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# DETERMINANTS OF ADOPTION OF IMPROVED SOYABEAN PRODUCTION TECHNOLOGIES AMONG RURAL FARMERS IN NORTH CENTRAL NIGERIA

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**Abstract**

The study assesses determinants of adoption of improved soyabean production technologies among rural farmers in North Central Nigeria. All the soyabean farmers in North Central Nigeria formed the population of the study. Multi- stage sampling techniques was used to select 320 respondents for the study. Primary data were obtained by means of structured questionnaire administered to the respondents. The data were analysed using both descriptive and inferential statistics. The results shows that (58.9 %) of the respondents were male, many (41.0 %) of the respondents were between 21 and 40 years of age with mean age of about 36. The result also shows that many (81.3%) of the respondents were married, while (12 %) of them were single. The pooled results further shows that (49.4 %) of the respondents had household size ≤6persons. Most (95.0 %)) of the respondents indicated farming as their primary occupation also, majority (92.8 %)) of them were into full time farming in the pooled results. The pooled results shows that majority (88.4%) of the respondents have high level adoption of NCRI recommended planting season of June–July as soyabean production technology, many (79.4 %) of them adopted Sam soy2, about 63.1 % of them adopted fertilizer (N.P.K) 3bags and SSP4bags/ha. The results on ordered logit Regression analysis shows significant effect of the selected farmers' socio-economic characteristics on adoption level. The results revealed that majority (96.3 %) of the respondents got information on agricultural technologies through family members.In conclusion, the adoption of improved soyabeanproduction technologies by farmers leads to increase in farm output Based on the results, it is recommended that farm input supply should be timelyand at affordable price, there should be creation of awareness and farmers training on technology usage, there should be provision of credit and loans to farmers, more

markets and good roads should be made available mostly in the rural areas.

**Key words: Adoption, Improved Soyabean, Production Technologies, Farmers**

**Introduction**

The government and some non-governmental bodies have been grappling with some strategies put in place to combat poverty, so as to reduce it to the barest minimum (Fayam, 2004). The importance of agriculture to national development cannot be over-emphasized because agriculture is the major source of livelihood for man and animals. Nobody can do anything without food. Generally, all nutrients that are essential for normal growth and development of humans are derived from Agriculture. These include carbohydrates, protein, vitamins, minerals, water, fat and oil. Malnutrition, especially protein-malnutrition in young children, continues to be the first and most outstanding health problem in Nigeria. It should be noted that majority of Nigerians in rural areas, are resource-poor and hardly able to afford even their carbohydrates daily requirements talk less of protein. Protein from animal sources is unaffordable by most farm-families, hence the wide spread of preventable protein-deficiency diseases in most rural communities in Nigeria.

It was becoming increasingly necessary to supplement protein requirement of Nigerians (especially the farm-families) with relatively inexpensive plant protein (Tiamiyu et al., 2001).Soybean is a farm crop that belongs to the family of legumes. It is scientifically called*(Glycine max (L) Merrill)*. It is an annual herbaceous plant which is bushy, erect and with leafy plant structure. Soyabean, popularly called the “poor man's meat”, contains 40.3% protein, 20% oil and as high as 91.9%total digestible nutrient (Fukushima, 2000; Fabiyi, 2007).Health benefits of soyabean include prevention of heart diseases, cancer, high blood pressure, diabetes-related diseases and many others. Soyabean oil is rich in fatty acids and devoid of cholesterol. It is an excellent source of calcium, iron, and vitamins such as niacin, thiamin and riboflavin (World's Healthiest Foods,2004).Consumption of food containing soyabean constituents has been associated with reduced heart disease risk factors, reduced osteoporosis; alleviation of menopausal symptoms reduced cancer risk and in a limited number of studies reduced diabetes. It also helps people to stay lean (reduced obesity). Isoflavone compounds found in Soyabean can be very beneficial to diabetic patients. Soyabean, especially genistein may help human to stay lean by producing fewer and smaller fat cells (Naaz*et al*., 2003). About 6 million men and 6.3 million women who are living today have a history of coronary heart disease. Soyabean works in the

prevention and minimizing the conditions through controlling cholesterol, blood pressure, vascular function and direct effects on the cells of the artery wall (American Heart Association, 2000).

