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Influence of farmers' socio-economic and technology characteristics on soybean seeds technology adoption in Southern Borno State, Nigeria

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Soybean is one of the most important sources of protein known to man. It is the cheapest source of protein in terms of accessibility, especially in the developing countries. The importance of the crop informed its introduction to Borno State in 2004. This study examined the determinants in likelihood of improved soybean seeds adoption among farmers in southern Borno State. Data for the study were obtained from 360 respondents selected through multi-stage sampling procedure. The purposive and random sampling techniques were employed at the various stages of selection. Inferential statistical technique, the logit model, was used to estimate the likelihood of technology adoption among the respondents. The results of the study revealed that farm size and expenditure on hired labor were the most important socio-economic factors that significantly ($p \leq 0.05$) influenced the likelihood of adoption of improved soybean seeds among the respondents; while yield, household utilization and maturity period of soybean were the significant ($p \leq 0.05$) technology characteristics that influenced the likelihood of adoption of improved soybean seeds by farmers in the study area. Based on the findings of this study, it was recommended that: labor-saving technologies be made available to farmers in order to cushion the effect of their expenditure on hired labor, and farmers should also be linked to sources of financial support so as to enable them afford hired labor. Improved soybean seeds should be provided to farmers, while extension service should educate and encourage farmers on the utilization of soybean as a nutritious household food item.

Key words: Socio-economic characteristic, technology characteristics, soybean seeds, adoption, Borno State.

INTRODUCTION

Soybean is the richest source of plant protein known to man (Odusanya, 2002). It is also the cheapest and most readily available source of protein, especially in developing countries. It is therefore very important in rectifying the protein deficiency which is very common in diets of people, particularly those in the rural areas. Soybean has the capacity to improve soil fertility by fixing nitrogen into the soil through nitrification which is carried out by nitrogen-fixing bacteria resident in the roots nodule of soybeans (Onyibe et al., 2006). Soybean also has the capacity to ameliorate the nutritional situation, improve incomes, enhance productivity of other crops and also

protect the environment from allelophethic tendencies of agricultural chemicals (FAO, 1998; Fakiyesi, 2001; Shala and Stacey, 2001).

As recognized by Doss (2003 and 2006), one way of improving agricultural productivity, in particular and rural livelihood in general, is through the introduction of improved agricultural technologies to farmers. Doss et al. (2003) also opined that adoption of improved technologies is an important means to increase the productivity of small holder agriculture in Africa, thereby fostering economic growth and improved wellbeing for millions of the poor households. Ouma et al. (2006) suggested that the use of improved technologies will continue to be a critical input for improved farm productivity. Soybean was introduced to Borno State as a commercial crop in the year 2004 to contribute to food security, improve nutritional status and reduce environmental degradation

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(PROSAB 2003). To achieve this, it is necessary that farmers adopt the improved soybean seed as a production technology. The study was therefore designed to find out the likelihood of adoption of improved soybean seeds by farmers in the project area following its introduction in the year 2004. The study also aimed at ascertaining the socio-economic and technology specific factors that influenced the decision of farmers to adopt the improved soybean seed as a production technology.

METHODOLOGY

The study was conducted in southern Borno State, Nigeria. Multi-stage sampling technique was used in selecting communities and respondents for the study. The three Local Government Areas (LGAs) where soybean production is promoted by PROSAB were purposely selected out of the 27 LGAs in the State. These LGAs include Biu, Hawul and Kwaya-kusar. Four soybean producing communities were selected from each of Biu and Hawul LGAs, while one soybean producing community was selected from Kwaya-kusar LGA. This was done in proportion to the soybean producing communities in the LGAs. Three hundred and sixty respondents were selected proportionately from the soybean producing communities earlier selected. The numbers of respondents selected from each LGA are: Biu, 158 (43.89%); Hawul, 176 (48.89%) and Kwaya-Kusar, 26 (07.22%). These 360 respondents were administered the structured questionnaire. Inferential statistic, the Tobit model, was used to analyze the data collected for the study.

Data analysis

Data for the study were obtained mainly from primary sources. These were collected through the use of structured questionnaire administered to the 360 selected respondents. The Logit regression model was used to establish relationship between the likelihood of adoption of improved soybean seed and the various factors affecting it. The application of it in explaining relationships between dependent variable and a set of explanatory variables is well demonstrated. The Logit model has been shown to be more precise and appropriate in analyzing the relationships involving binary dependent variable and a set of independent variables. (Capps and Crammer, 1985; Akinola, 1987; Adesina and Seidi, 1995)

Theoretically, the Logit model is expressed as:

$$\mu = B_0 + B_1X_1 + B_2X_2 + \ldots\ldots B_nX_n$$

Where:

μ = Likelihood of adoption, otherwise labeled as ADOPT. It is quantified as:
Adopter = any farmer that devoted at least 10% of his/her land for soybean production; and Nonadopters = any farmer that devotes less than 10% of his/her land for soybean production, as used by Ojiako et al., 2007.

