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BOOSTING FARM PRODUCTIVITY THROUGH INTENSIFICATION OF SOYBEAN PRODUCTION TECHNOLOGY

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ABSTRACT

This study aims to critically bring to the fore appropriate soybean production technologies that boost the level of farm productivity. Multistage sampling techniques were used in selecting respondents for this study. Primary data was collected using structured questionnaires. Descriptive statistics and Multinomial Logit regression model were the analytical techniques employed. The results indicated that most (35%) were within the age bracket of 21-30 years; 39.7% had farming experience of 1-5 years. Most (73.3%) had extension contact; most (75%) were married, and most (63.3%) were male. Furthermore, most (55%) had farm size of ≤1.9 hectares; most (38.3%) had household size of 11-30 people. Also, planting on ridges (80%), use of viable seeds (79.2%) and recommended harvesting time (50.0%); were the prevalent soybean production technologies adopted in the study area. In addition, the coefficient of multiple determinations (R2) was 0.7831 suggesting that 78% of the variation in the soybean farmer's adoption decision was accounted for by the variables in the regression model. The remaining 22% is attributable to omitted variables and the stochastic error term. Furthermore, the most significant constraints of adoption of soybean production technologies were; high cost of technology (68.3%), lack of technical expertise (50.8%), inadequate capital (40.8%), and poor market linkages (40.0%). Thus, this study revealed that socioeconomic variables affected farmer's adoption decisions. Moreover, technology adoption was relatively low with consequent declining farm productivity. However, improved extension service, subsidized and improved access and/ or supply of inputs, credit and market linkages are strongly recommended.

Contribution/Originality: This study is one of the few studies which have investigated appropriate soybean production technologies that boost farm productivity.

1. INTRODUCTION

Soybean (*Glycine max*) was seen as being appropriate only for large- scale commercial farming for production of seed that are used in making livestock feed. The major soybean producing countries in the world are the United States, Brazil, China, Nigeria, India, Argentina, South Africa and Uganda (International Institute of Tropical Agriculture (IITA), 2009). Soybean cultivation in Nigeria starts in May / June with land clearing, and it's harvesting is normally done in October through November. The crop is harvested 3-4 months after planting, depending on the time of sowing and the variety cultivated. Soybean can contribute to the enhanced sustainability of intensified cropping systems by improving soil fertility through nitrogen fixation, permitting a longer duration

of ground cover in the cropping sequence, and providing useful crop residue for animal feed (Rahmianna & Nikkuni, 2002). Over the last two decades, International Institute for Tropical Agriculture (IITA) has made substantial effort to improve the productivity of the crop by developing high yielding, early maturing varieties capable of modulating in association with the local rhizobia, and possessing and other good agronomic traits. Nigeria as a developing nation had long sought for improved agricultural technologies through the launching of numerous agricultural projects and programmes. Despite all the efforts to boost agricultural production with a view to improving the living standards of rural farm households; this has not been fairly reflected in the productivity of farmers, which remain at downtown of return to scale. This could be as a result of many constraints faced by farmers and thus, making it very difficult for improved agricultural technologies to be employed. However, empirical attempts to study the adoption of farm technologies among soybean farmers in Nigeria are grossly inadequate (Ani & Undiandeye, 2001).

