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Effect of Improved Farm Technologies Adoption on Productivity among Staple Crop Farmers of Nigeria Agricultural Transformation Agenda

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ABSTRACT: Agricultural technology development is an essential strategy for increasing productivity among farmers. This study evaluates the effect of adoption of improved farm technologies on output among staple crop farmers of Nigeria agricultural transformation agenda. Multistage sampling technique was used to select 220 farmers each of Staple Crop Producing Zone (SCPZ). Primary data were collected with the aid of structured questionnaires. The data collected were analyzed using descriptive statistics, likert scale rating and z-statistic. The results showed an average age of 47 years for cassava, 44 years for sorghum and 44 years for rice farmers. The is higher adoption rate observed among the farmers with weighted mean score greater than 3.00 cut off.. The average farm size put into cassava, sorghum and rice production were 1.91, 1.66 and 2.1 respectively. The average yield of cassava before ATASP-1 project was12, 096.11Kg/ha while the average yield after the project was double at 24, 292.23Kg/ha. Subjecting these yields to z-statistic test revealed that there was statistical significant difference between the yield before and after the project has taken off at 1% level of significance. Since there is positive impact of technology adoption impact on crop output of farmers who participated in ATASP-1 project it is therefore recommends that the volume of beneficiaries should be expanded so as to allow more people to benefit from the programme.

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The role of agriculture on economic growth cannot be under estimated. It is at the center of any rural development programme and important livelihood options to reduce poverty and enhancement of food security among rural households in developing countries (Mwangi and Kariuki, 2015). In Nigeria agriculture is the main thrust of national survival, source of employment, food and foreign exchange earnings (Adebayo and Okuneye, 2005). The sector has played a key role in the industrial growth and development of most industrialized countries. Despite the importance of the oil sector in Nigeria, agriculture still contributes about 41 percent to the Gross Domestic Product (GDP) and provides about 70 percent of the nation's total food requirements (CBN, 2009).Despite the potential of agriculture to transform Nigeria economy and to achieve socioeconomic development, the sector is still performing below expectation. Agriculture is the main source of occupation for people living in the rural area where most of them engaged in the production of food to feed the country population either directly or indirectly (Akindeyin, 2003). The poor performance of agricultural sector could be attributed to the fact that

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majority of Nigeria farmers live in rural areas with agricultural practices being so rudimentary, subsistent and counter-productive that the nation has been found wanting in her struggle toward making great efforts to increase food production in quantity and quality for her fast ever growing population (Ekong, 2009).Furthermore, over dependency on traditional technologies which is characterized by poor yield and inefficiency is the major problem facing agricultural development in Nigeria. Transformation of traditional farming system for increased food production hence calls for adoption of improved practices. Agricultural development depends, to a great extent, on the willingness and ability of the small scale farmers to make use of new technology as developed in research laboratories. New innovations in agricultural development are of little value until they can be put to use for the economic and social well-being of the people involved (Oyewole and Ojeleye, 2015;Sennuga and Oyewole, 2020).In order to meet food insecurity challenge and rising demand for food with ever increasing population growth there is need for increased agricultural productivity. This may not be achieved without the adoption of improved and modern approach to food production (Challa, 2013). Agricultural technologies include all kinds of improved techniques and practices which affect the growth of agricultural output (Jain *et al*., 2009). The main aspect of technology development for improved productivity include promotion for crops include new varieties and management regimes; soil as well as soil fertility management; weed and pest management; irrigation and water management (Loevinsohn*et al*., 2013). Improved technologies tend to raise output level and reduce average cost of production which in turn results in substantial gains in farm income (Challa, 2013).Agricultural technologies can leads to significant increase in agricultural output and stimulate the transformation of subsistence nature of farming characterized by low-productivity to a high-productivity and ultimately towards the agro-industrial economy (Dontsop-Nguezet *et al*., 2011). It has been reported that appropriate land use pattern and intensification of technology give opportunity to higher increase in farm productivity and income levels (Olagunju and Salimonu, 2010). Income generation among farmers after the adoption of new technology is significantly higher than revenue generated before adoption on an average (Adofu *et al*., 2011). Technology adoption among farmers has attracted considerable attention among development analyst due to the fact that the livelihood sustainability directly depends on agricultural sector (Nweke and Akorh, 2002). There exists a positive and significant impact of agricultural technology adoption which is applicable to smallholder farmers. This makes it priority for development efforts to promote agricultural production. This study was conducted to evaluate the effect of technology adoption on farm-level productivity to provide useful information for policy analyst associated with agricultural development.