B_0 = intercept;

$B_{1\ldots\ldots n}$ = estimated parameters;
$X_{1\ldots\ldots n}$ = Set of independent variables.

For the Logit model, the equation for the relationship between socio-economic characteristics of respondents and the likelihood of their adoption is specified as:

$$ADOPT = B_0+B_1AGE+B_2SEX+B_3MST+B_4EDU+B_5HHS+B_6FMS+B_7FXP+B_8XPL+e$$

Where
ADOPT= Likelihood of adoption and dummy variable (1 for adoption and 0 for non adoption).
AGE = Age of respondents (measured in years).
SEX = Gender of respondents (male or female).
MST = Marital status
EDU = Educational level (measured in years spent in formal schooling).
HHS = Household size (measured in persons living under the care of the respondent).
FMS = Farm size (total area of land owned/operated by respondent measured in hectares).
EXP = Farming experience (measured in number of years spent as soybean farmer
XPL = Expenditure on hired labour measured in Naira value
e = Error term which satisfies all the econometric conditions of ordinary least square (OLS).

The equation for the relationship between technology characteristics and the likelihood of adoption is specified as:

$$ADOPT = B_0+B_1YLD+B_2MTT+B_3UTL+ e$$

Where:
UTL = Utilization of soybean at household level, dummy variable.
YLD = Yield (physical output of improved variety measured in kilogram).
MTT = Maturity period (measured in days improved crops spend on field before harvesting)
e = Error term which satisfies all the econometric conditions of ordinary least square (OLS).

RESULTS AND DISCUSSION

Socio-economic factors affecting the likelihood of technology adoption

The socio-economic characteristics that significantly influenced the adoption of improved soybean seeds by farmers include farm size and expenditure on hired labor. These factors were statistically significant at 5%. The coefficient of farm size was found to be significant (p≤0.05) but negatively related with the adoption of improved soybean seed in the study area (Table 1). This confirms the hypothesis that small farmers, in comparison to large farmers, adopt improved technologies at a faster rate if additional gains are substantial (Shiyani et al., 2002). This might likely be due to two reasons. First, small farmers live at subsistence level that attracts them to adopt improved varieties which give better yields, earn more income and thereby helping in raising their standard of living. Secondly, limited availability of improved seeds might have compelled large farmers to partly continue producing alternative crops or recycled local seeds. As a result, they lagged behind in adopting improved seed. This also agrees with the findings of Allaudin and Tisdell (1988) that small farmers adjust quickly and adopt new innovations at a faster rate than large-scale farmers.
Table 1 further shows a positive and significant

Table 1. Logit estimate of likelihood of adoption based on respondents' socio-economic characteristics.

Likelihood of adoption	Coefficient	Std. error	Z	P> |z|	(95% Conf. Interval)	
Age	-.0108678	.0091023	-1.19	0.232	-.0069723	.028708
Sex	.4067453	.2688421	1.51	0.130	.9336661	.1201756
Education	.0299189	.0700357	0.49	0.669	.1073486	.1671863
Household size	.0390558	.0293156	1.33	0.183	.0965134	.0184017
Farm size	-.6723619	.2962722	-2.27	0.023[**]	-1.253045	-.0916791
Farming experience	.2033259	.1127525	1.80	0.071	.0176649	.4243168
Use of hired labor	.2903237	.291032	1.00	0.318	.860736	.2800886
Expenditure on labor	.0000249	.0000115	2.15	0.031[**]	2.23e-06	.0000475
Cons	.189562	.73451	0.26	0.796	1.250051	1.629175

[**]= Significant at 5%.

Table 2. Logit estimate of likelihood of adoption based on technology-specific characteristics.

Likelihood of adoption	Coefficient	Std. err.	Z	P> |z|	(95% Conf. Interval)	
Use of soybean	1.115597	.494053	2.47	0.014[**]	1.022848	1.216756
Maturity period	-1.369532	.3474143	-1.24	0.015[**]	-.8329999	2.251644
Yield of soybean	1.000661	.00016	4.13	0.000[***]	10000347	1.000974

[**]= Significant at 5%.
[***]= Significant at 1%.

relationship ($\rho \leq 0.05$) between farmers' expenditure on hired labor and adoption of improved soybean seeds in the study area. This means that soybean farmers who had resources to engage the services of hired labor were more likely to adopt improved soybean as a production technology compared with farmers who depended solely on the family labor. This could be explained by the fact that hired labor is generally used by medium-scale and large-scale farmers in Nigerian agriculture where labor-saving technologies are not always readily available. This, coupled with the fact that the family labor, even though it constitutes a bulk of the labor force used in agriculture in Nigeria, is not always available for farm operations (Bamire and Manyong, 2003). Consequently, soybean farmers who could afford to hire labor will tend to maximize returns on investment in soybean farming. This can trigger adoption of improved soybean seed among other production technologies. It is generally believed that in the rural communities, including the study area, labor is available and relatively affordable. As such, apart from providing employment for the abundant 'idle' human resource and promoting large-scale production, patronizing hired labor in farming communities could also encourage the diversion of rural labor force into generating non-farm incomes and thereby diversifying sources of income for rural dwellers.