Soyabean products and their uses have been promoted in Nigeria (Odebode, 2005), particularly in the Eastern States of Nigeria through the extension unit of the Agricultural Development Programme (Mathews-Njoku, 2005). The promotion of soyabean by the agricultural extension service (especially the women in agriculture- WIA) have lead to the emergence of several varieties of soyabean products in both rural and urban markets in Nigeria. Soybean consumption according to International Institute for Tropical Agriculture (IITA)(2003), has increased dramatically, improving nutrition particularly among the urban, poor and middle income groups .Soybean fortified products not only have more protein and minerals than their non-fortified counterparts, they are considerably cheaper than other sources of high-protein such as fish, meats, milk and other protein-rich legumes. Many Nigerians now incorporate soybean into their diets and the Nigerian Government has declared its production and utilization a national priority (IITA, 2003).Research efforts to improve the existing soyabean varieties, to expand and increase production in Nigeria were initiated in different research institutes from the mid 1970's (Misari and Idowu, 1995). The adoption of new technology has been recognized as one of the essential tools to increase agricultural productivity. This has resulted in among other measures, development and dissemination of new improved technologies by the research institutes. The National Cereals Research Institute (NCRI) Badeggi has the national mandate for the genetic improvement of soybean crop. Improved varieties released and other production and post-harvest value addition technologies of soybean recommended by NCRI in Nigeria include: TGX1448-2E, TGX1904-6F, TGX1835-10E, TG X 1485-ID, Samsoy 2, correct spacing, NPK fertilizer application, use of herbicide, use of pesticide, mono-cropping, use of threshing machines, the use of soya milk processing machines etc (Amosun*et, al*., 2009).

The Africa's serious malnutrition problem is especially acute in terms of protein deficiency. Livestock constitute the major source of protein for human body, but a combination of factors including the recent persistent drought and the poor performance of indigenous animals have led to the situation where the prices of such conventional livestock products such as meat, eggs and milk have risen beyond the reach of ordinary man. In view of this problem an alternative source of high quality cheap protein was sought for and

soybean was found to have the potential to meet part of this need. Soyabean protein has been developed for use in hospital diets, particularly for post-operative diets and soy flour protein concentrates and isolates have been incorporated into infant food as rice to increase their protein contents. In spite of all efforts made by concerned agencies to bring scientific discoveries to the door steps of the targeted farmers in Nigeria, the farmers seem not to be responding much to the waves of these changes (Obinne, 1991). The broad objective of the study was to assess determinants of adoption of improved soyabean production technologies among rural farmers in North Central Nigeria.

The specific objectives of the study were toi describe the socio-economic characteristics of the respondents in the study area; ii identify improved soyabeanproduction technologies adopted by rural farmers;iii ascertain sources of information on improved agricultural technologies by farmers andiv ascertain the effects of socio-economic characteristics of the respondents on adoption level of improved soyabeanproduction technologies in the study area.

Based on the specific objectives of this study, the following null hypothesis was stated and tested:

Ho: Socio-economic characteristics of the respondents have no significant effect on adoption level of improved soyabean production technologies in the study area.

**Methodology**

The study was carried out in North Central Nigeria. The zone has a land area of 296, 898 $km^2$ representing nearly 32 percent of the country's total land area (NBS, 2008). There are six states in the zone and the Federal Capital Territory, Abuja. The States include Benue, Kogi, Kwara, Nasarawa, Niger and Plateau. It is located in the central part of Nigeria and in the sub-humid region of the country, and bounded to Bauchi, Kaduna, Zamfara and Kebbi States to the north; Cross-River, Ebonyi, Enugu, Edo, Ondo, Ekiti, Osun and Oyo States to the south; Taraba State and Republic of Cameroon to the east and the Republic of Benin to the west.Situated between latitudes $6^{o}$ 30" - $11^{o}$ 20"N and longitude $7^{o}$– $10^{o}$E, the zone has 20.36 million people with the rural population constituting 77 percent(NPC, 2006). The major ethnic groups of the study area are the Gwari, Baruba, Bargana, Nupe, Tiv, Yoruba, Igala, Idoma, Angas and Birom.According to Shaib, Aliyu and Bakshi (1997), the total arable land in the area was estimated at 24.7 million hectares, but only 6.6 million hectares were under cultivation. This indicated that the zone had substantial scope for expansion of the agricultural area as only about 25 percent of the arable land was cultivated. Further, the

