



DETERMINANTS OF ADOPTION OF SOYBEAN PRODUCTION TECHNOLOGIES AMONG SMALL SCALE FARMERS IN THE CENTRAL AGRICULTURAL ZONE OF GOMBE STATE, NIGERIA

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ABSTRACT

The study examined the determinant of the adoption of recommended Soybean production technologies practices among small scale farmers in Central Agricultural Zone of Gombe State. Multi-stage sampling techniques were used in selecting 206 respondents from the study area. Data were collected through the administration of structured questionnaires and analyzed using both descriptive and inferential statistics. The result from the study reveals that majority (75.2%, 65.6%) of the respondents were males, married and within the ages of 28-47 years, respectively, also majority (87.4%, 82.5% and 75.2%) of the respondents had 1.6-3.0ha of land, 2-21 years of farming experience and 4-9 persons per household size in the study area respectively. The result further shows that majority (72.8% and 55.3%) of the respondents had an annual income of ₦50,000-₦100,000 and had attained secondary/tertiary levels of education in the study area respectively. The result shows that use of implements in land preparation, soy bean harvest between 3-4 months and mid-June – early July planting of soy technologies were mostly and frequently practiced by the respondents and were ranked 1st, 2nd and 3rd in the study area, respectively. The result also shows that socioeconomic characteristics of the respondents had significant influence on their adoption of technologies in the study area, sex, land size, membership of association, years of membership in association, inadequate extension contact, lack of credit access and other sources of credits were highly significant ($P < 0.001$), while farming experience and extension contact in 2020 were significant at ($P < 0.05$). However, high cost of technologies; insufficient information and non-accessibility of technologies were the major challenges/constraints faced by the respondents in the study area. The study concluded that sex, land size, membership of association were the factors influencing the adoption of soya bean technologies in the study area. Based on the findings highlighted the study recommended that, ADP should make available and affordable technologies to the farmers, more extension agents should be recruited to reach or widened the coverage of extension activities in the study area.

Keywords: Adoption, Technologies, Small-scale farmers, Soybean, Respondents.

INTRODUCTION

Soybean (*Glycine max* L. Merrill) has been variously described as a miracle bean because it is a cheap and protein-rich grain. Soybean originates from East Asia (Onasanya, 2012). According to Singh *et al.* (2014) it contains 40% high quality protein, 20% edible vegetable oil, a good balance of amino acids and has therefore, remarkable potentials to improve the nutritional status and welfare of the families of resource-poor farmers. Soybean also 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 residues for animal feed (Rahmianna and Nikkuni, 2010).

In Nigeria, soybean production is gaining increasing importance with the crop now being cultivated in almost all ecologies, but with the greatest potential in the Guinea savannas. The main growing states include Gombe, Benue, Kaduna, and Katsina. Studies have revealed that Nigeria is the biggest soybean producing country in SSA in terms of both area cultivated and production level (Coulibaly *et al.*, 2009). Between 1990 and 2007, Nigeria cultivated an average area of 564,927 ha of soybean and produced an average of 176,954 tons (t) (Coulibaly *et al.*, 2009). Adoption of agricultural technologies refers to the decision to apply a technology and continue with its use (Agbamu, 2006 cited in Abdullahi *et al.*, 2021). The adoption occurs in three phases; acceptance, decision to use and continued use. It is generally a multi-stage process under taken most often sequentially and being influenced by a wide range of social, physical and technical aspects of farming activities and practices. Smallholder farmers are those farmers whose production capacity is ≤ 4.99 hectares (FOS, 1999 cited in Abdullahi *et al.*, 2021). One of the features that agricultural production system in Nigeria is strangely large fraction of the agricultural output is in the hands of these smallholder farmers whose average holding is about 1.0-3.0 hectares (Abdullahi *et al.*, 2021).

Food insecurity and malnutrition are among the major challenges faced by the developing countries which Nigeria is not an exception. These challenges are more serious in rural than urban areas mainly because of a low level of understanding about nutrition and lack of capacity to purchase animal source proteins. Soy bean can be an alternative source of protein to replace the animal protein. The crop supplies food for local consumption and raw materials for domestic manufacturing industries. Despite all these importance, its production is faced with a number of challenges. The major ones are: adverse climatic conditions, lack of appropriate land use system resulting soil and other natural resource degradation, limited use of agricultural technologies and the predominance of subsistence agriculture which is made up of smallholder farmers (ATA, 2014). Soybean is farmed extensively by small scale farmers with low yields. This could be attributed to poor production technologies, inadequate supply of inputs such as improved seed varieties, fertilizers and machineries, as well as pesticides and herbicides for pest and weed control respectively (Oyekan, 2015). Eziakor (2017) stated that there is a growing realization that the successful adoption and implementation of improved practices by the small-scale farmers holds the key to increased yields on their smallholdings. Previous studies have shown that, there is little or no literature about adoption of soy bean production practices among small scale farmers in the study area, it is against this background that this study wish to be conducted.

