NIGERIAN AGRICULTURAL JOURNAL
ISSN: 0300-368X
Volume 52 Number 1, April 2021 Pg. 188-200
Available online at: http://www.ajol.info/index.php/naj
https://www.naj.asn.org

MARKET ORIENTATION, INNOVATION ADOPTION AND PERFORMANCE OF FOOD CROPS FARMERS IN ABIA STATE, NIGERIA

Iheke, O. R., Onu, D. O. and Egem, M. A.

Department of Agricultural Economics, Michael Okpara University of Agriculture, Umudike
PMB 7267, Umuahia, Abia State, Nigeria
Corresponding Authors' email: ralphiheke@gmail.com, iheke.onwuchekwa@mouau.edu.ng

Abstract
Food crop farmers, like other farmers, are faced with the challenge of producing sufficient crops to meet the ever-growing consumer demand in the face of limited resources. Specifically, the study examined the socioeconomic characteristics of the food crop farmers, determined their level of commercialization, innovation and performance, estimated the relationship between commercialization, innovation and performance, and estimated the determinants of commercialization, innovation adoption and performance of the food crop farmers. The study adopted a multistage sampling technique in the selection of 60 respondents for the study. Structured questionnaire complimented with oral interview was used in collecting data from the respondents. Data were analyzed using descriptive and inferential statistical tools. The result showed that 68.33% of the respondents were married and the mean age of the respondent was 36.7 years. About 53.33% of the farmers were males and 90% of the food crop farmers had one form of formal education or the other. The mean years of farming experience and mean household size were 14.7 years and 6 persons per household, respectively. The major source of fund for their farming activities was from personal savings. Also, 75% of the farmers do not have contact with extension agents and 48.33% were members of farmers' cooperative societies. The mean level of commercialization and adoption of innovation was 54.61% and 32.22% respectively. The result showed that food crop production was profitable as the farmers made a net return ₦246,200. There was a significant positive relationship between commercialization and innovation, and between innovation and performance. The significant determinants of commercialization were age ($P<0.01$), years of education ($P<0.01$), gender ($P<0.01$), income ($P<0.01$), farming experience ($P<0.05$), labour ($P<0.01$), distance to the market ($P<0.10$), and depreciation ($P<0.01$). The probit regression estimates showed that the significant determinants of adoption were age of the farmer ($P<0.01$), gender ($P<0.01$), educational attainment ($P<0.01$), extension visits ($P<0.05$), income ($P<0.01$), access to credit ($P<0.01$), cost of innovation adoption ($P<0.05$) and membership of farmers association/cooperative society ($P<0.05$). The significant variables influencing performance (measured by the net returns/profit from farming) of the food crop farmers were gender ($P<0.01$), age ($P<0.01$), education ($P<0.01$), farming experience ($P<0.01$), cooperative membership ($P<0.01$), amount of credit received ($P<0.01$), and transportation cost ($P<0.01$). The study recommended that policies that would enhance farmers' adoption of innovations such as strengthening the agricultural extension system which serve as channel for diffusion of innovations, and access to credit and agricultural inputs should be implemented for increased productivity and commercialization. There is also need for free and affordable educational policies that will enable the farmers' access and process information on innovations that will enhance productivity and commercialization. Farmers are encouraged to form groups/cooperatives to be able access information, inputs and resources, thereby enhancing economics of scale

Keywords: Market, Orientation, Commercialization, Innovation, Performance, Food crops

Introduction

Market orientation is the organization-wide generation of market intelligence pertaining to current and future customer needs, dissemination of the intelligence across departments, and organization-wide responsiveness to it (Adenegan *et al.*, 2013). Market orientation in agriculture is basically a production decision issue as influenced both by production conditions and market signals (Berhanu and Moti 2010). Market orientation in agriculture is the degree of allocation of resources (land, labour and capital) to the production of agricultural produce that are meant for exchange or sale. Numerous studies have examined strategies, structures and systems as potential barriers to developing market orientation (Gebremedhin and Jaleta, 2012; Goshu *et al*., 2012; Adenegan *et al*., 2013). These studies found

that market orientation in smallholder agriculture is basically a production decision issue of what to produce for profit maximization. It is very much difficult to choose the commodities which can maximize profits of the smallholder farmers as different areas are characterized by different geographic structures. Examining the trend of market orientation is a method of accessing the smallholder farmers' participation in the output market so that the objective of small-holders agricultural commercialization can be justified.

