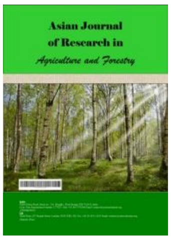

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Adoption Behaviour of the Rural Farming Household in South West Nigeria: A Panacea for Agricultural Promotion Policy (APP)

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Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

The study examined the adoption behaviour of the rural farming household in South-West Nigeria. A cross-sectional sample survey of 200 farmers were randomly chosen for the study. Descriptive statistics and Tobit regression were used to calculate the probability of adoption. The study showed the magnitude of change in the level of adoption of agroforestry-based technologies by performing simulated analysis on some identified variables that could influence government policies. The simulation is done with an increase in the values of the variables by 5%, 10% and 20%. The results of this simulation of policy variables revealed that adoption will decrease with increase in age and credit facility. Also, any policy that will improve the quality and/or coverage of extension education is likely to increase adoption of agroforestry-based technologies. Landowners are likely to adopt agroforestry based technologies than tenants. Any policy that provides land to prospective farmers is likely to increase adoption of agroforestry-based technologies. Some of the general conclusion which have emerged from this investigation are that: Only availability of credit to farmers has significant effect on adoption of agroforestry-based technology at 0.05 level. However, at 0.10 level of significance, distance of input source from farm, membership of cooperative society and farmers'

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educational status are significant in explaining adoption decision of farmers in the area. It is therefore recommended that there is need for provision of regular and better extension services to keep farmers abreast of the latest agroforestry-based technologies.

Keywords: Adoption; agriculture; policy; simulation; technologies; Nigeria.

1. INTRODUCTION

Agroforestry has been defined as a land use system in which woody perennials are grown with food crops and/or livestock leading to many beneficial, ecological and economic interactions between trees and non-trees components. The International Council for Research in Agroforestry (ICRAF) now World Agroforestry Centre defined agroforestry as a dynamic ecologically based natural resources management system that through interactions of trees on farm and in the agricultural landscape diversifies and sustains production, enhancing social, economic and environmental benefits for land users at all levels. Dawson et al*.* [1] observed that more than 1.3 billion people worldwide practice the system which ranges from open packed assemblagesto dense imitation of tropical rainforests suchas home gardens to planted mixture of only few species to trees planted in hedges or on boundaries of field and farms with different levels of human involvementin various management. They observed that agroforestry supports food and nutrition through the direct provision of food, by raising farmers' income and providing fuel for cooking and through various ecosystem services.

Garrity and Stapleton [2] noted that agroforestry is one of mankind best hopes to create a climate-smart agriculture, increase food security, alleviate rural poverty and achieve a truly sustainable development. Awe et al*.* [3] opinion that a wider application of agroforestry system will reduce the necessity to cut down additional forest and encourage a fuller use of natural forest ecosystems for the products and services which they only can provide. This, he said, is an addition to its potential to increase organic matters of the soil leading to a more efficient nutrient cycling and improvement of the soil physical conditions among others.

In recent years, it has become increasingly apparent that agroforestry project implementation in many countries is hampered by the lack of appropriate policies to support such efforts. Furthermore, several international reviews of agroforestry research and development have identified policy research as an area of high priority [4].

Policy here refers to the rules and regulations of government administration and politics (as opposed to societal and cultural norms) that bind the whole citizenry of a political system. The issuance of money, the passing laws, tax collection, prevention of (or permitting) access to reserved forests, regulation of import or export of agricultural commodities, etc. are all examples of state policies or interventions that affect the lives of citizens [5].

These public policies have a tremendous impact on land-use patterns. The experience in Asia and Africa with regard to the development of the agriculture is not dissimilar [6].

Important constraints appear to be preventing wider-scale adoption of agricultural technologies. Experience across many countries has shown that the adoption and spread of agricultural technologies requires a change in commitment and behaviour of all stakeholders. For farmers, social mechanisms that encourage experimentation, learning and adaption to local conditions are a prerequisite. For policy-makers and institutional leaders, transformation in agricultural systems requires that they fully understand the large economic, social and environmental benefits that these system offer. Such transformations call for sustained policy and institutional support that provides both incentives and motivations to encourage farmers to adopt agricultural innovations and improve them over time.