The broad objectives was to examine the determinants of adoption of soybean production technologies among the small-scale farmers in Central Agricultural Zones of Gombe State. The specific objectives were to:

- i. describe the socio-economic characteristics of soybean farmers in the study area;
- ii. identify the recommended soybeans production technologies available to farmers in the study area;
- iii. determine factors influencing soy beans adoption; and
- iv. identify the constraints to adoption soy beans production technologies among farmers in the study area.

The findings of this study will provide information on farmers' socio-economic characteristics that influence soybean farmers' decisions on the adoption of recommended soybean production technologies. The outcome is expected to be used by policy makers in fashioning out sustainable strategy to improve soy bean production in the study area. It will



also serve as an addition to existing literature as well as opening for further research. The population of the study focused on small scale soya bean farmers in the central zone Gombe state.

MATERIALS AND METHODS

The Study Area

The study area is Gombe State, which is located on Latitude: 10.283333 Lat: 10° 16' 59.9988" N and Longitude: 11.166667 DMS Long: 11° 10' 0.0012" E Northeastern region of the country. It has an enable land area of about 20, 265 km². The State has two distinct seasons (rainy season which starts from April to October with an average rainfall of 850 mm and the dry season which starts around November to March) bordered to the north and northeast by the states of Borno and Yobe, to the south by Taraba State, to the southeast by Adamawa State, and to the west by Bauchi State. Named for the city of Gombe, the state's capital and largest city, Gombe State was formed from a part of Bauchi State on October 1, 1996. The state is among the multilingual states in Nigeria. Of the 36 states in Nigeria, Gombe is the 21st largest in area and the 32nd most populous, with an estimated population of 2,365,000 people as at 2006 census and 3,960,100 in 2021 at a growth of 3.0 National Population Commission [NPC], 2006).

Sampling Procedure

A multi-stage sampling technique was used to select the respondents from the study area. In the first stage, Gombe Central Zone of ADP was purposively selected due to its potentials for soya bean production. In the second stage two districts will be randomly selected from the six districts of the two local Governments in the zone. In the third stage from the selected districts, six villages will be randomly selected, from the selected villages 50% of the respondent will be randomly selected from registered soy beans farmers obtained from the ADP. The total registered farmers in the study area are 412 based on that the sample for the study will be 206 soy beans farmers randomly selected from the study area.

Method of Data Collection

Data for this study will be collected through the administration of structured questionnaire to the respondent in the study area.

Method of Data Analysis

The data will be analyzed using both descriptive and inferential statistics. The descriptive statistics such as frequency, percentage, mean, minimum and maximum and standard deviation will be used in analyzing objectives i, ii, iii, v and vi objectives.

The inferential statistics to be use is logit regression, which will be use in analyzing objective iv, and the explicit form of the model is expressed bellow;

$$Y = a + b \times 1 + x_2 + x_3 + x_4 \dots X_n$$

where;

Y = (Adoption which is a binary i.e Yes=1 or No = 0)

X₁ = Age

X₂ = Marital Status

X₃ = House Household size (N0)

X₄ = Education

X₅ = Farming Experience

X₆ = Membership of Association

X₇ = Extension Contact

X₈ = Credit Access

X₉ = Affordability



X₁₀ = Comfortability

X₁₁ = Complexity

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

The result from Table 1 reveals that 34% of the respondents were within the ages of 28-37 years, while 31.6%, 22.8%, 6.3% and 5.3% of the respondents were within the age bracket of 38-47, 48-57, 18-27 and above 58 years respectively with an average age of 41 years. This implies that most of the respondents were within their active ages of production in the study area, which is very important factor in determining adoption of technologies. Young men and women adopt technologies and innovations easier and faster than the older farmers who have over years been practicing local production technologies. The result also shows that majority (75.2%) of the respondents were male, while only 24.8% of the respondents were female, this implies that the male gender dominates Soybean production in the study this cannot be unconnected to the religious and cultural believes of the respondents that hinders women from participating in some agricultural activities in the study area.

