has been completely abandoned (World Bank, 1992).

In the absence of sound soil management practices, the breakdown of the traditional fallow practices and the increasing land use intensification in Imo State result in accelerated leaching of soil nutrients, erosion, decreased moisture retention, increased weed population and a decline in soil fertility (IITA, 1992 and Lal, 1983). Soil fertility decline adversely affects crop yield, labour productivity and returns to farming (Lal, 1983).

Like in many other intensified farming systems in Africa, Asia and America, one of the foci of the Imo State to combat the negative consequences of the emerging land use intensification is the promotion of farm level extension programs aimed at accelerating farmers' adoption and use of alley farming technology. Alley farming is an agro forestry technique involving the cultivation of food crops between nitrogen fixing leguminous hedgerows species developed at the International Institute of Tropical Agriculture in the 1980s (Kang *et al*, 1990). The leguminous species have deep roots for nutrient capture and recycling, produce substantial biomass which are applied to crops as mulch, and contribute to nitrogen fixation. The technology requires farmers to periodically prune the leaves of hedgerow trees or shrubs for application as mulch. The technology has been shown to increase and sustain crop production compared to conventional bush fallow, prevents soil erosion, controls weed, enhances nutrient recycling, and build up soil organic matter under the most intensely cultivated and continuous cropping systems (Kang et al 1990 and Lal, 1983) .

Variants of this technology are being introduced to farmers for adoption and utilization on continuing basis in Imo State, Nigeria by the State Ministry of Agriculture and Natural Resources and the World Bank assisted Agricultural Development Project (ADP) with huge support from the International Centre for Research in Agro forestry (ICRAF) and Alley Farming Network for Tropical Africa (AFRNETA) since the early 1990s. While the potential constraints to the adoptability of the technology under intensified Agriculture have been identified by some researchers to include high cost of labour for pruning the trees and incorporating the biomass, long gestation period between the establishment and accrual of benefits and inappropriate land use rights regime (Dvorak, 1996; Carter, 1995; Tonye *et al*, 1993); socioeconomic studies of the determinants of farmers' actual adoption and utilization of the technology are limited generally and completely lacking in Imo

Sate, Nigeria. The existence of this gap in knowledge creates difficulties in formulating appropriate strategies for agro forestry extension efforts to optimize their impacts and ensure increased adoption rates and utilization of the alley farming technology by the potential farmer adopter categories in Imo State.

It is in an attempt to fill this gap in knowledge that this study identified and quantified factors that influence farmers' adoption of the alley farming technology in the intensified agricultural production systems in Imo State, using a qualitative choice (logit) model.

2. MATERIALS AND METHODS

2.1 The study area

Imo State is one of the seven States of the agro-ecological zone covered by Southeast Nigeria. Administratively, the state is divided into 27 local government councils, which are grouped into three agricultural zones, namely Okigwe, Orlu and Owerri.

Land per capita in the State is among the least, while farming population densities rank among the highest in rural Africa (Eboh & Lemchi; 1994; Lagemann, 1977 and Nwosu, 1974). Estimates by the "Village Listings" of Imo State (1980) and Agronomic Survey Reports (1985 and 2002) of Imo State ADP show that the population densities range between 25.04 to 27.09 households per square kilometre (i.e. about 175 to 215 persons km^{-2}). Fallow lengths are very short across communities, ranging from 0 – 3 years (Onus, *et al*, 1998).

Rainfall distribution in Imo State is bimodal and ranges from 1150mm to 2000mm annually. There is a distinct wet season of about 4 to 6 months and a dry season of 4 to 5 months when rainfall falls below 25 millimetres per month. Rains start in April, peak in August and end in October-November. In most areas of Imo State, high intensity rainfall causes severe soil erosion. Like in many other parts of Southeast Nigeria, the soils are derived mainly from sandstones of sedimentary origin and as a result are loose, highly leacheable and erodible, susceptible to deficiencies in previously available micro and macronutrients when they are continuously cultivated (Freeman, 1994; Lagemann, 1997; Nwosu, 1974). Large amounts of nitrogen and sulphur are lost from the soil through the traditional 'slash and burn' technique of crop residue and bush re-growth removal from farm fields. Farmers practice minimum tillage and grow crops on either mounds or flat seedbeds.