According to Iheke *et al.* (2015), meeting the challenge for improving rural income in Nigeria will require some form of transformation out of the semi-subsistence, low input, low productivity farming system that currently characterize much of rural Nigeria. This can be achieved through market orientation and innovation adoption. Market orientation of farmers is an ultimate result of agricultural commercialization. Market orientation of the high valued crops like fish, livestock products, fruits, spices and vegetables etc. is one of the potential avenues of agricultural commercialization. As high valued agricultural products are generally more perishable than the traditional staples, due to the lack of advanced post-harvest technologies, smallholder farmers cannot be the active participants in the market. In this context, the government and non-government organizations (NGOs) are recently trying to transform smallholder agriculture from subsistence to market oriented (Azad, 2015). Nevertheless, market orientation differs from market participation (Gebremedhin and Jaleta, 2012). Although market orientation translates into market participation, most of the researchers overlook market orientation and try to analyse agricultural commercialization only for output market participation; smallholder farmers are now participating in output markets with income mediated benefits (Osmani and Hossain, 2015). The World Bank (2008) noted that commercial transformation of subsistence agriculture is an indispensable pathway towards economic growth and development for most agriculture dependent developing countries. According to Gebremedhin and Jaleta (2010), commercialization entails market orientation (agriculture production decision destined for markets-based signals) and market participation (produce offered for sale and use of purchased inputs). Agricultural transformation from subsistence to commercial agriculture is made possible through adoption of innovations.

Agribusiness innovations has been defined as the application of new inputs, machines, and methods used in agricultural production processes in order to increase production, yield or quality (Akkoyunlu, 2013). According to Akkoyunlu (*ibid*), innovations in agribusiness can reduce poverty, foster development, and stimulate economic growth in many developing countries. In particular, the adoption of innovation can transform the lives of farmers through increased incomes and improved living conditions. Iheke and Nwaru (2014), noted that innovation adoption is key to increasing farm productivity. Innovativeness is critical to the long-term success of a firm and the economic health of an industry and the overall economy (Gertner, 2004). As noted by Fan (2011), most rural households lack access to reliable and affordable innovations which have the potential to improve their livelihoods and food security status (Fan, 2011). Therefore, non financial services such as marketing and extension services offer new opportunities for small farmers to increase their productivity and incomes.

The Nigeria agricultural landscape is mostly dominated by smallholder farmers, who are poor. The burgeoning incidence of poverty and lack of support to farmers has constrained adoption of agricultural technologies (with attendant low productivity) and has made the transition from subsistence to commercial agriculture difficult. Inefficiency in the marketing of agricultural food crops has reduced its supply to major markets in the State, and as a result affects regional and inter-regional trade, which will decrease the profitability of production. As noted by Iheke *et al.* (2015), despite the contributions of the small holder agriculture to national economic growth, market orientation of smallholders over the years have been faced with diverse setbacks: the subsistent farming methods, low level of literacy, land tenure problems, and financial and input constraints. This situation has continued unabated and must be addressed if the goal of agricultural transformation for self-sufficiency in food production and export of marketable surplus is to be achieved.