The result further reveals that majority (75.2%) of the respondents were married, while 20.9% and 3.9% of the total respondents were single and separated respectively, this implies that most of the respondents were married and had household responsibilities to carter for, hence the need for the adoption of new technologies so as to improve their level of production and income in general. The result also reveals that less than half (49%) of the respondents had a household size of 4-6 persons while 26.2%, 8.3% and 4.9 of the respondents had 7-9, 1-3 and 10-12 persons respectively as their household size with an average of 5 persons. This implies that most of the respondents had a relatively small number of household members in the study area. of households were female-headed as compared to 93.7% of households that were dual-headed

The result also indicates that 47.6% of the respondents had a farm size of 2.6 - 3.0 ha while 36.9% ,7.8%, 4.9% and 2.9% of the respondents had 1.6 - 2.0 ha, 3.0 - 3.5 ha, 1.0 - 1.5 ha and 2.1 - 2.5 ha of land respectively with an average of 2.5ha in the study area. This implies that most of the respondents had relatively medium size land for agricultural production in the study area.



Table 1: Socio-economic characteristics of the respondents (n = 209)

Variables	Frequency	Percentage	Min.	Max.
Age			18	65
18-27	13	6.3		
28-37	70	34.0		
38-47	65	31.6		
48-57	47	22.8		
58 and above	11	5.3		
Sex				
Male	155	75.2		
Female	51	24.8		
Marital status				
Single	43	20.9		
Married	155	75.2		
Separated	8	3.9		
Household size			1	14
None	23	11.2		
1-3	17	8.3		
4-6	101	49.0		
7-9	54	26.2		
10-12	10	4.9		
13 and above	1	.5		
Land size (ha)				
1.0-1.5	10	4.9		
1.6-2.0	76	36.9		
2.1-2.5	6	2.9		
2.6-3.0	98	47.6		
3.0-3.5	16	7.8		
Farming experience (years)			2	48
2-11	61	29.6		
12-21	109	52.9		
22-31	16	7.8		
32-41	16	7.8		
42 and above	4	1.9		
Annual income (₦)				
50,000-100,000	150	72.8		
101,000-150,000	20	9.7		
151,000-200,000	16	7.8		
201,000-250,000	11	5.3		
251,000 and above	9	4.4		
Educational level				
Non-formal education	49	23.8		
Adult education	2	1.0		
Islamic education	12	5.8		
Primary education	29	14.1		
Secondary education	45	21.8		
Tertiary education	69	33.5		

Source: Field Survey, 2021



Table 1: Socio-economic characteristics of the respondents (n = 209) **Contd.**

Variables	Frequency	Percentage	Min.	Max.
Experience in soy bean farming (years)				
2-6	81	39.3		
7-11	94	45.6		
12-16	6	2.9		
17-21	9	4.4		
22 and above	16	7.8		
Soy bean as Sole Farming				
Yes	123	59.7		
No	83	40.3		
Other occupation engaged				
None	123	59.7		
Civil servant	37	18.0		
Trading	16	7.8		
Artisan	5	2.4		
Farm produce marketing	25	12.1		
Membership of Association				
Yes	98	47.6		
No	108	52.4		
Years of Membership				
None	108	52.4	3	18
3-5	60	29.1		
6-8	7	3.4		
9-11	15	7.3		
12-14	-	-		
15 and above	16	7.8		
Extension Contact				
Yes	66	32.0		
No	140	68.0		
Frequency of Contact				
None	140	68.0		
Monthly	20	9.7		
Quarterly	11	5.3		
Annually	35	17.0		
Access to credit for soy bean				
Yes	96	46.6		
No	110	53.4		

Source: Field Survey, 2021

The result further shows that majority (72.8%) of the respondents had an annual income of ₦50,000 - ₦100,000, while 9.7%, 7.8%, 5.3% and 4.4% of the respondents had an annual income of ₦101,000 - ₦150,000, ₦151,000 - ₦200,000, ₦201,000 – ₦250,000 and above ₦251,000 respectively in the study area. This implies that most of the respondents' low-income earners in the study area.