A majority of the farmers do not own land in freehold, but customary rights over farmland exist through inheritance and other communal entitlements. Most agricultural production in the State is on a small scale, with complex crop combinations, associations and mixtures to maximize the use of available land and labour resources, and to ensure all year round food availability and a balanced diet for the farming household (Leihner, 1983). The major crops grown across the state are cassava *(Manihot escullentum)*, yam *(Discorea spp.)*, maize *(Zea mays L.)*, cocoyams *(Xanthosoma Sagitiffolium)* cowpea *(Vigna Unguiculata*), rice *(Oryza Sativa)*, egusi melon *(Cucumis Sativus)* and other vegetables.

2.2 Sample selection and data collection

Data used for this study were collected through oral and farm level survey of 480 randomly selected farmers from 12 agriculturally intensified autonomous communities in Imo State. The communities are Umuokaele, Egbeada, Dikenafai, Ekwereazu, Ubomiri, Mgbidi, Eziowa, Nekede, Ikenazizi, Orlu, Awommamma and Oguta. These communities were purposively selected because they have the highest farming population densities, and practice highest forms of agricultural intensification as documented by the "Village Listings" of Imo State (1980) and Agronomic Survey Reports (1985 and 2002) of Imo State ADP. Extension education/service activities on alley farming and other agro forestry technologies are being conducted on a continuing basis by the research and development workers of the State Ministry of Agriculture and Natural Resources and the World Bank assisted ADP in these twelve communities.

The respondents were randomly selected from the list of farmers (both adopting and non-adopting) provided by the resident Agricultural Extension Agents using random numbers. The sample therefore included both adopting and non-adopting farmers. The study assumed that non-adopters have a demand for the technology but exhibited market behaviours in not adopting the alley farming technology during the survey period. Structured and validated interview schedules and trained field enumerators conversant with the local dialects and customs of the communities were used to collect data from the respondents.

The survey covered information on farmers' knowledge, adoption and utilization of the introduced alley farming technology, farm size, farm income, non-farm income, level of education of farm household head, family size, age of farm household head, land ownership status, length of land lease, gender, contacts with agro-forestry extension agents and farmers' participation in their community social organizations. The survey and data collection lasted from October, 2004 until March, 2005.

2.3. Analytical framework and model specification

Descriptive statistics including mean scores, percentages and standard deviations were used in analyzing the socio-economic characteristics of the respondents; while factors influencing farmers' adoption of alley farming technology were established using a qualitative choice (logit) model.

Applications of qualitative choice models in explaining socioeconomic phenomena are not new, and have been shown to be more precise and appropriate in analyzing relationships involving a discrete dependent variable and a set of independent variables (Akinola, 1987; Capps & Krammer, 1985, Lee & Stewarts, 1983; Bagi; 1983 and Debertin *et al*, 1980). Alternative specifications of qualitative choice models include the linear probability model, the probit model and the logit model (Pindyck and Rubinfeld, 1981; Judge, et al, 1980). The probit (cumulative normal distribution) and the logit (the logistic density function) models are the two most frequently used in applications (Polson and Spencer, 1991), and have been widely applied to adoption studies (Honagbode & Doppler, 1997; Adesina & Sirajo, 1995; Polson & Spencer, 1991, Akinola, 1987 and Bagi, 1983). However, because of the close similarities of the two distributions, it is difficult to distinguish between them statistically unless one has extremely large numbers of observations.

