

# IMPACT OF IMPROVED TECHNOLOGIES ON SMALL-SCALE SOYBEAN PRODUCTION: EMPIRICAL EVIDENCE FROM BENUE STATE, NIGERIA

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The study examined the impact of improved technologies on the lives of small-scale soybean farmers in Benue State, Nigeria. A total of 160 respondents were selected using simple random sampling technique. Data were analyzed using descriptive statistics, Tobit model and the Kruskal-Wallis test. Findings revealed that 35.6% of the respondents were between 31 and 40 years old, 40.6% had household size of between 6 and 10 members. Majority of the respondents were male, married, and had secondary school education. Tobit analysis revealed that farmers' socioeconomic characteristics which include gender, educational status and farming experience; and farmers' knowledge on soybean innovations were significant factors determining the adoption of improved soybean production technologies. These factors were statistically significant at  $p=0.05$ . The adoption of improved soybean technologies has had a clear positive impact on farmers' belief on soybean innovations. The major problems facing farmers in the adoption of improved soybean production technologies according to Kruskal-Wallis ranking were high cost of inputs, problem of labour availability and lack of credit/loan. The results of this study provide a strong case for the promotion of soybean as a solution for malnutrition and a means of poverty alleviation for poor people.

**Keywords:** Impact, improved technologies, small-scale farmers, soybean innovation.

## INTRODUCTION

Soybean (*Glycine max*) is native to East Asia and ranks high among the leguminous crops of the world in terms of its nutritional value. It is the only plant that contains all the essential amino acids as well as up to 61% polyunsaturated and 24% monounsaturated and other healthy types of fat required by the human body (McGonigal, 2010). It has been cultivated for many years in China, Japan and other countries of the East and South East Asia where it contributes substantially in the diet.

Various products and byproducts can be produced from soybean for food of human and livestock such as soybean flour, soymilk, etc. (Dugjie *et al.*, 2009). According to IITA (2009), Nigeria is the leading producer of soybean in sub-Saharan African; therefore the importance of the crop as a veritable source of protein in the nutrition of a typical farm family in Nigeria is without doubt. Soybeans may be the most practical means of relief from *Kwashiokor* caused by protein calorie malnutrition which affect many children developing countries (White, 2012).

In Nigeria, soybean is relatively new but the International Institute of Tropical Agriculture (IITA) has made tremendous research advances on the crop. Since 1985 soybean food products have been an important part of the Institute's Soybean research program. The Federal Government of Nigeria became interested in the program and then made funds available for research. The major aim

was to develop appropriate soybean technology for household use and also, small scale ventures (Ayoola, 2001). Recently, there is now a greater demand not only for demonstrating the actual impacts of research but also for maximizing impacts through targeting research benefits to poor people. There has been increasing pressure to direct agricultural research towards the needs of small-scale farmers and the rural poor. Emphasis has been given to assess the potential impacts of agricultural research on poverty alleviation strategies with a view to set priorities of research (Alwang and Siegel, 2003). The overall purpose of the study was to assess the social impact of improved technologies on the lives of small-scale soybean farmers in Benue State, Nigeria. Specifically, the objectives were:

- To examine the socio-economic characteristics of small-scale soybean farmers in Benue State, Nigeria.
- To determine farmers' knowledge on improved soybean utilization innovations.
- To examine the farmers' perceptions on the benefits of improved technologies in soybean production.
- To identify the factors influencing farmers' adoption of improved soybean production technologies.

## MATERIALS AND METHODS

The study was conducted in Benue State, Nigeria. The State derives its name from River Benue, the second largest river in Nigeria. Benue State has a population of 4.22 million

people spread among three agricultural zones: Eastern (A), Northern (B) and Central (C). It has a land mass of 30,955 square kilometers distributed among 23 local government areas (14 in Tiv speaking areas, 7 in Idoma speaking areas and 2 in Igede speaking areas). Soybean is mainly produced in the Northern and Eastern Zones of the State. A two stage sampling procedure was used to obtain a total of 160 respondents from twenty rural communities purposively selected, based on intensity of soybean cultivation. The selection was done based on advice by experts and experienced field officers in the State's Ministry of Agriculture and the Benue State Agricultural and Rural Development Authority (BNARDA), due to paucity of current published data on soybean production in the State. A structured questionnaire was the instrument used for data collection.