Assessing the policy framework in response to the need to end hunger and malnutrition in Nigeria, the government took appropriate step with the implementation of a new Agriculture Promotion Policy (2016-2020) as a strategy. Also referred to as "The Green Alternative". The policy is the outcome of an intensive consultative process between November 2015 and April 2016, which involved multiple stakeholders. From farmer groups to investors to processors to lenders to civil servants to academics, many stakeholders provided detailed input, commentary, and support [7]. The policy is driven by engagement of marketplace participants, farmers, states, investors, financial institutions, and communities. The vision of the government for agriculture is to work with key stakeholders to build an agribusiness economy capable of delivering sustained prosperity by meeting domestic food security goals, generating exports, and supporting sustainable income and job growth. Therefore, the Nigeria policy during the periods of 2016 to 2020 now readjusted to solve the aforementioned challenges with the four targets: food security; import substitution; job creation; and economic diversification [7].

The investigation likewise reveals generous unseen heterogeneity impacts, which initiate heterogeneous effects in the impact of the informative factors among farmers with comparable noticeable attributes. The study additionally shows that overlooking these behaviours bear significant implications in measuring the impact of some policy interventions which are intended to work with innovation adoption. For example, disregarding these components prompts critical misjudgment of the viability of extension services in working on innovation adoption. Therefore, the objective of this paper is to evaluate the effect of some simulated government policies on adoption behaviour of the rural farming households.

2. MATERIALS AND METHODS

The study area was conducted in Oyo State, Nigeria. The study area contains two of the eight ecological zones of crop production in Nigeria. The northern part of Oyo State is gradually turning into derived savannah from the original western moist rainforest that dominates the southern part. The state lies between latitudes 7^{o}N and 9^{o}30N and longitude 2^{o}E and 4ºE. The total land area is about 42862 sqkm. Also, two climatic seasons can be distinguished in the study area namely: The dry season between November and March and the rainy season between April and October (There have been some distortion of these ranges). A cross sectional sample survey of two hundred farmers was randomly selected for the study. Stage one involved the purposive sampling of four (4) Local Government Areas (LGAs) in the State. The justification for the purposive sampling of four LGA was because IITA had previously worked on agroforestry in the LGAs which would prevent exclusion of representative samples. The second stage involved a random sampling of fifty (50) farmers from each selected LGAs, making a total of 200 respondents using a well-structured questionnaire.

2.1 Analytical Model

Following Kassie [8], farmers' adoption decisions on agroforestry-based technologies are assumed to be based upon utility maximization. Define the agroforestry technologies by j, where j = 1 for the new technology and j = 2 for the old technology. The non-observable underlying utility function which ranks the preference of the i^{th} farmer is given by $U(M_{ji}, A_{ji})$. Thus, the utility derivable from the agroforestry-based technology depends on M which is a vector of farm and farmer specific attributes of the adopter and A which is a vector of the attributes associated with the technology. Although the utility function is unobserved the relation between the utility derivable from a j^{th} technology is postulated to be a function of the vector of observed farm, farmer socio- economic characteristics (e.g., farm size, age, experience of farmer), and the technology specific characteristic (e.g., yield, taste, tillering capacity, etc.,) and a disturbance term having a zero mean:

$$U_{ji} = \alpha_j F_i (M_i, A_i) + e_{ji} j = 1, 2; I = 1, \ldots, n \quad (1)$$

Equation (1) does not restrict the function F to be linear. As the utilities U_{ji} are random, the i^{th} farmer will select the alternative j = 1 if $U_{1i} > U_{2i}$ or if the non-observable (latent) random variable y* = $U_{1i} - U_{2i} > 0$. The probability that Y_i equals one (*i.e.,* that the farmer adopts agroforestry-based technology) is a function of the independent variables.

$$Pi = Pr(Yi = 1) = Pr(U_{1i} > U_{2i})$$

$$\begin{aligned} &= Pr\,[\alpha_1 Fi(Mi,Ai) + e_{1i} > \alpha_2 Fi(Mi,Ai) + e_{2i}] \\ &= Pr[e_{1i} - e_{2i} > Fi(Mi,Ai)(\alpha_2 - \alpha_1)] \\ &= Pr[\mu i > -Fi(Mi,Ai)\beta] \\ &= Fi(xi\beta) \qquad (2) \end{aligned}$$

Where X is the n x k matrix of the explanatory variables, and β is a k x 1 vector of parameters to be estimated, Pr(.) is a probability function, μi, is a random error term, and $F(X_i\ \beta)$ is the cumulative distribution function for μ evaluated at $X_i\ \beta$. The probability that a farmer will adopt the agroforestry-based technology is a function of the vector of explanatory variables and of the unknown parameters and error term. For all practical purposes, equation (2) cannot be estimated directly without knowing the form of F.