large inter-annual variability of rainfall subjected the area to frequent dry spells that sometimes resulted in severe and widespread drought that imposed serious socio-economic constraints (FAO, 2001). Rainfall in the zone is largely seasonal and highly variable from year to year, with mean annual rainfall of between 1500 mm and 1800 mm in north and south respectively. Agricultural activities depend mostly on rainfall, with rain-fed agriculture accounting for more than 90 percent of the production systems. The estimated irrigable land in the zone was 1.5 million hectares, although only 64.007hectares (4.3%) are currently under irrigation. Fadama development under irrigation, therefore, has high potential in the area. The climate of the area is characterised with relatively high temperatures throughout the year. The average annual maximum temperature varies between 35ºC and 31ºC throughout the year while the average annual minimum temperature is between 23ºC and 20ºC (FAO, 2001). On the Jos plateau, altitude makes for relatively lower temperatures, with the maximum temperature of 28ºC and minimum temperature of 14ºC (FAO, 2001). Agriculture is the backbone of people's economy: 85 % of the population depends either directly or indirectly on it for their livelihood, while others constituting (15 %) are involved in occupations such as white collar jobs, business, craft and arts. Crops grown in the State include cereals (guinea corn, millet, maize and rice), grains and legumes (cowpeas and bambara nuts), root and tubers (yam, cassava and potatoes), oil seeds and nuts (soya beans, sheanuts, groundnut and sesame), fruits (mango, orange, banana, melon, cashew and guava) and fibers (cotton and kenaf). Natural and mineral resources found in the State include talc, gold, silica, marble, copper, iron, lead, granite and limestone.

**Population and sampling procedure**

The population for the study include all soyabean farmers in the North Central Nigeria which include; Benue, Kogi, Kwara, Niger, Nasarawa,Taraba Plateau states and the FCT Abuja. Due to the enormity of the population of the study, a sample size of three hundred (320) respondents were selected as sample size using purposive and multi-stage sampling procedure to select respondents from the lists obtained from the Niger State Agricultural Mechanization and Development Authority (NSAMDA) and the Benue State Agricultural and Rural Development Authority (BNARDA).First, two States, namely Niger and Benue were purposely selected. Niger State was selected because NCRI headquarter is located in BadeggiBida, Niger State where most of the improved soyabean production and post-harvest technologies are developed and disseminated to targeted farmers, while, Benue

State was selected because it is the leading soyabean production State in the Zone, Secondly, two Local Government Areas from each of the three zones in the two States making twelve (12) LGAs were selected using purposive sampling technique base on the high concentration of soyabean production in those local government areas.Thirdly, from the sampling frame of each LGAs, 1% of the respondents were selected using simple random sampling techniques resulting to sample size of 320 respondents used for the study. Data for this study were collected from primary source. Primary data were collected using a well-structured questionnaire through the help of agricultural extension agents covering the selected extension circles.

**Data analysis techniques**

Data for this study were subjected to both descriptive and inferential statistics. Frequency, percentage and mean were used to analyze objective i, ii and iii. The ordered logit model was used to analyze objective iv and test the null hypothesis.

**Results and Discussion**

**Socio-economic characteristics of the farmers**

The results shows that many (58.9 %) of the respondents were male, while 41.1% of them were female in table 1. This indicates the dominance of male in soyabean production in the study area, which could be due to the tedious nature of farm work that requires enormous strength and energy. This result is consistent with the work of Agwu*et,al* (2008) who reported that majority (81.5 %) of the farmers were male in their study. The results show that a reasonable Proportion (41.0 %) of the respondents were between 21 and 40 years age bracket, while 37.8 % were between 41and 60 years with mean of about 36, indicating that most farmers were young and able bodied producers. indicating that most farmers were young and able bodied producers. The result agreed with the findings of Aphunu and Otoikhian (2008) that majority of the farmers in delta State belong to age bracket of 30-49 years. The results further revealed that majority (81.3 %) of the respondents were married.The analysis of the data on the level of education of respondents shows that 71.6 % of them had formal education bellow 6 years whereas 20.6 % of them had 7-12 years of education, with mean of about 5 years. This implies that farmers in the study area had low level of educational attainment which can hinder them from reading and understanding extension bulletins. Most of the farmers that are engaged in subsistence agriculture in Nigeria have low Education and poor technical knowledge about the use of agricultural

inputs, due to the poor educational background (Nworgu, 2006).