Data were analyzed using descriptive statistics such as frequency counts, percentage and mean. Tobit model was used to analyze the determinants of adoption while the Kruskal-Wallis test was used to rank the constraints to effective adoption of improved technologies. Perception on benefits of improved technologies was measured using a likert-type-scale. A 4-point likert-scale ranging from "strongly agree" (4), "agree" (3), "disagree" (2), to "strongly disagree" (1), was used to rate respondents' perception on the benefits of improved soybean production technologies. A mean score of 3.00 and above indicated strong perception while a mean score lower than 3.00 indicated weak perception.

## RESULTS AND DISCUSSION

**Personal characteristics of respondents:** The personal characteristics of the respondents are presented in frequency and percentage (Table 1). It was shown that majority of the respondents were male (66.9%). Low percentage of women farmers might be due to the fact that they are less likely to command the resources (such as land, credit, or information) to take full advantage of the technology (Ogunlela and Mukhtar, 2009). This might also be due to the fact that women are generally more involved in off farm activities such as buying and selling of farm produce in most African countries (McCarthy and Sun, 2009). Table 1 also reveals that majority of the respondents were married (80.0%). This implies that respondents that have responsibilities to discharge to their families actually dominated the farming system. This also means that marriage is highly cherished among the people in the study area.

Most of the respondents were in the age group of 31-40 years which is regarded as the active productive age, meaning that the population is active. It also implies that soybean production activities are in the hands of this age group which constitute the active population. The sense of responsibility at this age is very high and they also have

enough energy, virility and capability to harness for effective production. Thus, adoption of improved soybean technologies can be further enhanced or encouraged in Benue State, Nigeria. Majority (40.6%) of the farm households comprised of 6-10 persons. Large households will be able to provide the (family) labour that might be required by improved soybean technologies, if only farming serve as their primary occupation. Thus, household size would be expected to increase the probability of adopting improved soybean technologies. Furthermore, (54.4%) of the respondents had secondary school education. This implies that their level of education is relatively low; hence, extension deliveries on improved soybean technologies should rely more on visual and broadcast materials rather than written materials so as to facilitate comprehension.

**Table 1. Summary of socio-economic characteristics of respondents (n=160)**

Characteristics	Percentage	Frequency
Gender		
Male	107	66.9
Marital Status		
Married	128	80.0
Age Bracket (in yrs)		
31-40	57	35.6
Household Size (in persons)		
6-10	65	40.6
Educational Status		
Secondary	87	54.4
Farming Experience (in yrs)		
1-10	67	41.9
Soybean Farm Size (in ha)		
1-2	67	41.9
Kind of Labour		
Family	57	35.6
Soybean Income (in naira)		
>40,000	87	54.4
Membership in Farmers' Organization	123	76.9
Member		

Source: Field Survey, 2012

Also, 41.9% of the respondents had farming experience in soybean production ranging between 1-10 years. According to Ejembi *et al.* (2006), the length of experience is probably an indicator of a person's commitment to the profession. This result implies that majority of the farmers were relatively new in soybean farming and so they would be very keen to pay close attention to their future in terms of the crop's profitability and their own welfare. Farm size is an

indicator of wealth and perhaps a proxy for social status and influence within a community. More than 40% of the respondents had their soybean farm size ranging from 1-2 ha. This result implies that majority of these farmers operate on a small scale. This also agrees with the findings of Agwu (2004), Chukwuone and Agwu (2005) and Wiggins (2008) that most of the rural farmers in Nigeria are small scale farmers cultivating less than 10 ha of farmland. Nearly 36% of the respondents used family labour on their farm. This was probably due to the fact that marriage is greatly cherished among the farmers and coupled with the fact that majority had a relatively high household size of 6-10 persons. Data in Table 1 further reveals that about half of the respondents realized above N40, 000 per season from their respective soybean farms. This amount is relatively high, and it can be used to cater for their domestic needs. It also means that soybean production is a lucrative business among the rural farmers and thus their living conditions can further be improved.