MATERIALS AND METHODS

The study was conducted in the four staple crop processing zones SCPZs across the country. These zones covered three Geo-political zones of the country (South East, North Central and North West). There is variation in climatic conditions across the zones. The agroecological zones are tropical rainforest in the South East, Guinea Savanna in the North central and Sudan Savanna in the North West of the country. The study focused solely on the program beneficiaries in ascertaining the intensity of the use of technologies and the effect on productivity by Agricultural Transformation Agenda Project (ATASP-1).

*Sampling Procedure and Sample Selection:*The study made use of multi-stage sampling techniques in the selection of the respondents for the study. A total of 220 samples comprising 20 respondents were randomly selected from each of Staple Crop Producing Zone (SCPZ). These zones were Kebbi-Sokoto, Kano-Jigawa, Bida-Badeggi and Adani-Omor SCPZ. The sampling was done to cover all the 33 Local Government Areas (LGAs) where the program is being executed across the country.

*Methods of Data Collection:*Primary data were collected for this study. These were solicited through the use of structured questionnaires. The questionnaires were administered to participating farmers under the programme. Data collected covered background information, institutional information, intensity in the use of technologies and the effect of technology on crop output of the farmers.

Method of Data Analysis: The study employed descriptive statistics such as frequency count and percentages to describe the socioeconomic characteristics of the farmers. A five point likert scale was used to determine the intensity in the use of improved farm technologies among the farmers. This was graded as regularly =5, Often =4, Sometimes =3, rarely=2 and Never=1. The mean score of respondent is computed as: 5+4+3+2+1=15; 15/5 = 3 cut off point Using the interval scale of 0.50, the upper cut-off point was determined as 3.00 + 0.50 =3.50; the lower limit as 3.00 – 0.50=2.50. On the basis of this, mean scores below 2.50 (i.e. MS < 2.50) was ranked Low level of adoption; those between 2.50 – 3.49 was considered as Moderate adoption and while mean scores that was greater than or equal to 3.50 (i.e. MS ≥ 3.50) was considered non adopter of the technology.

Z-Statistic model was used to compare the differences in yield of the farmers before and after adoption of improved technologies. The z-test formular is given as

$$z = \frac{\bar{X} - \mu}{S_X}$$

Where, Z = calculated Z value; $\bar{X}$= Mean of the sample; S_X = Standard error of the mean

$$S = \sqrt{\frac{\sum(X_i - \bar{X})^2}{n-1}}$$

Where, Xi = individual observation;$\bar{X}$= mean of the distribution; n = sample size

RESULTS AND DISCUSSION

Socioeconomic characteristics of the farmers: The socioeconomics characteristics of farmers across the three crops under ATASP-1 were presented in Table 1. It was revealed that 12% of cassava farmers were within age 21-30 while for sorghum, about 14% of the farmers are within this age bracket and for rice, about 16% of the farmers are within that age bracket. For 31-40 age brackets, cassava has 20% while sorghum has about 19% and rice has about 21%. On the average, the mean ages of farmers across the SCPZs across the country are about 47 years for cassava, 44 years for sorghum and about 44 years for rice. These mean ages are very similar to what is obtainable at various zones The implication is that the project has encouraged youth participation in food production as a business and this has a lot of significant for future food production and food security for the country. Age is an important socioeconomic variable in agricultural production because it determines the productivity of the farmers (Amaza *et al.,* 2009). On the gender distribution of the people engaged in ATASP-1 project, 75%, 48.75 and 92.5% of the people involved in cassava sorghum and rice production under the project were male respectively. The non-involvement of women in cassava production possibly may be due to cultural-religion factor as well as the fact that the crop is relatively not as popular as grain crops where women are very much involved in their production and processing. In terms of marital status, 68.33%, 86.35% and 97.5% of farmers under cassava, sorghum and rice farmers respectively were married. The significance of marital status among rural communities with respect to farm business and livelihood activities can be explained in terms of the supply of agricultural family labour. It is expected that family labour would be more available where the household heads are married. Another important socioeconomic variable is educational attainment of the household head. From table 4, cassava participants have highest, about 13% as illiterate while sorghum and rice have 5% and 2.5% respectively as illiterate participants. It is very significant that farmers participating in all crops in the project had one form of education. The implication of this is that these participants are better positioned to understand and adopt innovations that will facilitate productivity and better livelihood as opposed to when we have illiterate participants. The average household size of cassava and sorghum was 7 members per household while the farmers under rice production had 11 members in their household. The household size is fairly large which is this could be source of family labour especially where the members belong to the working group. The average farm size put into cassava, sorghum and rice production were 1.91, 1.66 and 2.1 respectively.