Methodology

The study was conducted in Abia State, Nigeria. It has a land mass of 6320km^2, population of 2,845,380 (NPC, 2006) and an estimated population of 3,727,347 (NBS, 2018), with a population density of 650/km^2. The State, created out of Imo State on August 27, 1991, has 17 Local Government Areas (LGA) which are grouped into three agricultural zones namely; Aba, Umuahia, and Ohafia. The state lies between longitudes 7^o 23$'$ and 8^0 02$'$ East of Greenwich Meridian and latitudes 5^o 49$'$ and 6^o 12$'$ North of the Equator. Abia State is bounded on the north and northeast by the states of Anambra, Enugu and Ebonyi; to the west of Abia is Imo State; to the east and southeast are Cross River State and Akwa Ibom State respectively and to the south is Rivers State. The state is endowed with a rich fertile soil that supports the growth of crops such as yam, cassava, cocoyam, melon, maize, oil palm, garden egg, cocoa, etc. Poultry, goat, pigs and sheep are the major livestock kept. The study adopted a multistage sampling technique. The three agricultural zones in Abia State were purposively selected in the first stage. In the second stage LGAs were randomly selected from each of the zone. Third stage involved a random selection of two communities each from the 4 LGAs, set aside for the research (i.e. 12 communities). In the fourth stage, the assistance of Extension Officers of the Agricultural Development Programme were employed to help identify food crop farmers in each community from which a random sample of 5 food crop farmers were selected, giving a sample size of 60 respondents. Data collected from the respondents using structured questionnaire complimented with oral interview were analyzed using descriptive and inferential statistical

tools. The socio-economic characteristics of the respondents and level of commercialization and innovation adoption were analyzed using descriptive statistics. Net return analysis was used to determine the performance of the farmers. The relationship between commercialization, innovation and performance of food crop farmers was realized using correlation analysis. The determinants of commercialization and performance were realized by estimating the Ordinary Least Squares (OLS) regression model, while the determinants of adoption was realized using the probit regression model. The models were specified as follows:

Performance

$NR = TR - TC$ ..... (1)

$TR = P_iQ_i$ ..... (2)

$TC = TVC + TFC$ ... (3)

Where in equations (1), (2) and (3): NR = net returns, TC = total cost, P_i = unit price of the ith output, Q_i = quantity of the ith output, TVC = total variable cost (cost of planting materials, fertilizer, labour, etc), and TFC = total fixed cost (capital consumption allowance, rent, etc).

The correlation coefficient is given as:

$$r_{xy} = \frac{n\sum XY - \sum X \sum Y -}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum X^2 - (\sum X)^2]}} \text{ ..... (4)}$$

Where in equation (4): r_{xy} = correlation coefficient ($-1 \leq r_{xy} \leq 1$), n = sample size, and X and Y are the variables under consideration (commercialization and innovation adoption or performance).

Determinants of Commercialization

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12})$ ..... (5)

Y= Level of commercialization given as:

$$Y = \frac{\text{Gross value of output of food crops sold}}{\text{Gross value of food crops produced}} \times 100 \text{ .... (6)}$$

Where in equation (5): X_1 = Age (years); X_2 = Educational attainment (years); X_3= Gender (male =1, female =0); X_4 = Income (naira); X_5 = Experience (years); X_6 = Labour (naira); X_7=Distance to market (km); X_8= Membership of society (yes =1, no =0); X_9= Transport cost (naira); X_{10}= Depreciation (tools and implements) in naira; X_{11} =Access to credit (yes =1, no =0); and X_{12}= Quantity sold (naira).

Determinants of innovation adoption

For the determinants of adoption of innovation/technologies, the Probit regression model was estimated. Following Iheke and Nwaru (2014), the model is given as:

$$P(Yi = 1/\chi) = \Phi(\chi'\beta) = \exp(-z^2/2)dz \text{ ..... (8)}$$

Where P is the probability that the ith household used the new technology, and 0 otherwise. The probit model is generated by a simple latent model of the form:

$Y^* = \chi'\beta + \varepsilon$ ..... (9)