More than two-thirds (76.9%) of the respondents were members of farmers' organization. It has been shown that membership of farmers' union/organization could impact positively on adoption and farm productivity among soybean farmers (Idrisa *et al.*, 2012; Nyanga, 2012). Such membership could enhance farmers' level of exposure to useful information on improved soybean technologies, while also enjoying assistance in form of credits and other incentives often extended to farmers' unions and organizations by governments and NGOs, in order to expand both their output and income.

#### **Knowledge on improved soybean utilization innovations:**

One of the most important indicators of social change is the introduction of new attitudes, values, and beliefs within the society and the family. According to the report submitted by Sanginga *et al.* (1999), Tiv people were initially prevented and discouraged from consuming soybean even though they had grown the crop for a long time. However, results of household interviews showed evidence of changes in these beliefs and attitudes. Tiv farmers have developed positive attitudes towards the value of soybean as a food crop for household consumption (Sanginga *et al.* (1999). It was revealed that virtually all farmers were aware of the utilization of soybean in the local diet (dadawa). Soy dadawa was most popular in the study area where all the respondents (100%) acknowledge its use (Table 2). This finding is consistent with the findings of Fabiyi and Hamidu (2011) that soy dadawa was widely used as local diet in Tafawa Balewa LGA of Bauchi State, Nigeria. Among the eleven innovations considered in the study region, only three (3) products (tofu, soybean coffee and soy meat) were not popular, scoring lower percentages of 25.0%, 26.3% and 31.9% respectively. In general, farmers are fully aware of the various soy products that can be produced for

consumption, thereby enhancing their adoption decision. This result also supports earlier findings by Sanginga *et al.* (1999) that household utilization formed a major reason for the adoption of soybean cultivation in Benue State. The three products with less awareness are likely to be new in the study area or require a very complicated processing.

**Table 2. Percentage distribution of respondents' knowledge on improved soybean utilization innovations**

Characteristics	Percentage	Frequency
Soy milk	157	98.1
Soy akara (Akwese)	158	98.8
Soy cheese	159	96.4
Soy moin moin	155	96.9
(Akpupa/bread)	160	100.0
Dadawa	147	91.9
Soy vegetable soup	51	31.9
Soy meat	42	26.3
Soybean coffee	152	95.0
Soy flour	132	82.5
Soy yoghurt	40	25.0
Tofu (Acidified Soymilk)		

\*Multiple Responses

Source: Field Survey, 2012

#### **Perception on benefits of improved soybean production technologies:**

Information regarding farmers' perception as to whether or not to embrace improved technologies in soybean production could help pacify issues relating to whether farmers are willing to adopt the technologies. The result from this study indicates nine strong benefit perception/variables out of the ten (Table 3). The strongest perceived benefit was 'increase in household income' ( $\bar{X}=3.75$ ). This will have a positive bearing on farmers' living conditions as income is seen as one of the indicators in evaluating standard of living. Following closely was 'improvement in nutritional status of household members' ( $\bar{X}=3.70$ ). Thus, food security and general wellbeing within the household would also be ensured. The only weak perception was 'early maturity of improved varieties' leading to yearly double cropping ( $\bar{X}=2.90$ ). This seems to disagree with the report of Sanginga *et al.* (1999) that there was no doubt in the opinion of farmers that the practice of double cropping with soybean was economically and socially profitable. However, the fact that majority of the study's respondents acknowledged the various potential benefits accruing to the adoption of improved technologies in soybean production will invariably increase the incidence of adoption.