The results further shows that 49.4 % of the respondents had household size ≤6persons, while a reasonable (44.4 %) Proportion had household size between 7-15 persons with mean of 7.Household size in traditional agriculture determines the availability of labour and level of production (Ani *et al.,* 2004). Most (95.0 %) of the respondents indicated farming as their primary occupation. Many (92.8 %) of them were into full time farming. From the pooled results majority (75.3) of the respondents had ≥10 years of farming experience while 18.4 % of them had years of farming experience ranging between 4-6 with mean of 19. Implying that farmers can easily accept new technologies and utilize them properly as increase in years of farming experience tends to increase adoption level. Improved agricultural technologies tended to be accepted and adopted by experienced farmers as they understand the importance of technologies in farming (Bello *et al*., 2011). The results further shows that most (49.7%) of them had farm size ≤ 2.5 hectares of land with mean of 3, implying that land area used by farmers in the study area is small and can hinder them from engaging in large scale farming. This result is in consistent with the findings of Agwu*et al.* (2008) who reported that most of the farmers in the country cultivate below 2 hectares, many (89.4 %) of the respondents indicated that they do not have access to credit. This could hinder farmers from carrying farm work in large scale, as capital is needed to acquire farm input. One of the reasons for the decline in the contribution of agriculture to the Nigerian economy is the lack of a stable national credit policy and paucity of credit institutions which can assist farmers (Odoemenem and Obinne, 2010). Results on annual farm income shows that a reasonable Proportion(44.7%) of the respondents had their annual farm income of ≤ N 100000 while 21.6 % of the respondents had annual farm income between N100001 – N 200000. This could mean farmers had low level of income which can hinder them from purchasing farm input in the study area. Many (50.6 %) of the respondents do not belong to farmers organization.High level of social participation leads to high innovativeness among the respondents due to group dynamic effects (Onu and Madukwe, 2002).

**Table 1: Distribution of Socio-Economic Characteristics of Respondents (n=320)**

| Variables | Frequency | Percentage | Mean. |
|---|---|---|---|
| Sex | | | |
| **Male** | 187 | 58.9 | |
| **Female** | 133 | 41.1 | |
| **Total** | 320 | 100 | |
| Age (yrs.) | | | |
| **= 20** | 24 | 7.5 | |
| **21 — 40** | 171 | 53.4 | |
| **41 — 60** | 121 | 37.8 | |
| **61+** | 4 | 1.2 | |
| **Total** | 320 | 100 | 36 |
| Marital status | | | |
| **Married** | 260 | 81.3 | |
| **Single** | 41 | 12.8 | |
| **Widow** | 18 | 5.6 | |
| **Total** | 320 | 100 | |
| Level of formal ed.(yrs) | | | |
| **= 6** | 229 | 71.6 | |
| **7 — 12** | 66 | 20.6 | |
| **13 — 18** | 25 | 7.8 | |
| **Total** | 320 | 100 | 5 |
| Household size | | | |
| **= 6** | 158 | 49.4 | |
| **7 — 15** | 142 | 44.4 | |
| **16 — 24** | 13 | 4.1 | |
| **25+** | 7 | 2.1 | |
| **Total** | 320 | 100 | 7 |
| Primary occupation | | | |
| **Farming** | 304 | 95.0 | |
| **Civil servant** | 4 | 1.2 | |
| **Trading** | 12 | 3.8 | |
| **Total** | 320 | 100 | |