In this study, the logit model used is implicitly expressed as (equation 1):

$$P_i = P_i(Y_i = 1) = Q(X_i, e)\ (i = 1, 2, ---- n) \text{ ----- ----- } (1)$$

The model assumed that the probability of *ith* farmer adopting alley farming technology, $P_i\ (Y_i = 1)$, is a function of the vector of explanatory variables, X_i, and the unknown parameter vector, e. Because the functional form of Q is unknown, practical application of the model in equation 1 in this study was not feasible. Therefore, an explicit functional specification of Q was done as in equation (2) and used to analyze the factors influencing farmers' adoption of alley farming technology under intensified agriculture in Imo State as follows:

$$\begin{aligned} \text{AFTA} = {} & B_0 + B_1\text{AGE} + B_2\text{AGE}_1 + B_3\text{FAMSZ} + \\ & B_4\text{FAMS1} + B_5\text{EDUC.} + B_6\text{FMSZ} + B_7\text{FMS1} + \\ & B_8\text{FINC.} + B_9\text{NFIN.} + B_{10}\text{OWN} + B_{11}\text{LLL} + \\ & B_{12}\text{MEMB} + B_{13}\text{EXT} + B_{14}\text{GEND} + e \text{ - - - - - - - - - - - - } \quad (2) \end{aligned}$$

The variables in equation (2) are defined and explained in Table 1.

Table 1: Definition and explanation of variables used in the empirical logit model

Variable	Unit or Type	Description
AFTA	Binary	1, if farm household adopts alley farming technology; 0 otherwise.
AGE	Years	Age of farm household head in number of years.
AGE_1	Binary	1, if age of farm household head exceeds sample average of 44 years; 0 otherwise.
FAMSZ	Hectare	Average household farm size.
$FAMS_1$	Binary	1, if household farm size exceeds the sample average of 0.7ha; 0 otherwise.
EDUC	Years	Number of years of formal education attained by farm household head
FMSZ	Number	Total number of people in a household, excluding adult-age children not living at home.
FMS_1	Binary	1, if family size exceeds the sample average of 9; 0 otherwise.
FINC.	Binary	1, if farm income (in naira) exceeds sample mean of ₦17,000; 0 otherwise.
NFIN	Binary	1, if farm household earns income from other sources different from farming; 0

Variable	Unit or Type	Description
		otherwise.
OWN	Binary	1, if farm household owns and controls allocation of cultivated land; 0 otherwise.
LLL	Years	Number of years a farmer uses rented farmland.
MEMB	Binary	1, if the household head is a member of the community/farmers' association, 0 otherwise.
EXT	Binary	1, if household head benefits from agro forestry extension agents' contact; 0 otherwise.
GEND	Binary	1, if household head is male; 0 otherwise.

The error term, *e*, represents the unobservable socioeconomic and demographic circumstances of the survey households; and it is assumed to be independently distributed over the survey period. Table 2 shows the sample statistics of the variables measured and used in the empirical logit model.

Table 2: Summary of statistics of variables used in the empirical logit model

Variable	Mean	Standard Deviation	Minimum	Maximum
AGE	44.3812	11.0942	18	82
FAMSZ	0.7036	0.6473	0.10	11
EDUC	1.04682	0.7340	0	12
FMSZ	9.3682	3.3340	1	22
FINC	17,435	0.3538	9,998	222000
NFIN	12600	0.98164	0	1
OWN	0.4292	0.7217	0	1
LLL	1.2021	0.4912	1	5
MEMB	0.6824	0.3948	0	1
EXT	0.8216	0.4432	0	1
GEND	0.6938	0.4678	0	1

3. RESULTS AND DISCUSSION

3.1 Farmers' knowledge, adoption, utilization and assessment of alley farming technology under intensified agriculture in Imo State, Nigeria

Table 3 shows that the majority (92.08%) of the respondents were aware (had knowledge) of the introduced alley farming technology. Only 7.92% of the sample had never heard of the technology and may not have appreciated its agronomic advantages over the traditional bush fallowing. The table shows that 42.92% of the sample had adopted the use of alley farming technology, while 10.21% were experimenting with the technology to properly evaluate its agronomic and socioeconomic advantages in maintaining the fertility of their arable lands by making contacts with fellow farmers and agro forestry extension agents. About 16% of the respondents have discontinued the use of the technology, probably due to problems associated with its high labour requirements for pruning, lack of quality seeds, lack of information on proper management, and competition with tree crops as identified by Dvorak (1996) and Carter (1995).