The result from Table 1 further shows that 33.5%, 23.8% and 21.8% of the respondents had attained tertiary, non-formal and secondary level of education respectively in the study area. Only 14.1%, 5.8% and 1% of the respondents had attained primary, Islamic and adult education as their level of education, respectively. This implies that majority of the respondents had attained one or other level of education in the study area which is an important component in understanding and adopting of new technologies in the study area. The result also shows that 45.6% of the respondents had 7-11 years of soy bean farming experience, while 39.3%, 7.8%, 4.4% and 2.9% of the respondents had 2-6 years, above 22 years, 17-21 years and 12-16 years in soy bean farming in the study area. This implies that the respondents had experience in soy bean production and have tried several technologies in the production of soy bean and will be willing to adopt better technologies aimed at improving their productivity potentials. The result also reveals that majority (59.7%) of the respondents were only soy bean farmers as their only occupation in the study area, while 40.3% of the respondents had other occupation apart from soy bean farming in the study area. The result further indicated that majority (59.7%) of the respondents had no other occupation apart from farming, while 18%, 12.1%, 7.8% and 2.4% of the respondents were into civil service, farm produce marketing, trading and artisanship as other livelihood occupation apart from soy bean farming in the study area respectively. This implies that majority of the respondents were farmers. The result also shows that majority (52.4%) of the respondents were not members of any farmers association, while 47.6% of the respondents were members of farmers associations in the study area. This implies that majority of the respondents were not members of any farmers association in the study area, it could be attributed to the facts that there are few farmers association in the study area.

The result further reveals that majority (68%) of the respondents had no extension contact, while 32% of the respondents had extension contacts in the study area. This implies that most of the respondent had no contact with extension agent which is a strong determinant of adoption of new technologies. The result further reveals that 35%, 26.7% and 21.8% of the respondents had 8-9 bags, 10-11 bags and 4-5 bags of soy bean as output from their farm per season in the study area. Meanwhile, 14.1% and 2.4% of the respondents had 12 bags and above and 6-7 bags respectively in the study area. The result also shows that majority (53.4%) of the respondents had no access to credit while 46.6% of the respondents had access to credit in the study area.

Technologies Available and Practice by the Respondents

The result from Table 2 reveals the recommended technologies available and practiced by the respondents in the study area. The result shows that use of implements in land preparation, soy bean harvest between 3-4 months and mid-June – early July planting of soy technologies were mostly and frequently practiced by the respondents and were ranked 1st, 2nd and 3rd in the study area respectively. This implies that farmers were sensitized on early harvesting to reduced incidence of shattering of the bean due to over drying of the pod. On the other hand planting of improved varieties, recommended plant spacing, seed rate/hole, weed control measures, germination test, seed quantity/ha and recommended fertilizer applications technologies practiced in soy bean production were ranked 4th, 5th, 6th, 7th, 8th, 9th and 10th among the technologies that were available and practiced by the respondents in the study area respectively Others were storage at 10% moisture content, seed treatment and planting resistant variety technologies in soy bean production and were ranked 11th, 12th and 13th in the study area, respectively.



Table 2: Distribution of respondents according to technologies practiced

Variable	Percentage	Rank
Land Preparation	99.5	1 st
Harvesting	95.6	2 nd
Planting	91.3	3 rd
Improved Varieties	88.3	4 th
Recommended Plant Spacing	86.9	5 th
Recommended Seed Rate/hole	85.9	6 th
Recommended Weed Control Measures	79.6	7 th
Germination Test before Planting	67.0	8 th
Recommended Seed Quantity/ha	66.0	9 th
Recommended Fertilizer Rate	65.0	10 th
Storage	63.1	11 th
Seed Treatment before Planting	62.6	12 th
Pest and disease control	62.1	13 th

Source: Field survey, 2021

Factors Influencing Rate of Adoption of Technologies

Table 3 shows the regression analysis of factors influencing the adoption of recommended Soybean production technologies in the study area. Sex, land size, membership of association, years of membership, extension contact and access to credit were found to be significant. The result shows that sex and membership of association were found to be negative and significant ($P < 0.01$) in influencing adoption of Soybean production technologies among farmers in the study area. This implies that as female farmers increase the adoption of the technologies will decrease compared to their male counterparts that dominates the Soybean production in the study area. The female farmers have little access to information and production inputs and also have some religious and cultural factors hindering their participation in agricultural production activities in the study area. In the case of membership of association, it implies that as membership of association increases the adoption of Soybean production technologies decreases. This is not in line with *a priori* expectation which hold the view that farmers that are members of association have easy access to technology and how to put it to practice compared to those that did not belongs none.

Table 3 further depicts that years of membership of association and farm size were also positive and significant ($P < 0.01$) in influencing adoption of Soybean production technologies. This implies that as farm size and years of membership of farming household's increases, adoption will also increase and vice versa. Since land is one of the major production constraints to farmers. Also, years of farmers' membership tends to facilitate dissemination of information on improved technologies and innovation on Soybean production in the study area, hence increase in membership of associations and years of membership plays a significant role especially in educating members on Soybean production after adoption of technologies by early adopters in the association.