There is insufficiency of data or empirical analysis on how rural farmers adopted and combine improved crop production technologies to increase farm production and ensure sustained survival of their households and communities. Literature is also inadequate in assessing empirically factors that affect the rate and levels of adoption of improved technologies (Ani & Undiandeye, 2001; Okunola, 2003). Rural farmers are also continuously searching for options including risks management strategies that will complement and strengthen their technological capacities and poverty reduction, but this has not been sufficiently documented. The objective of the Nigeria food security programme of increasing agricultural production for food self-sufficiency is still far being realized (Agbaje, Ogunsumi, Oluokun, & Akinlosotu, 2005). This is even more so with soybean production. In fact, available statistics show that the supply of soybean fall short of its demand. For instance, (International Institute for Rural Reconstruction (IIRR), 1998) asserts that while the average growth rate of the Nigerian population is between 2.5 – 3.0% per annum, domestic food production lags behind at a growth rate of less than 2% per annum thereby creating food supply gap. Agbaje et al. (2005). Acquah and Evange (1991) attributed high cost of planting materials, high labour cost, intensive and laborious cultural practices, inadequate capital and high cost of input as factors contributing to decreased agricultural production. Furthermore, not much has been adequately unraveled regarding how rural farmers 'technical knowledge can contribute to an increase in their agricultural productivity in Nigeria. Nweke, Ugwu, Asadu, and Ay (1991); Omotugba et al. (2008) however, identified planting materials and high labour requirement as major constraints to increased farm production. The decreased output of agricultural produce over the years may not only be connected with deviations of farmers 'practices from technical recommendations but also with the use of resources at sub–optimal levels which ultimately leads to technical and allocative inefficiencies (Coelli & Battese, 1996; Omotugba et al., 2008). This necessitated the need to assess the adoption of improved production technologies by soybean farmers in the study area with a view to proffering appropriate policy recommendation that revolutionize soybean production in Nigeria and particularly in Jos-East Government Area of Plateau State. This study aims to analyze factors that influence adoption of soybean production technologies that enhance farm productivity. This study will also help to critically and objectively bring to fore the importance of soybean production technologies, appropriate technologies that boost the level of farm productivity and the contributions of soybean production to food security particularly in the study area. This study would guide future researchers in estimating the index and rate of adoption of soybean production technologies. This study was therefore conducted to provide answers to the following research questions;

1. What are the socioeconomic characteristics of the soybean farmers in the study area?
2. What are they soybean production technologies available?
3. What are they factors influencing the adoption of soybean production technologies?
4. What are they constraints adoption of soybean production technologies?

1.1. Research Hypothesis

H_o: There is no significant relationship between the farmer's socioeconomic variables and their adoption decisions.

2. METHODOLOGY

2.1. Study Area

Jos-East Local Government Area (LGA) has a population of 622682 with an area of 1037 square kilometer, it is located between latitude 9.6^0-9.9^0N and longitude of 9.06^0-9.1^0E (https://en.m.wikipedia.org/wiki/jos_east).. The study area has a temperature of about 26^0c and rainfall of about 100mm per annum. Jos East is made up of five (5) districts namely: Federe, Fursum, Fobur, Shere and Maigemu. They are popularly known for agriculture and commercial activities.

2.2. Sampling Technique

Multistage sampling technique was employed in this study; in the first stage Jos-East LGA was selected due to the prevalence of soybean farmers in the study area. The second stage involved random selection of some villages from each district. Sample size was estimated from the sample frame using a constant sampling proportion to determine the number of respondents for the study. The last stage, involved the random selection of 120 respondents representing 3.5 % of the total population. Table 1 presents the sample frame distribution.

Table-1. Sample Frame.

District	Selected village	Sample frame	Sample size
Fobur	5	683	24
Fursum	5	667	23
Shere	3	308	11
Maigemu	7	922	32
Federe	5	840	30
Total	35	3420	120

2.3. Method of Data Collection

Primary data were collected from the soybean farmers in the study area, with the use of structured questionnaires.

2.4. Analytical Techniques

Descriptive statistics (such as mean, percentages and frequency distribution) were used to analyze objectives i, ii and iv. Multinomial Logit (MNL) regression model was used to analyze objective iii. Multinomial Logit (MNL) Regression analysis was used to determine the relationship between the factors that influence adoption decisions of soybean farmers and production technologies available to them. The regression analysis was used in estimating the interrelationships between the independent and the dependent variable so as to determine the variables that influence farmer's adoption decisions. Multinomial Logit (MNL) regression analysis was also used to test the hypothesis for this study. The coefficient of determination indicates the degree of association between the variables under consideration. Equation 1 presents the regression model in its explicit form;

$$Y = a + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + e \quad (1)$$

Where;

Y = Soybean Production technology; a = constant; X_1 = gender (male=1, female=0); X_2 = education (years); X_3 = marital status (married=1, single=0); X_4 = experience (years); X_5 = farm size (hectares); X_6 = extension contact (yes=1, no=0); $\beta_1 - \beta_6$ = regression coefficient; e = error term.