It is the distribution of μ_i that determines the distribution of F. If μ_i is normal, F will have a cumulative normal distribution.

Following equation 3.9, the functional form of F is specified with a Tobit model, where μi is an independently, normally distributed error term with zero mean and constant variance:

$$Y_i = X_i\beta \quad \text{if} \quad i^* = X_i\beta + \mu_i > T$$

$$= 0 \quad \text{if} \quad i^* = X_i\beta + \mu_i \leq T \qquad (3)$$

Where Y_i is the probability of adopting (and the intensity of use of the agroforestry-based technologies. i* is a non-observable latent variable and T is a non-observed threshold level. The Tobit model therefore measures not only the probability that a farmer will adopt the new technology but also the intensity of use of the technology once adopted [9]. Thus, equation (3) is a simultaneous and stochastic decision model. If the non-observed latent variable i* is greater than T, the observed qualitative variable y_i that indexes adoption becomes a continuous function of the explanatory variables, and 0 otherwise (*i.e.,* no adoption). This study however looked at the farmers socioeconomic characteristics alone.

3. RESULTS AND DISCUSSION

3.1 Socio-Economic Characteristics of the Respondents

According to the Table 1, the age of the farmers ranged between 21 and 78 years, with the average age of about 48 years. The data showed that the majority (45%) of the farmers were between the ages of 41 and 50 years. This is in agreement with earlier studies that age of the farmer is related to adoption decisions. Younger farmers have been found to be more knowledgeable about new practices and may be more willing to bear risk due to their longer planning horizons [10]. Majority (87%) of the respondents were male and nearly 54% of the respondents formed the majority that had primary school education. More than half (56%) of the sampled farmers had experience between 11 and 20 years with the mean experience of 32 years. More than half (52%) of the sampled farmers cultivated farm sizes which were less than 2.0 hectares of farmland. On the basis of cultivated area, such farmers were referred to as small farmers. The average farm size was 1.13ha. The reasons given by farmers for the observed pattern of holdings included land tenure problems, risk aversion strategies and edaphic/topographic factors. This is in agreement with the findings of Ullah et al. [11]. Most farmers mention credit constraints as a major determinant in their adoption decisions. They obviously cannot adopt when their purchasing power is ineffective. Most (40%) of the farmers sampled did not employ credit claiming not to have access to any form of credit and use their personal savings as the capital for farming. The information on their income showed that majority (67%) of them earned up to N500,000.00 per annum from off-farm income with an average of N381,512.00. Likewise, the majority (78%) of the sampled farmers accrued at most N500,000.00 per annum with average of N715,983.10. The results shared similar view with the studies that were carried out among farmers in the area [9,12,3].

Table 1. Socio-Economic characteristics of the respondents

Variable	Majority	Mean	SD	Min.	Max.
Age (years)	41 – 50 (45%)	47.81	36.10	21	78
Gender	Male (87%)	0.87	0.13	0	1
Experience (year)	11 - 20 (56%)	32.33	30.12	1	67
Level of education	Primary school education (54%)	1.18	1.23	0	4
Farm size (ha)	0.30 – 2.00 (52%)	1.13	2.01	0.1	7.12
Credit source	Personal (40%)				
Off-farm income	≤ 500,000 (67%)	381,512.00	619,099.10	23,000	2,500,000
On-farm income	500,001 – 1,000,000 (78%)	715,983.10	672,231.88	37,000	2,700,000

3.2 Effects of Policy Changes Using Stimulation Approach of the Tobit Regression

The magnitude of change in the level of adoption of agroforestry-based technologies as a result of changes in government policies was obtained by performing simulated analysis on some identified variables that could be influenced by government policies. Tables 2 and 3 showed the simulation results by assuming a change in policy that affects the identified variables. The simulation was done with an increase in the values of the variables by 5%, 10% and 20%. The results of this simulation of policy variables revealed that adoption will decrease with increase in age and credit facility. An increase in the age of the operators of agroforestry-based technologies from 5% through 20% cause a decline in adoption by up to 20%. The meaning of this is that younger people are more likely to adopt new technologies than the older rigid farmers. Any government policy that encourages younger people to go into farming will increase the level of adoption of agroforestry-based technologies in the study area and consequently better utilization of the little available land.