**Table 3. Respondents' perception on benefits of improved soybean production technologies in Benue State, Nigeria (2012)**

Perception	Mean score	Majority
Low production cost	3.22	SA
Early maturity of improved varieties	2.90	A
Increase in soybean yield	3.70	SA
Increase in yield of other crops	3.58	SA
Increase in household income	3.75	SA
Improved varieties meet consumer's taste	3.60	SA
Improvement in soil fertility	3.58	SA
Effectiveness in pest and disease control	3.59	SA
Effectiveness in weed control	3.55	SA
Improvement in nutritional status	3.70	SA

Likert Scale: 4-strongly agree (SA), 3-agree (A), 2-disagree (D) and 1-strongly disagree (SD). Mean score  $\geq 3.0$  indicates strong perception; mean score  $< 3.0$  indicates weak perception.

**Adoption of improved production technologies:** It was revealed that most of the improved soybean production technologies were adopted by the respondents (Table 4). The technology that is mostly adopted was timely harvesting (96.9%). This is probably due to the fact that late harvesting encourages pod shattering which eventually leads to yield loss. Following closely was planting of improved soybean variety (96.2%). This might be necessitated by the fact that local varieties produce very low yield. The least adopted technologies were use of liming, use of cow dung/green

manure and watering after sowing scoring lower percentages of 15.0%, 25.0% and 31.9%, respectively.

**Tobit model estimation result:** Analysis of the factors determining adoption is essential to discover what factors that determine farmer's likelihood to adopt improved soybean technologies. The results of the Tobit regression analysis showed that four independent variables were significant at 5% level in explaining the adoption of improved soybean technologies (Table 5). These were the gender of the respondents, education, farming experience and farmers' knowledge on soybean innovations. Gender showed significant relationship with adoption of improved technologies in soybean production. Due to many socio-cultural values and norms, males have freedom of mobility and participation in different extension programs and consequently have greater access to agricultural information. However, Doss and Morris (2001) in their study on factors influencing improved maize technology adoption in Ghana showed insignificant effects of gender on adoption.

Exposure to education will increase a farmer's ability to obtain, process, and use information relevant to the adoption of improved soybean technology. It will also help farmers to search for appropriate technologies to alleviate their soybean production and consumption constraints (Boz *et al.*, 2011; Idrisa *et al.*, 2012b). Thus, education could therefore increase the probability that a farmer will adopt an improved soybean technology. Obasi and Obasi (2004) found in their study that, among other factors, educational level influenced adoption decisions of farmers in Gboko localities of Benue State. The present study also agrees with that of Tiamiyu *et al.* (2001) who found positive and significant relationship

**Table 5. Tobit estimation result to determine factors affecting the adoption of improved technologies in soybean production**

Explanatory Variable	Coefficient	Std error	t-value	P> t
Constant	0.38821	0.12866	3.02	0.000*
Age	-0.01790	0.01402	-1.28	0.204
Gender	0.11607	0.03360	3.45	0.001*
Marital Status	0.00648	0.03623	0.18	0.858
Education	0.02160	0.01314	1.64	0.103*
Household size	0.00041	0.01402	0.03	0.977
Farming experience	-0.02549	0.00785	-3.25	0.001*
Soybean farm size	-0.00517	0.01433	-0.36	0.719
Soybean income	-0.00213	0.01043	-0.20	0.839
Total farm income	0.00000	0.00000	0.07	0.948
Farmers' knowledge on soybean innovations	0.22930	0.77209	2.97	0.004*
Farmers' perception on benefits	0.22594	0.09804	2.30	0.023

\*Significant at 5% level; Source: Field Survey, 2012

between literacy level and adoption of soybean production technologies in Niger State, Nigeria.