Some of the recommended soybean production technologies available in the study area include;

i. Plant date ii. Fertilizer application iii. Planting on ridges

iv. Use viable seed v. Weeding interval vi. Recommended Harvesting time
vii. Herbicide application viii. Processing method ix. Disease control
x. Pesticides application xi.Spacing

3. RESULTS AND DISCUSSION

3.1. Socioeconomic Characteristics of the Respondents

3.1.1. Age

Table-2. Distribution of respondents based on their age.

Age	Frequency	Percentage (%)
< 20	15	12.5%
21-30	42	35%
31-40	26	19.2%
41-50	24	20%
> 50	13	10.8%

Table 2 revealed that most (35%) of the soybean farmers are within the age bracket of 21-30 years. The implication of the foregoing result is that soybean farming in the study area has higher patronage among people who are energetic enough to withstand the stress involved in agricultural activities. This implies that most of the farmers are still within their active and productive age and can participate adequately in farming activities. Young people are thought to be more receptive to modern ideas than their older counterparts; which therefore suggests an inverse relationship between age and technology adoption. Furthermore, this age bracket can be regarded as the youthful and economically active period when farmers can make vital impact in agricultural production and technology development generally (Enitan, 2010). This agrees with the findings of Ume and Okpukpara (2006) who reported similar results on farmer's demography. The age of an individual is believed to be capable of influencing their perceptions and interest. Many studies have linked innovativeness with young age (Akpoko, 2004).

3.1.2. Gender

Table-3. Distribution of respondents based on their gender.

Gender	Frequency	Percentage (%)
Male	76	63.3
Female	44	36.7
Total	120	100.0

Table 3 revealed that most (63.3%) were male while 36.7% were female. This result reveals that soybean production in the study area is mostly carried out by men. This corroborates with the findings of Ani., Ogunbameru, and Undiandeye (2008) who also revealed the predominance of men in soybean production which may be attributable to their access to production inputs over their female counterparts.

3.1.3. Marital Status

Table-4. Distribution of respondents based on their marital status.

Marital Status	Frequency	Percentage (%)
Single	30	25.0
Married	90	75.0

Table 4 revealed that the most (75%) were married. This suggests that majority of the soybean farmers in the study area had families which can supply basic farm labour. Thus, marital status can be a determinant of household

size, which also serves as proxy to family labour required for carrying out farm activities. Most farmers in the study area were married; this can be attributable to the fact that farming requires adequate labour supply which can be sourced from family members. Ayanda et al. (2008) in a study of rice farmers in Jigawa state, observed that 85.3% of the farmers were married. Tologbonse and Adekunle (2000) also discovered that 98.5% of the farmers in Benue state were married. This also corroborates with Sabo (2006) who found that majority of the participants and the non-participants in a community-based agricultural and rural development programme in Zaria local government area were married. However, married farmers may have larger household sizes which may encourage them to adopt many improved agricultural technologies in order to raise their income and standards of living.

3.1.4. Level of Education

Table-5. Distribution of respondents based on their level of education..

Education	Frequency	Percentage (%)
Primary	27	22.5
Secondary	81	67.5
Tertiary	12	10.0

Table 5 revealed that most (67.5%) of the respondents attended secondary; primary education had (22.5%), while tertiary education was (10%). This suggests that majority of farmers were literate. High level of literacy among the respondents may facilitate better adoption of improved soybean production technologies and better ability of impacting knowledge and skills for adoption of an innovation. Olaleye (2000) submitted that education is an important characteristic especially in the adoption of agricultural technology or innovations. Okunade (2006) also opined that most farmers had attained a form of education. In the past few years, populations of highly educated people have also taken up farming either as a secondary occupation or as full-time business and are deploying their knowledge in the management of their farms. This results also corroborates with the findings of Ray (2001) which revealed that adoption of innovation is enhanced by high rate of literacy and educational attainment; as literate farmers can understand the benefits of technological innovations and their implication better than illiterate counterparts.

3.1.5. Household Size

Table-6. Distribution of respondents based on their household size.