Again, increased availability of credit causes a 20% increase in the elasticity of adoption of agroforestry-based technologies from 5% through 20%. Policy that increases the amount of credit available to farmers or reduce the “bottlenecks” associated with credit acquisition, will lead to an increase in adoption of agroforestry-based technologies.

The results also showed that elasticity of adoption will increase with rising level of role of extension agents, Cooperative societies, farmers’ educational status and tenural status. The expected use intensity follows the same trend. An increase in the farmer’s level of education from 5% through 20% raised the elasticity of adoption probability by 16.7%. There was also a 20% increase in elasticity of adoption from 0.10 to 0.12 from 5% increase in cooperative membership through 20%. Nearly 33% increase was reported for elasticity of adoption with a 5% through 20% increase in presence of extension agents. With 20% change in adoption, tenural status was increased by 25%.

The implication of the foregoing analyses is that education, and extension education are some of the policy variables which can be used by policy makers to improve the current level of adoption of agroforestry-based technologies among farmers in the study area. Hence, any agricultural policy in similar situation in Nigeria that would attract people with higher levels of education into adopting agroforestry-based technologies and/or encourage illiterate farmers to undergo education training would be expected to lead to increase in adoption of the technologies. Also, any policy that will improve the quality and/or coverage of extension education is likely to increase adoption of agroforestry-based technologies. Landowners are likely to adopt agroforestry-based technologies than tenants. Any policy that provides land to prospective farmers is likely to increase adoption of agroforestry-based technologies.

Table 2. Simulation results of variation in policy variables on expected use intensity

Variables	Expected use intensity	+5%	% Ch	+10%	% Ch	+20%	% Ch
Age	-0.02	-0.02	0	-0.02	0	-0.02	0
Credit’s access	0.20	0.21	5	0.22	10	0.24	20
Extension agent	0.03	0.03	0	0.03	0	0.04	33
Cooperative	0.10	0.11	10	0.11	10	0.12	20
Education	0.06	0.06	0	0.07	16.7	0.07	16.7
Tenural status	0.04	0.04	0	0.04	0	0.05	25

Table 3. Simulation results of variation in policy variable on total elasticity

Variables	Elasticity of adoption probability	+5%	% Ch	+10%	% Ch	+20%	% Ch
Age	-0.22	-0.23	4.5	-0.24	9.1	-0.26	18.2
Credit	0.33	0.35	6.1	0.36	9.1	0.40	21.2
Extension	0.05	0.05	0	0.06	20	0.06	20
Cooperative	0.19	0.20	5.3	0.21	10.5	0.23	21.1
Education	0.13	0.14	7.7	0.14	7.7	0.16	23.1
Tenural status	0.07	0.07	0	0.08	14.3	0.08	14.3

4. CONCLUSION AND RECOMMENDATIONS

Some of the general conclusion which have emerged from this investigation are stated as: only availability of credit to farmers has significant effect on adoption of agroforestry-based technology at 0.05 level. However, at 0.10 level of significance, distance of input source from farm, membership of cooperative society and farmers' educational status are significant in explaining adoption decision of farmers in the study area. Since increases in agricultural productivity are attributable to improved technologies, the rate of adoption of agroforestry-based technologies becomes important due to implication for rapid productivity increases in agriculture. It is therefore recommended that Government should provide funds for formal sources of credit, and the procedures relaxed to allow farmers easy access to formal credit facilities. This is necessary because of the important role credit can play in boosting agricultural production. There is need for provision of regular and better extension services to keep farmers abreast of the latest agroforestry-based technologies. This step will remove some of the constraints the farmers have in adopting agroforestry-based technologies as farmers are more informed about the potentials of including forestry and livestock in their agricultural components. There is need for government policy to support research into agroforestry and design of location – specific agroforestry practices.

CONSENT

As per international standard or university standard, respondents' written consent has been collected and preserved by the authors.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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