Table 1: Structure of farmer's household across crops in the ATASP-1 Project

Socio-economic characteristic Age	**Crops**		
	Cassava	**Sorghum**	**Rice**
Age			
21-30	7(11.67)	11(13.75)	13(16.25
31-40	12(20)	15(18.75)	17(21.25)
41-50	17(28.33	23(28.75)	30(37.5)
51-60	18(30)	20(25)	18(22.5)
> 60	6(10)	10(12.5)	2(6.67)
Mean	46.67	43.74	43.6
Gender			
Male	45(75)	39(48.75)	74(92.5)
Female	15(25)	41(51.25)	6(7.5)
Marital status			
Married	41(68.33)	69(86.25)	78(97.5)
Single	19(31.67)	11(13.75)	2(2.5)
Education			
None	8(13.33)	6(7.5)	4 (5.0)
Koranic	2(3.33)	4(5)	10(12.5)
Primary	4(6.67)	5(6.25)	12(15.0)
Juninor	14(23.33)	9(11.25)	4(5.0)
Senior secondary	22(36.67)	29(36.26)	17(21.3)
Tertiary	10(16.67)	27(33.75)	33(41.3)
Household size			
1-5	18(30)	17(21.25)	16(20.0)
6-10	15(25)	27(33.75)	25(31.3)
11-15	12(20)	19(23.75)	24(30.0)
>15	15(25)	17(21.25	15(18.8)
Average	7	7	11
Farm size			
0.1-0.5	24(40)	25(31.25)	5(6.25)
0.51-1.0	10(16.67)	43(53.75)	31(38.75)
1.1-1.5	8(13.33)	9(11.25)	10(12.5)
1.51-2.0	13(21.67)	5(6.25)	11(13.75)
>2.0	5(8.33)	1(1.25	24(30)
Average	1.91	1.66	2.1
Extension visit			
Yes	59(98.33)	79(98.75)	78(97.5)
No	1(1.67)	1(1.25)	2(2.25)

Figures in parentheses are percentages

These implied these farmers could be classified as subsistence farmers. According to Ojuekaiye (2001), small scale farmers are those cultivating between 0.1-

6.0 hectares. As shown in Table 1, 98% of cassava participating farmers claimed they have contact with extension agents while less than 2% claimed they do not, about 99% of sorghum participating farmers claimed they have contact with extension agents while barely 1% claimed they do not and about 98% of rice farmers claimed they have contact with extension agents while about 2% claimed they do not. This greater number of farmers with extension visit is a good indication to enhance adequate information dissemination.

Mode of practicing technologies extended on cassava production: The analysis of the mode of practicing recommended practices delivered to cassava farmers are as presented in Table 2 revealed that improved cassava varieties were highly in use by these farmers as the average weighted score was 4.1 which was by far greater than 3.00 indicating the cutoff point where the effective usage of this technology begins. On site selection, the weighted average of 4.4 showing that farmers have keyed into this technology. With about 62% of them claiming that they regularly use this technology. Land preparation was another technology disseminated to cassava farmers and this technology also has a weighted score of 4.7 showing its wider applicability among these farmers. Furthermore plant spacing and the right plant population was another technology disseminated to farmers and this is very important if optimum crop yields are to be obtained from any cropping system. About 53% claimed they regularly use this technology. The weighted score of 4.3 is an indication that farmers are using this technology to the maximum. Weed management is very important because good management of weed could lead to substantial yields while lack of weed management could spell doom for the crop yield. For this technology, the weighted score was 4.5 showing it has been widely accepted. About 63% of these farmers claimed they regularly use this technology. Soil fertility weighted score was 3.4. There is need to place more emphasis on this technology because the fertility of any soil will determine the output from such soil. There were six technologies disseminated to sorghum farmers under ATASP-1 project as presented in Table 2. It was revealed that improved sorghum variety has a weighted score of 4.43 showing that it is widely accepted by farmers. From all indication, there is overwhelming acceptance of this technology among the participating farmers across the SCPZs of the project. Seed dressing with apron star was another technology disseminated to farmers under the project indicated that the weighted score was 3.35 when the modes of practicing technologies were analyzed. The right plant population was another technology disseminated to these sorghum farmers and the weighted score was 4.2 which are considered to be very high and as such this technology enjoys wider applicability.

Fertilizer application employing the micro dosing of organic with inorganic fertilizer is another technology disseminated and it has a weighted score of 4.03 showing its wider acceptability. However, two of the technologies disseminated are yet to be widely accepted and these two are minimum tillage with a weighted score of 2.75 and mechanization with a weighted score of 2.6. There is therefore the need to intensify efforts at convincing these farmers of the importance of these two technologies so as to change their acceptability.