Table 3: Categorization of farmers' knowledge, adoption and utilization of alley farming technology in the intensified farming communities in Imo State, Nigeria

	Farmer adopter categories	Frequency	Percentage (%)
(a)	Sample farmers that have never heard about alley farming technology	38	7.92
(b)	Sample farmers that have heard about alley farming technology	442	92.08
(c)	Sample farmers that have adopted alley farming Technology use	206	42.92
(d)	Sample farmers that are still evaluating the alley farming technology	49	10.21
(e)	Sample farmers that rejected and never tried alley farming	111	23.13
(f)	Sample farmers that have discontinued or abandoned the use of alley farming technology	76	15.83

[x](a+b = 100% = 480); (c + d + e + f = b = 92.05% = 442).

Table 4 shows farmers' assessment of the benefits from alley farming technology usage compared with the traditional bush fallow system. The table shows that farmers' reasons for adopting alley farming technology were its superiority over fallow systems in improving soil fertility (93:69%) and insurance of continuity of yields over time from their intensified land use (82:81%). Other reasons adduced by the farmers were soil erosion and weed control (85:92% and 88.35% respectively), and as a labour saving device for land clearing (65.05%).

Table 4: Farmers' assessment of the benefits from alley farming compared with bush fallow in the intensified farming systems of Imo State, Nigeria

Alley Farming Technology Attributes	Reason for use of Alley Farming Technology (% of (206) Adopters)	Advantages of Alley Farming over bush fallow for different benefits (% of (442) sample that have knowledge of the Technology)
Improvement of soil fertility	93.69	69.99
Insurance of continued crop yield overtime	82.81	67.79
Save labour for land clearing	65.05	59.45
Suppression of weed	88.35	88.01
Fallow length reduction/continuous cropping	67.96	68.10
Provision of fuel wood	32.04	23.98
Fodder supply	29.13	19.00
Erosion control	85.92	68.10

Farmers' comparisons of the benefits of alley farming to the bush fallow technique (Table 4) show their preference for alley farming in terms of its superiority in soil fertility improvement (69.99%), labour reduction for land clearing (59.95%), weed suppression (88.01%), insurance of continuity of crop yields (67.79) and promotion of continuous cropping (68.10%) of their arable lands. The findings suggest that farmers view alley farming technology as a viable land use option in the intensified agriculture and land use systems in Imo State, and that the observed farmers differential adoption rates and utilization behaviours over the technology may have resulted from differences in the farm household socio-economic and demographic characteristics which this study herein analyzed.

3.2 Econometric (logit) model results

The results of the logit model estimated through an iterative maximum likelihood procedure are presented in table 5. The table shows that the model classified 86% of the alley farming technology adopter categories in the intensified agricultural production systems of Imo State. A maximum of six iterations were required for convergence of the logit model. The likelihood ratio test indicates that the model as specified, explained significant non-zero variations in the factors influencing farmers' adoption decisions. Parameter estimates for the model was evaluated at 0.5 level of significance. Nine of the fourteen parameters included in the logit specification were significant determinants of farmers' alley farming technology adoption behaviours. These parameters relate to age of farm household head, farm size above sample mean farm size of 0.7 hectares, level of formal education of farm household head, farmers' ownership and control over cultivated lands, length of land lease, membership of farmer's associations and other community groups, contacts with agro forestry extension agents and gender.