**Table 1 continues**

| Farming Status | Frequency | Percentage | Mean |
|---|---|---|---|
| Full | 297 | 92.8 | |
| Part time | 23 | 7.2 | |
| Total | 320 | 100 | |
| **Farming exp.(yrs)** | | | |
| = 3 | 0.0 | 0.0 | |
| 4 — 6 | 59 | 18.4 | |
| 7 — 9 | 20 | 6.3 | |
| 10+ | 241 | 75.3 | |
| Total | 320 | 100 | 19 |
| **Farm size (ha.)** | | | |
| = 2.5 | 159 | 49.7 | |
| 2.6 - 5.0 | 144 | 45.0 | |
| 5.1 - 7.5 | 11 | 3.4 | |
| 7.6+ | 6 | 1.9 | |
| Total | 320 | 100.0 | 3 |
| **Access to credit** | | | |
| Yes | 34 | 10.6 | |
| No | 286 | 89.4 | |
| Total | 320 | 100 | |
| **Annual farm income(#)** | | | |
| = 100000 | 143 | 44.7 | |
| 100001 – 200000 | 69 | 21.6 | |
| 200001 – 300000 | 51 | 15.9 | |
| 300001+ | 57 | 17.8 | |
| Total | 320 | 100 | 191063.25 |
| **Membership of co.** | | | |
| Non member | 162 | 50.6 | |
| Member | 158 | 49.4 | |
| **Total** | 320 | 100 | |

**Source: Field Survey, 2019**

***Farmers' adoption level of improved soybean production technologies***

Table 2 shows the adoption level of improved soyabean production technologies by farmers. Theresults shows that majority (88.4%) of the respondents have high level adoption of NCRI recommended planting season of June– July and many (79.4 %) of the respondents highly adopted Sam Soy 2, this could be as a result of its high yielding potential over other varieties. Many (63.1%) of the respondents have high level adoption of fertilizer (N.P.K) 3bags and SSP 4bags /ha, indicating the possibility of increase in crop yield as application of improved agricultural practices have positive impact on crop yield. The results of the study revealed that 54.7 % of the respondents have high level adoption of single cropping. Some (45.3%)) of the respondents adopted TGX 1448-2E at high level, while 44.7 % of them adopted fusillade: 2 Lt/ha at high level. Results also shows that 37.2% of the respondents adopted Pendimethalin: 3-4Lt/ha at high level, also (36.9 %) of the respondents adopted Butachlor:2-3Lt/ha at high level and 36.6 % of them adopted TGX 1904-6F at high level. About 33.4 % of them adopted Decis at 40ml/10L of water at high level and (32.8 %) of them highly adopted Nuvacron:5ml/10L of water. The results in Table 4 further revealed that 30.3 % of the respondents adopted Karate:20ml/10L of water at high level, while 28.7 % of them adopted Weeding frequency (first: two weeks after planting and second weeding six weeks after planting) at high level.The low level of adoption of improved agricultural technologies could be due to low expected benefits from the practice or could be due to other factors such as farmers' attitude or institutional factors which may not encourage the adoption of technologies by farmers (Ajibefun, 2006).

***Sources of farmers' information on agricultural technologies***

Results in Table 3 shows farmers' sources of information on agricultural technologies in the study area. The pooled results for the two State revealed that majority (96.3 %) of the respondents got information on agricultural technologies through family members. This implies that family members serve as the main source of information to farmers. Many (91.6%) of the respondents indicated radio as their source of agricultural information, meaning that radio is still effective as a source of agricultural information in the study area. This result agreed with the findings of Ani and Baba (2009) that radio use among farmers in remote areas is still popular.

Results of the study further revealed that 86.6 % and 71.6 % of the respondents received information from neighbor and extension agents respectively. Again, the study showed that 70.6 %