Technology-specific factors affecting the likelihood of technology adoption

Among the technology-specific characteristics considered

for the study, the results showed that respondents' utilization of soybean at household level, maturity period and yield of soybean were found to be significant ($\rho \leq 0.05$) in influencing the decision to adopt improved soybean as production technology (Table 2). Even though soybean was introduced recently into the study area, it has rapidly gained popularity in terms of household usage. Results from the study showed that virtually all farmers in the study area use soybean at household level. Soybean is rich in protein (Sanginga et al., 1999), which is commonly deficient in the diet of most communities, especially rural communities. Among the uses to which soybean was being put in the study area are preparation of soy pulp, *akara,* cheese/milk, *dadawa* and weaning food. This implies that soybean has come to the aid of many households in the study area in terms of cheap source of protein. Given that majority of the population in the study area is engaged in farming, it is obvious that they will plant soybean on their farms even if only to meet their household needs. This agrees with earlier findings by Sanginga et al. (1999) that household utilization formed a major reason for the adoption of soybean in Benue State.

Maturity period was also found to be an important determinant influencing the adoption of improved soybean seed in the study area. The variable was significant at 5% probability level with negative sign (Table 2). This means that adoption of improved soybean seed by respondents increased with decrease in time taken to maturity by the crop. This is expected as early maturity gives the crop an advantage, especially in the study area

which is prone to drought. One of the characteristics of the study area's ecology is the dry Harmattan wind which sets in at the end of the rainy season, thereby facilitating pod shattering (Sanginga et al., 1999). Early maturity therefore enables soybean crop to escape pod shattering, pest infestation and terminal drought due to receding soil moisture. These factors gave it an advantage over alternative crops such as the traditional cowpea which is highly vulnerable to all the above due to its relatively long maturity period. As such, the probability of adoption of soybean increased with decrease in its maturity period. Yield of soybean was found to be a very important factor that influenced the adoption of improved soybean seed among farmers in the study area. The yield variable was found to be positive and significant at 1% level of probability (Table 2). Yield is a direct measure of seed's performance, and a crop variety that is high yielding stands to be adopted by farmers since high yield would raise output and subsequent gross earning. This finding agrees with Ojiako et al. (2007) that yield of soybean was significant in influencing the adoption of improved soybean in northern Nigeria. Adesina and Zinna (1993) also reported that yield significantly influenced farmers' decision to adopt improved mangrove swamp varieties of rice in Sierra Leone.

Alimi (1991) observed that one of the main problems facing agricultural production in developing countries is low yield.

The practice of planting traditional/low yielding variety of crops by farmers may partly be responsible. This necessitated the development of high yielding varieties of crops by agricultural research institutes with the hope that these improved varieties of crops will be adopted by farmers so as to improve their yield. To that effect, a variety of crop that has high capacity for high yielding has high chances of being adopted. The likelihood of adoption is even higher if the crop variety does not depend so much on complementary inputs such as fertilizers and pesticides. Soybean, being a leguminous crop, has the capacity to fix atmospheric nitrogen into the soil. This implies that it can generate part of its nutrient requirements, thus, it can guarantee yield even without supply of fertilizers (Onyibe et al., 2006). Soybean is also not susceptible to most of the local pests and diseases which hinder the production of related crops such as cowpea. All these give soybean some added advantage over other grain legumes.

Conclusion and Recommendations

In this study, the factors affecting the likelihood of adoption of improved soybean seed by farmers in southern Borno State were analyzed. It was found that farm size, which is an indicator of wealth status, significantly (ρ≤ 0.05) influenced the likelihood of adoption of improved soybean seed among the respondents in the study area. This study also concludes that expenditure on hired labor

significantly (ρ≤ 0.05) influenced the likelihood of adoption of improved soybean seed. Utilization of soybean at household level was found to be important in influencing the likelihood of adoption of improved soybean seed by the respondents (ρ≤ 0.05). Yield of soybean also significantly (ρ≤ 0.01) influenced the likelihood of adoption.

Based on the findings of this study, the following were recommended. Labor-saving technologies should be made available to farmers to cushion the effect of expenditure hired labor. Farmers should also be linked to sources of financial support so as to enable them afford hired labor. Improved seeds that possess high yielding and early maturing characteristics should be provided to farmers, while extension service should educate and encourage farmers on the utilization of soybean as a household food item.

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