Table 5 also shows that although, factors such as average farm and family sizes, farm and non-farm incomes had positive relationships with farmers' adoption decisions; they were not important determinants of farmers' alley farming technology adoption behaviours. The table rather shows that farm sizes above the sample mean farm size of 0.7 hectares significantly influenced farmers' adoption behaviours. This may have resulted from the fact that alley cropping requires that farmers set aside a part of their land for growing trees, thereby reducing cultivatable areas under food crops. Farmers operating land holdings below the sample mean of 0.7 hectare may have viewed the tree planting associated with establishing alley farming as competing with their food crops over their land scarcity situation in Imo State; and may have lacked sufficient land for experimenting with the hedgerow shrubs and tree species. This may have accounted for their lower

Table 5: Logit estimates of the factors influencing farmers' adoption of alley farming technology under intensified agriculture in Imo State, Nigeria

Variable	Parameter estimate	Asymptotic standard error	Change in probability	T-Value
Constant	-6.1382	2.71182	-4.2243	-2.263**
AGE	-0.1029	0.14993	0.0278	-2.061**
AGE_1	-3.1536	1.4903	0.5792	-2.116**
FAMSZ	0.93614	0.30360	0.2792	0.308
$FAMS_1$	1.2586	0.5392	0.6249	2.334**
EDUC	1.1746	0.3964	0.3425	2.396**
FMSZ	0.1083	0.3258	0.0527	0.332
FMS_1	-0.2278	0.5861	0.4662	-0.389
FINC	0.0392	0.0232	0.5126	0.5799
NFIN	1.4261	2.2124	0.3861	0.6446
OWN	0.0901	0.04595	0.5231	1.961**
LLL	0.2360	0.0882	0.1789	2.676**
MEMB	0.3100	0.1072	0.6873	2.8929**
EXT	0.1990	0.0500	0.7236	3.9741**
GEND	-0.0771	0.0065	0.3362	2.6123**

Mc Fadden's R^2 = 0.4523
Log likelihood function = -52.2201
Likelihood ratio test = 50.5748
Percentage of farmers correctly classified = 86%
Total number of iterations = 6
*** Significant at 0.05 level.*

likelihood to adopt the technology. Because farm size is an indication of the level of economic resources available to farmers under intensified agriculture, probability of adopting alley-farming technology increased by 0.62 as farm size increased above the sample mean of 0.7 hectares. The above finding raises a cautionary note to the conventionally held view to target alley-farming technology to areas with high land use and demographic pressures (Carter, 1995). Farmers in these areas are perhaps more likely to have higher labour productivity from investments in other resource management technology alternatives such as organic manure and chemical fertilizers.

Contrarily, farmers below the sample mean age of 44 years had greater probabilities of adopting alley-farming technology. The change in probability was 0.58 for the logit model. This implies that younger farmers exposed to improved farm technologies will have an increasing likelihood of adoption, other factors being equal, as they become more aware of the benefits of adoption and have the opportunity to adjust productive resources over time. This may be because younger farmers are more flexible, have longer planning horizons and tend to have lower risk aversion tendencies than their older counterparts. These younger "progressive" farmers should be the primary targets of extension information regarding new farm practices (Polson & Spencer, 1991). For this study, farmers between 18 to 44 years are assumed to satisfy this requirement (Table 2). Table 5 also shows that literate farmers are less sceptical of the new farm technology, as adoption increased significantly with increased farmers' level of formal education.

Farmers' ownership and control over cultivated land positively and significantly influenced farmers' alley farming technology adoption decisions. The forms of land ownership as used in this study needs clarification. Subsistence producers in Imo State have traditional ownership rights to farmland either through inheritance or as part of communal holdings, but control over land use and allocation differ. Four forms of land ownership based on degree of control over allocation and use were prevalent in the studied communities namely; purchased/received as gift, divided inheritance, undivided inheritance and secondary access. Land held under divided inheritance means that land is divided among the heirs, with each having full control over his/her own parcel of land. Land held under undivided inheritance means that land passes to heirs collectively, with the result that no person has absolute control over any part of the land. Secondary access generally implies that land is obtained through pledge, loan or rental agreement. In this study, adoption of alley farming technology increased as private ownership and individual control over land increased, with land under divided inheritance and purchased/gift forms constituting more favourable conditions for alley farming applications.