The study revealed a significant relationship between adoption and farming experience among the respondents. With increased farming experience, farmers are generally better able to assess the relevance of new technologies. This often comes from their interactions with their neighboring farmers and the outside world. It can also be argued that the experience of farmers can generate or erode confidence. In other words, with more experience, a farmer can become more or less risk-averse to new technology and thus this variable can have a positive or negative effect on a farmer's decision to adopt improved technology. The study result disagreed with the report of Sangina (1999) that the adoption of improved soybean varieties in Benue State was insignificantly related to farmers' farming experience in soybean cultivation.

However, the Tobit result showed no significant relationships between farmers' age, household size, soybean farm size, farm income and adoption of improved soybean production technologies.

**Constraints to adoption of improved soybean production technologies:** the study revealed some of the prevalent problems to adoption of improved soybean production technologies as reported by the respondents (Table 6). The result reveals that the most prevalent problems were: high cost of inputs, problem of labour availability, lack of credit/loan, problem of land ownership, inadequate marketing system, and lack of technical knowledge as reported by 97.5%, 96.9%, 93.8%, 90.0%, and 81.3%, respectively. However, the Kruskal-Wallis test was employed to prioritize and rank the constraints. The summaries are presented in Table 6.

**Table 6. Summary of Kruskal-Wallis Test for farmers**

Constraints	Mean Rank	Rank
High cost of inputs	963.64	1
Lack of credit/loan	943.27	3
Lack of improved varieties	438.84	9
Inadequate organic/inorganic fertilizer	808.61	7
Lack of technical knowledge	847.40	6
Influence of the community culture/tradition	773.63	8
Lack of extension activities	398.87	10
Problem of land ownership	908.55	4
Problem of labour availability	963.51	2
Inadequate marketing system	908.50	5
Chi-square ( $X^2$ )	543.46	
Degree of freedom		9
Asym. Sig.	0.001	

Source: Author's Work, 2012

Table 6 shows the ranking of farmers' constraints to adopt the improved soybean production technologies. All the constraints were indicated as significant constraints. The  $\chi^2$  is 543.462 and statistically significant at 1% level implying that the identified constraints were significant and statistically different from one another. However, the major constraints as ranked under the Kruskal-Wallis test were high cost of inputs, problem of labour availability and lack of credit/loan ranking first, second and third respectively.

This study used the SIA framework to assess the actual impacts of soybean on the lives of small scale farmers in Benue State, Nigeria. A person cultivating less than 4ha is regarded as a small scale farmer in Nigeria (National Bureau of Statistics, 2009). The analysis showed that men were more involved in soybean cultivation than women in the study area. This finding is in line with the results of some case studies in African agriculture which also show that there is an increasing male dominance in agricultural activities, including food crops (Adisa and Adekunle, 2010). Now in the study area there is also a change in the attitude of Soybean growers regarding its cultivation. People now have an appreciable knowledge on the various soybean innovations for maximum consumption benefits as against initial negative perceptions.

An individual's decision to adopt innovation is determined by many factors which include socio-economic factors, resources, personal values, profitability, and suitability (Mutandwa *et al.*, 2007). The results of the Tobit model show that farmers' socioeconomic circumstances and farmers' knowledge on soybean utilization innovations were important in shaping farmers' adoption behaviour. However, the major problems facing farmers in the adoption of improved soybean production technologies as revealed by Kruskal-Wallis test were high cost of inputs, problem of labour availability and lack of credit/loan.

**Conclusions:** As policy implication from results of this study, the following should be noted:

- (i) This study suggests a transition from the past focus of predicting potential impact based on economic data alone towards a more empirical and comprehensive assessment of the actual impact of agricultural technologies on farmers' welfare and other social processes in the community.
- (ii) Food specialist extension workers should be sent to various towns and regions in Benue State to continue with the education of rural people on awareness of less popular soybean products such as soybean coffee, soybean meat and tofu. This will further buffer the effect of food insecurity in the region.
- (iii) Finally, it is necessary for the government and concerned private sectors to increase the farmers' adoption of improved technologies in soybean production by reducing cost of inputs and providing

credit/loan as measures to reduce constraints faced by these small scale farmers. This will definitely lead to soybean development in Benue State, Nigeria.

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