**Table 2: Soybean Production Technologies Adopted by Farmers**

**Pooled Result**

| Type of technology | Adoption Level | | | | | |
|---|---|---|---|---|---|---|
| | H | M | L | N | S | |
| **Improved varieties** | **%** | **%** | **%** | **%** | **%** | **T** |
| Sam soy2 | 79.4 | 8.1 | 4.1 | 8.4 | 0.00 | 100 |
| (b)TGX 1448-2E | 45.3 | 10.6 | 3.8 | 35.9 | 0.00 | 100 |
| (c)TGX 1904-6F | 36.6 | 5.6 | 9.4 | 48.4 | 0.00 | 100 |
| Fertilizer (N.P.K) 3ba &(SSP) 4ba. | 63.1 | 10.3 | 10.6 | 15.9 | 0.00 | 100 |
| **Pest and Diseases control** | | | | | | |
| Decis at 40ml/10l of water | 33.4 | 1.3 | 1.4 | 61.0 | 0.3 | 100 |
| (b) Nuvacron:5ml/10L of water | 32.8 | 2.8 | 5.6 | 57.8 | 0.9 | 100 |
| (c) karate:20ml/10L of water | 30.3 | 3.1 | 4.7 | 61.3 | 0.6 | 100 |
| **(Use of herbicides)** | | | | | | |
| **(i)Pre-Emg.** | | | | | | |
| (a) Butachlor:2-3Lt/ha | 47.8 | 5.9 | 4.7 | 40.9 | 0.6 | 100 |
| (b) Pendimethalin:3-4Lt/ha | 37.2 | 4.7 | 7.2 | 50.7 | 0.3 | 100 |
| (ii)Post-em. Fusillade: 2Lt/ha | 44.7 | 3.4 | 5.6 | 52.8 | 0.6 | 100 |
| Single cropping | 54.7 | 2.8 | 1.9 | 40.0 | 0.6 | 100 |
| Weeding frequency. | 28.7 | 1 8.4 | 11.6 | 40.7. | 0.6 | 100 |
| Seed rate (40-50 kg/ha) | 10.9 | 3.4 | 9.1 | 76.3 | 0.3 | 100 |
| Planting time(June– July) | 88.7 | 8.4 | 1.9 | 0.6 | 0.3 | 100 |

Note; H= high level of adoption, M = moderate level of adoption, L = low level of adoption, N = Not adopted, S = stopped using and T= total

**Source:** Field Survey, 2019: Multiple responses recorded

of the respondents got information through contact farmers. The contact farmers also play a vital role in information dissemination, since they have better relationship with change agents that enable them to gain more knowledge on agricultural technology than other farmer in the society. About 69.4% of the respondents indicated village heads as their source of information, while 57.5 % of the respondents indicated television as their source of information, meaning that television is also a vital media through which farmers can get information on agricultural technologies. The results support the view of Age *et al.* (2012) who reported that television has created awareness and knowledge among farmers about use of technologies.

**Table 3: Distribution of Respondents Based on Information Sources**

| | **Pooled Result** | **(n=320)** | |
|---|---|---|---|
| **Source** | Freq. | % | Rank |
| Family members | 308 | 96.3 | 1st |
| Radio | 293 | 91.6 | 2nd |
| Neighbours | 277 | 86.6 | 3rd |
| Extension agents | 229 | 71.6 | 4th |
| Contact farmers | 226 | 70.6 | 5th |
| Village heads | 222 | 69.4 | 6th |
| Television | 184 | 57.5 | 7th |
| Extension bulletins/poster | 81 | 25.3 | 8th |
| Agricultural shows | 78 | 24.4 | 9th |
| Newspaper | 76 | 23.8 | 10th |
| Others | 8 | 2.5 | 11th |

**Source**: Field Survey, 2019: Multiple responses recorded

***Effects of socio-economic characteristics of farmers on adoption level of improved soyabean production technologies***

The results in Table 4 shows theresult of ordered logit regression analysis of performance to test the effect of sex ($x_1$), age ($x_2$), educational level ($x_3$), house hold size ($x_4$), farming experience ($x_5$), farm size ($x_6$), farm annual income ($x_7$) , marital status ($x_8$) access to credit ($x_9$), primary occupation ($x_{10}$), farming status($x_{11}$) and membership of cooperative ($x_{12}$) of the respondents on the level of adoption

This study used the parameter estimates from ordered logistic regression analysis to interpret the effect of socio-economic characteristics of farmers on adoption level of soyabean

production technologies. From the result, probability greater chi square (prob> $\chi^2$) was low enough (0.0000) to reject the null hypothesis that says socio-economic characteristics of farmers have no significant effect on adoption level of improved soyabean production technologies, suggesting that not all factors were equal to zero (table 4). This implied that socio-economic characteristics of farmers influence adoption level of improved soyabean production technologies in the study area. The log-likelihood ratio (LR) test was significant at 1% level of probability, meaning that the model is adequate in explaining the probability of the effect of the explanatory variables on adoption level of soyabean production technologies.