Length of land lease positively and significantly influenced farmers' adoption decisions. Table 5 shows that as the length of land lease for rented lands increased, farmers applied more of the technology on their rented lands. This must have resulted from the fact that shortened lease periods do not allow farmers to recapture the costs of their investments in alley farming technology practices; which entails insecurity and uncertainty over use of rented lands. This is not surprising since tangible benefits from alley farming trees may not become available for the first 2 to 3 years and, once establish, trees have to be well maintained for at least 8 to 10 years in order to derive long-term benefits. If the potential benefits of the practice can be realized and guaranteed through lengthened lease periods, the incentive for adoption of the technology becomes brighter for renters.

The positive and significant relationship between farmers' membership of farmers associations and adoption implies that the more social organizations farmers belong to and participate in its activities, the more likelihood of their predisposition to adopt new farm technologies. The exposure of farm families to the agro forestry extension services information was deemed very important in influencing farmers' adoption decisions. The probability increased by 0.72 with increasing extension activities in the studied communities (Table 5). Increased household exposure to extension programs in form of multiple visits by extension agents, and through information dissemination as well as technical support to farmers greatly increased farmers' knowledge gain of the available technology and their potential benefits, and acted as a trigger mechanism for alley farming technology adoption decisions to be taken by farmers.

The positive and significant sign for gender in Table 5, indicated that the probability of adoption of alley farming technology was higher for men than women farmers. This result is corroborated by the findings from other studies. For example, Fabiyi, *et al* (1991) found that in Southwest Nigeria, men farmers used more alley farming practices than women. This situation may have resulted from differential access to and control over land use rights between men and women farmers in the studied communities. Women in Imo State are rarely allocators of land rights; even their right to use land generally comes through men, either from a husband as a part of his holdings or from other male family members. This situation may have accounted for the observed lower likelihood of adoption of alley farming technology by women in the State.

Contrary to *a priori* expectation, family size (as well as family size above the sample mean family size of nine members) exerted insignificant influence on farmers' alley farming technology adoption behaviours. This may have resulted from the fact that subsistence farm households are resource poor. Larger family sizes may not, in real terms, contribute significantly in increasing the resource pool of the farm family, especially if some family members (i.e. school-age children) are not full time workers (Polson & Spencer, 1991). In the studied communities, major production decisions are made by the head of the household, and individual family members have very limited input in farm innovation adoption decisions.

4. CONCLUSIONS AND IMPLICATIONS

The objective of the study was to explain the factors important in farmers' decision to adopt alley farming practices in the intensified farming systems of Imo State, Nigeria. The logit econometric analysis used in the study showed that younger farmers cultivating at least 0.7 hectares of land, which they controlled with regard to its allocation and usage. They showed higher probabilities of adopting alley farming technology than their older counterparts. This study suggests that younger farmers are more likely to accept the risks associated with the new farm innovation.

The roles of extension activities were very crucial in the alley farming technology adoption decision processes of farm households. Benefits from extension activities therefore, would be maximized by targeting extension activities on farmers' groups and associations since farmers' membership in and participation in such group activities also significantly influenced their exposure behaviours and adoption decisions.

The limited land lease period (<1.20 years) found in the study (Table 2) increased farmers' risk of appropriation of their investment in alley farming practices, as it highlights insecurity and uncertainty over the application of technology on rented lands, especially when the costs of the agro forestry innovations are considered. A system of cost sharing through multi-year-written leases between the landowners and operators are needed so that renters can recapture the benefits generated by their investments in alley farming practices. The results of this study showed that qualitative choice modelling using farmers' socio-economic and demographic variables can suggest precision in targeting farmers for accelerated alley farming technology adoption rates to occur.

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