Household Size	Frequency	Percentage (%)
≤5	32	26.7
6-10	42	35.0
11-30	46	38.3

Table 6 revealed that most (38.3%) had a household size of 11-30 people. This suggests adequate supply of family labour for farm activities. This finding is in line with Yahaya and Aina (2007) and Fakoya, Apantaku, and Unaese (2001) who reported that large household size provide and assist in carrying out farm and other household activities.

3.1.6. Extension Contact

Table-7. Distribution of respondents based on their extension contact.

Extension contact	Frequency	Percentage (%)
No	32	26.7
Yes	88	73.3

Table 7 reveals that most (73.3%) of the respondents had access to extension contact, while (26.7%) had no access to extension contact. Extension contact is expected to enhance soybean farmer's ability to efficiently utilize their resources through the adoption of new and improved methods in soybean production. According to Oladele and Kareem (2003) extension contact is very essential to the improvement of farm productivity and efficiency among farmers. Okunade (2006) also argued that higher extension contacts would increase adoption of improved farm production technologies.

3.1.7. Farming Experience

Table-8. Distribution of respondents based on their farming experience.

Farming Experience	Frequency	Percentage (%)
1-5	47	39.7
6-10	33	27.5
11-15	16	13.3
>15	24	20

Table 8 revealed that most (39.7%) of the respondents had 1-5 years farming experience, those with 6-10 years of farming experience were 27.5%, while 20% had >15 years of farming experience. The years of farming experience suggests that the farmers will be able to make sound decisions as regards resource allocation and general management of their farms. The study area is an agrarian community and hence most of the respondents had several years of farming experience. These years of farming experience provides the respondents with adequate knowledge and information on agricultural practices and technology that can enhance farm productivity. This result is in line with Idachaba (2007) who posited in his study on food crop production in Oyo State; that years of farming experience increased agricultural productivity among farming households. Similarly, Adeogun and Oluyole (2004) also reported that majority of the cocoa farmers in Oyo State had over 10 years' experience in farming.

3.1.8. Farm Size

Table-9. Distribution of respondents based on their farm size.

Farm Size	Frequency	Percentage (%)
≤1.9	66	55
2.0-2.9	34	28.3
≥3.0	20	16.7

Table 9 revealed that most (55%) of the respondents had farm size of ≤1.0 ha, 28.3% had farm size from 2.0-2.9 ha, while 16.7% had ≥3.0 ha of farmland. This suggests that majority of the farmers had small farm holdings which accounts for the predominance of subsistent level of soybean production in the study area, which prevents them from enjoying economies of scale. Similarly, small farm size is an impediment to agricultural mechanization because using farm machineries like tractors will be difficult. The small farm holdings may be attributable to the prevailing land tenure practices in the study area which further fragments farmlands.

3.2. Soybean Production Technologies

Table-10. Distribution Based on Soybean Production Technologies Adopted by the Farmers.

Production Technology	Frequency*	Percentage	Rank
Viable seeds	95	79.2	2nd
Planting date	41	34.2	8th
Planting on ridge's	96	80.0	1st
Herbicides application	45	37.5	7th
Recommended harvesting time	60	50.0	3rd

Spacing	52	43.3	6th
Weeding interval	56	46.7	5th
Pest control	33	27.5	9th
Processing method	57	47.5	4th
Diseases control	21	17.5	10th

Note: *Multiple Responses.

Table 10 revealed the various production technologies adopted by soybean Farmers in the Study Area. The significant practices adopted among soybean farmers include; Planting on ridges (80%), viable seeds (79.2%), recommended harvesting time (50.0%), Processing method (47.5%), weeding interval and pest control were both (46.7%), recommended Spacing (43.3%), herbicides application (37.5%), planting dates (34.2%), pest control (27.5%) and diseases control (17.5%). These production technologies adopted significantly affected soybean yield and enhanced farm level productivity. However, there was low adoption of soybean production technology in the study area among the respondents. This result corroborates with Rahmianna and Nikkuni (2002) who reported similar results on soybean production technology.

3.3. Determinants of Adoption of Soybean Production Technology

Table-11. Factors Influencing Adoption of Soybean Production Technologies.