From the results, the coefficient of age (-141) was negative and significant($P<0.01$). This implied that younger respondents are more likely to have high level of adoption of improved soyabean production technologies, while older farmers adopted technologies at low level in the study area. This means that increase in age of respondent leads to decrease in adoption level. Young farmers tend to be more flexible in their decisions, adopt new ideas more readily because of anticipated life span within which investment in new technology will pay off (Njoku, 2005). The coefficient of educational status (1.155) was positive and significant ($P<0.01$) It implies that respondents with higher educational level term to adopt technologies at high level, while farmers with lower educational level are likely to adopt at low level. This result is in line with the finding of Imoh and Essien (2005) who reported that farmers' level of education influence adoption of technology positively The coefficient of farming experience (.080) was positive and significant at5% ($P<0.05$) This implies that the more years a farmer spend on farming, the higher the adoption level, while farmers with fewer years spend on farming are likely to adopt technologies at lower level. Farming experience is significant variables that affect farm output (Nwosu *et al*., 2010). The coefficient of farm size (-.343) was negative and significant at 5% ($P<0.05$)This implies that farmers with smaller farm size term to adopt technologies at high level, while farmers with larger farm size, are likely to adopt at lower level. The coefficient of membership of cooperative (.779) was positive and significant at 5% ($P<0.05$)level This implies that Being a member of cooperative organization, a farmer tends to adopt technologies at higher level ,while those who do not belong to cooperative organization are likely to adopt at lower level.High level of social participation leads to high innovativeness among the respondents due to group dynamic effects (Onu and Madukwe, 2002).

**Table 4: Ordered logistic Regression model Analysis Results Showing the Effect of selected Socio- Economic Variables of Farmers on Adoption level of improvedsoyabean Production Technologies**

| | **Reg.**Coefficient | Wald | P-value |
|---|---|---|---|
| Sex | -.246 | .604 | .437 |
| Age | -.141 | 12.855 | .000 |
| Education | 1.155 | 11.749 | .001 |
| Household size | -.013 | .093 | .760 |
| Farming experience | .080 | 4.081 | .043 |
| Farm size | -.343 | 4.100 | .043 |
| Annual farm income | -1.159E-006 | .682 | .409 |
| Marital status | -.116 | .058 | .809 |
| Access to Credit | .758 | 2.265 | .132 |
| Primary 0cupation | 20.286 | 2.225 | 121 |
| Farming status | -1.350 | 2.390 | .122 |
| Membership of organization | .779 | 4.577 | .032 |
| Number of observations | 320 | | |
| Prob> $chi^2$ | .000 | | |
| LR $chi^2$ (12) | 188.949 | | |

Note: 1% , 5% and 10 % levels respectively.
Values in parentheses represent z-ratios
**Source**: Computed from field survey, 2019

## Conclusion and Recommendations

The study was conducted to analyse the determinants of adoption of improved soyabean production technologies among rural farmers in North Central Nigeria. Soyabean production in the study area is dominated by male who use more of traditional methods in soyabean productionstage, resulting to low level of adoption of improved soyabean production technologies. Many farmers are still carryout small scale farming which involves low capital investment, resulting to low output and income of the farmers. Farmers in the study area adopted improved soyabean production technologies such as Sam soy2, single cropping, correct planting time of June- July, and fertilizer application at high level. Adoption of improved soyabean production technologies by farmers leads to increase in farm output, In other words, income of farmers increases as a result of

adopting the improved technologies introduced in the study area whereby resulting to improved social well-being of the rural farmers. Based on the findings of the study, the following recommendations were made: recommended farm input such as TGX1448-2E, TGX1904-6F, Sam soy 2,fertilizer, insecticides and herbicides should be made available to farmers at the right time and place, Government should subsidize price of farm input to enable farmers to purchase them at affordable price Also, agencies responsible for distribution of agricultural technologies should create awareness and training services to farmers on the use of agricultural technologiesespecially in the Local Government Areas where the technologies have not been introduced.

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