Rice production technologies disseminated enjoyed wide acceptability and applicability among farmers under ATASP-1 project were nine technologies. Improved varieties had the highest weighted score of 4.7 indicating that there is overwhelming acceptance and applicability of this technology among rice farmers under the project. On site selection and land preparation, we have a weighted score of 4.6 showing its wider acceptability and applicability. More so, field preparation equally has a weighted score of 4.6 showing its wider acceptability and applicability. There is therefore and overwhelming acceptance of this technology. Another very important technology disseminated was seed preparation which recorded a weighted score of 4.2 showing it wider acceptability. Getting the seed aspect of production right is absolutely important and the acceptance of this technology is very important at getting the production right. Determination of the planting season is another technology disseminated to farmers under ATASP-1 project as planting at the right time will enhance crop productivity. From the table this technology has a weighted score of 4.2 showing its high level of acceptability. Moreover, crop establishment was another technology disseminated to rice farmers with weighted score of 4.2. Another important technology disseminated on rice was weed management with a weighted score of 4.5. The wider acceptability of weed control technology is of great significant since this will enhance higher yield. Fertilizer application technology is another very important technology disseminated and it recorded a weighted score of 4.5 showing its wider acceptability and applicability among the farmers. Finally, pest and diseases control is another technology disseminated by ATASP-1 project to rice farmers in the project areas and this recorded a weighted score of 4.0. This showed that this technology has gained wider acceptability among these farmers. The acceptance of technology for pest and diseases control is very significant since pest and disease can reduce yield to almost zero when left unchecked. From the results presented here, there is bound to be very significant increase in production of rice nationwide if these promising technologies are made to go round all rice producing zones in the country.

Table 2: Mode of practicing sorghum technologies

Technologies	Weighted score
Cassava	
Improved variety	4.1
Site selection	4.4
Land preparation	4.7
Plant spacing/population	4.3
Weed management	4.5
Soil fertility	3.4
Conservation of stem across	2.8
Sorghum	
Improved variety	4.42
Seed dressing with Apron star	3.35
Plant population 0.75 x 0.3m 2 plants per hill	42
Tillage: minimum Tillage (use of herbicides)	2.75
Fertilizer application: Micro dosing of organic and inorganic fertilizer	4.03
Mechanization	2.6
Rice	
Improved varieties (Faro 44, Faro 52, Faro 60 and Faro 61	4.7
Site/Land preparation	4.6
Field preparation	4.6
Seed preparation	4.2
Determine planting season	4.2
Crop establishment	4.2
Weed management	4.5
Fertilizer application	4.5
Pest and Disease control	4.0

Effects of adoption of Good Agronomic Practices (GAP) on crop production: One of the ways of evaluating the effects of good agronomic practices introduced by ATASP-1 is by looking at the yield before and after the project. As shown in Table 3, the average yield of cassava before ATASP-1 project was12, 096.11Kg/ha while the average yield after the project was double at 24, 292.23Kg/ha. Subjecting these yields to z-statistic test revealed that there was statistical significant difference between the yield before and after the project has taken off at I% level of significance. The implication of this is that the different in yield can only be attributed to the positive effect of the technologies introduced to farmers by the project.Also looking at table 2, result revealed the yield of sorghum before the project to be 1010.798Kg/ha while the yield after the project was 2629.08Kg/ha. Subjecting these yields to t-statistical analysis showed that there was statistical significant difference between the yield before and after the project has started at 1% level of significant. This significance increase in yield is attributed to the effects of good agronomic practices introduced by the project to the participating farmers.

Finally, we also looked at the effect of good agronomic practices introduced to rice producing farmers in the program and it was found that yields before the project was 3368.09Kg/ha while yield after the project was 5808.25Kg/ha. When these yields were subjected to t-statistical test of difference, it was shown that there was statistical significant difference between yield before the project and yield after the project at 1% level of significant. This significance increase in yield is attributable to the effect of improved practices or technologies introduced to the farmers.

Table 3: Effect of improved technologies on cassava, sorghum and rice production per hectare

Variables	Estimate	Cassava	Sorghum	Rice
Output Before adoption of GAP	Average	12096.11	1010.798	3368.09
	Min	5166.67	217.5	120.00
	Max	26133.33	3337.5	26250.00
	SD	6446.44	811.05	3871.46
	CV (%)	51.82	79.8025	114.95
Output after adoption of GAP	Average	24292.33	2629.08	5808.25
	Min	10200.00	596	750.00
	Max	99200.00	9459	45000.00
	SD	22077.06	2182.523	6060.79
	CV (%)	84.80	93.275	104.35
t-statistics		4.46***	5.68***	7.16***

**P<0.001*

Conclusion: The study showed that a number of technologies had been disseminated and promoted among farmers under Agricultural Transformation Agenda Project (ATASP-1) project. Higher adoption rate observed among the farmers is a good indication for increased productivity. Effect of adoption on crop yields has been very substantial in terms of improvement in the yields of cassava, sorghum and rice and the yields difference before and after ATASP-1. Efforts be intensified to strengthen the means of dissemination on improved technologies.

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