Variable	Coefficient	Standard Error	T-ratio
Constant	0.798**	0.267	2.988
Gender (X_1)	0.475 n.s	0.317	1.498
Education (X_2)	0.641**	0.24	2.670
M/ status (X_3)	0.321 n.s	0.219	1.465
Experience(X_4)	0.717***	0.189	3.793
Farm size(X_5)	0.338**	0.122	2.770
Extension(X_6)	0.657***	0.173	3.797
Prob<X^2	0.0031**		
PseudoR^2	0.7831		

Note: ***= significant at 1% (p<0.01), n.s= not significant.

The regression analysis presented in Table 11 revealed the factors influencing the adoption of soybean production technology in the study area. The Likelihood ratio statistic (as indicated by X^2 statistic) is highly significant (P<0.0031), suggesting that the regression model has a strong explanatory power.

Also, the result of the regression analysis revealed that the pseudo coefficient of multiple determinations (R^2) was 0.7831 implying that 78% of the variation in the soybean farmer's adoption decision was accounted for by the variables in the regression model. The remaining 22% not explained may be due to omitted variables and the stochastic error term.

The coefficient of education (0.641) was positive and statistically significant at 5% (p<0.05) probability level, suggesting that farmer's level of education influences the rate of adoption of agricultural technology or innovations that can enhance farm productivity and efficiency. The coefficient of farm experience (0.717) was positive and statistically significant at 1% (p<0.01) probability level, suggesting that farmer's experience and knowledge of agricultural technology and innovations made predominant contributions towards adoption.

The coefficient of farm size (0.338) was positive and statistically significant at 5% (p<0.05) probability level, suggesting that farm size facilitates easy adoption of agricultural technology hence small farm holdings require only limited farm areas that can be allotted for adoption purposes.

The coefficient of extension contact (0.657) were positive and statistically significant at 1% (p<0.01) probability level, suggesting that the frequency of contact between farmers and extension services influences their access to technical information on improved soybean production technology that can enhance their level of farm productivity. Thus, this implies that an increase in these positive variables, other factors held constant, will increase the

likelihood of the respondents adopting more options of soybean production technology that can enhance their farm productivity.

3.4. Constraints of Adoption

Table-12. Distribution based on the constraints of adoption of production technologies.

Constraint	Frequency*	Percentage	Rank
High cost of technology	82	68.3	1st
Lack of technical expertise	61	50.8	2nd
Inadequate capital	49	40.8	3rd
Poor market linkages	48	40.0	4th
Poor access to agricultural credit	47	39.1	5th
Inadequate extension contact	35	29.2	6th
Poor access to technology	9	7.5	7th

Note: *Multiple Responses.

Table 12 revealed the constraints of adoption of production technologies among soybean farmers in the study area. The significant constraints of adoption among the soybean farmers include; High cost of technology (68.3%), lack of technical expertise (50.8%), inadequate capital (40.8%), poor market linkages (40.0%), Poor access to agricultural credit (39.1%), Inadequate extension contact (29.2%), poor access to technology (7.5%). These constraints affected the adoption of production technologies among soybean farmers in the study area. This result is in line with Ray (2001) who reported similar constraints of technology adoption.

4. CONCLUSIONS

The study revealed that the socioeconomic factors of the soybean farmers affected their capacity to adopt options of production technology. Moreover, several options of recommended technology were available to the farmers. However, adoption was relatively low with consequent declining farm productivity. Furthermore, the socioeconomic variables in the regression model significantly affected soybean farmer's adoption decisions. All the constraints identified significantly affected the adoption of soybean production technologies in the study area. Based on the findings of the study, the following recommendations were made:

I. Government and other stakeholders need to invest more on improving extension service delivery services. This strongly has the potential to increase level of awareness and farmer sensitization on production technologies.
II. The government and other stakeholders should subsidize the cost of production technologies.
III. Formulation and implementation of policies that will ensure the adequate supply and access to production technologies and inputs.
IV. Formulation and implementation of policies that will facilitate adequate market linkages.
V. Formulation and implementation of policies that will facilitate adequate access to agricultural credit and farm capital.
VI. Formulation and implementation of policies that will facilitate capacity development in agricultural technology utilization.

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