Table 3: Factors influencing adoption of technologies

Adoption	Coef.	Std. Err.	T	P> t	[95% Conf. Interval]	
Age	.0001024	.0011098	0.09	0.927	-.0020875	.0022922
Sex	-.1702217	.0248791	-6.84	0.000***	-.219314	-.1211294
Marital status	-.0290838	.0217363	-1.34	0.183	-.0719746	.0138069
Household size	.000182	.0046912	0.04	0.969	-.0090748	.0094387
Farm Size	.1103773	.0194959	5.66	0.000***	.0719075	.1488472
Farming Experience	.0037592	.0016415	2.29	0.023**	.0005202	.0069982
Annual income	.0109143	.0124163	0.88	0.381	-.0135859	.0354146
Educational level	-.0037581	.0073241	-0.51	0.609	-.0182103	.0106941
Membership of Assoc.	-.9539216	.1346042	-7.09	0.000***	-1.219527	-.6883164
Years of Membership	.0423712	.0084571	5.01	0.000***	.0256834	.059059
Extension Contact	.8603316	.2674876	3.22	0.002**	.3325168	1.388146
Frequency of Contact	.1196985	.1458286	0.82	0.413	-.1680549	.4074519
Access to Credit	.2506326	.2288781	1.10	0.275	-.2009967	.7022619
Yield	-.0081773	.0104101	-0.79	0.433	-.0287188	.0123641
Constant	.4762659	.4945794	0.96	0.337	-.4996533	1.452185

*** = significant at 1%, ** = significant at 5%

Source: Field survey, 2021

In addition, the results also reveal that household size and contact with extension were positive and significant ($P < 0.05$) in influencing adoption of Soybean production technologies in the study area respectively. This implies that as the household size and contact with extension agents increases, adoption also increases. This finding is in agreement with the *a priori* expectation which holds the view that extension contacts improve farmers' tendencies of adopting technologies because extension agents help in persuading farmers to accept new technology and put them to practice. Also, farmers with larger households tend to accept technologies that are labour intensive because they have the potential of exploiting their family labour without incurring any labour cost.



Constraints/Challenges faced by the Respondents

The results from Table 4 reveals that, high cost of technologies, insufficient information and non-accessibility of technologies were the major challenges/constraints faced by the respondents in the study area and were ranked 1st, 2nd and 3rd respectively. While inadequate technical know-how, inadequate credit facilities and complexity of the technologies were ranked 4th, 5th and 6th respectively, others include pace of change and cost, inadequate awareness, inadequate government support, different social dynamics and lack of alignment between technologies curriculum and instructions were the problems associated with the adoption of technologies in the study area and were also ranked 6th, 7th, 8th, 9th, 10th and 11th, respectively. This implies that adjustment in the above-mentioned challenges will increase adoption rate and yield of soy bean per hectare in the study area. Furthermore, social institutions, organizational structures and policy changes that span spatial boundaries can affect farmer performance in agricultural technologies (Ward and Pede, 2014).

Table 4: Constraints/challenges faced by the respondents

Variable	Percentage	Rank
High cost of technologies	65.0	1 st
Insufficient information	64.6	2 nd
Non-accessibility	63.1	3 rd
Technical know-how	62.6	4 th
Inadequate credit facilities	62.1	5 th
Complexity of the technologies	60.7	6 th
Pace of change and cost	52.4	7 th
Inadequate awareness	51.9	8 th
Inadequate government support	51.5	9 th
Different social dynamics	24.3	10 th
Lack of alignment between technologies, curriculum and instruction	10.7	11 th

Source: Field survey, 2021

CONCLUSION AND RECOMMENDATIONS

Based on the findings it can be concluded that sex, membership of association, farm size, years of membership in associations, farming experience and contact with extension agents were the factors influencing the adoption of soy bean production in the study area. The need to advocates for more extension contact and making the improved soy bean production technologies available to farmers cannot be over emphasized because they have the potentials for improving the yield as well as the income the farmer. Based on the constraints highlighted, the study recommends the following:

1. Government through the ADPs should adjust the prices of technologies so as to be affordable to small scale farmers.
2. ADPs should recruit and train more extension agent so as to educate small scale farmers at the grass roots.
3. Farmers should form cooperative societies and raise funds so as to access technologies easier and faster for its members at subsidized rates.
4. Extension agents should organize demo days and field days to educate and practically demonstrate how to apply production technologies to the famers.



5. Farmers should join available farmers association and cooperatives and form group clusters so as to access credits in the study area.
6. Non-governmental organization should join the campaign of educating small scale and rural farmers on the importance of adopting technologies in soy bean production.

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