Where $x|\varepsilon$ is a normally distributed error term; Y is the index of use of technologies/innovation measured as Y = (U/V)*100, where U is the participatory score of the respondent household on the number of technologies/innovations adopted and V is the overall score of all the innovations available. Any index greater than or equal to 50 ($U/V \geq 50$, 1; otherwise 0) is assigned the value of unity and zero if otherwise. X is a vector of explanatory variables. The explanatory variables considered were age of the farmer in years (X_1), gender measured as a dummy variable with males taking the value of unity and females taking the value of zero (X_2), years of educational attainment (X_3), years of farming experience (X_4), access to extension services measured by the number of visits of extension agents during the cropping season (X_5), income measured in naira (X_6), access to credit measured by the amount of credit received (X_7), cost of technology adoption in naira (X_8), and membership of an agricultural association/cooperative society with members taking the value of unity and non-members taking the value of zero (X_9).

Determinants of performance

$Y = f(X_1, X_2, X_3, X_4, X_5, X6, X_7, X_8, X_9, X_{10}, X_{11}, X_{12})$ ..... (7)

Where: Y = Performance measured by farm profit (naira); X_1 = Gender (male =1, female = 0); X_2 = Age (years); X_3 = Level of education (years); X_4 = Experience (years); X_5 = Marital status (married =1, otherwise = 0); X_6 = Household size (number); X_7 = Cooperative membership (member of cooperative = 1, otherwise = 0), X_8 = Amount of Credit granted (naira); X_9 = Transport cost (naira); and X_{10} = Other marketing costs/charges (naira).

Results and Discussion

The socio-economic characteristics of the farmers are presented in Table 1. The result shows that 68.33% of the respondents were married. This implies that food crop production in the area is dominated by married individuals, who are seen to be responsible according to societal standards (FAO, 2017). The mean age of the respondent is 36.7. This implies that, the farmers were still in their active age, more receptive to innovation, and could withstand the stress and strain involved in agricultural production. Nwaru (2004) and Iheke and Onyendi (2017) noted that the risk bearing abilities and innovativeness of a farmer, his mental capacity to cope with the daily challenges and demands of farm production activities decreases with advancing age. About 53.33% of the farmers were males, while 46.67% were females. This implies that Nigerian agriculture is still male dominated. Iheke (2010), noted that the result is typical in the study area where the man, most often the husband, takes major decisions concerning the household businesses except where he is no longer alive. Most (90%) of the farmers in the study area were literate with diverse formal educational levels ranging from primary school education to tertiary education, Literacy (ability to read and write) would enable the farmers to better utilize effectively and efficiently available resources in the area for farm businesses which would improve their productivity and productivity. As

expected, higher education could enhance improved business ideas, skills, innovation and managerial ability for business sustainability. This result is in agreement with Nwibo and Okorie (2013), Onyenweaku, (1988) that as an individual increases his educational attainment; his managerial ability for business sustainability also increases.

Table 1: Distribution of respondents by their Socio-economic characteristics (n = 60)

Variable	Frequency(l)	Percentage (%)
Age (in years)		
21-29	23	23.33
30-39	25	41.67
40-49	11	18.33
50-59	4	6.67
60-69	6	10.00
Mean age: 36.7		
Sex		
Female	28	46.67
Male	32	53.33
Marital status		
Single	19	31.67
Married	41	68.33
Level of education		
No formal education	6	10.00
Primary	24	40.00
Secondary	17	28.33
Tertiary	13	21.67
Household size		
1-3	15	25.00
4-6	25	41.67
7-9	11	18.33
10-12	9	15.00
Mean: 6		
Farming experience(years)	38	32
1-10	30	55.00
11-20	24	18.33
21-30	10	16.67
31-40	4	10.00
Mean: 14.7		
Farm size(hectares)		
0. 1-1.0	31	51.67
1.1-2.0	15	25.00
2.1-3.0	9	15.00
3.1-4.0	3	5.00
4.1-5.0	0	0.00
5.1-6.0	2	3.33
Mean	1.6	
Sources of capital		
Personal savings	39	65.00
Cooperatives	3	5.00
Friends and relations	13	21.67
Money lenders	6	6.67
Extension Contacts		
No	45	75.00
Yes	15	25.00
Cooperative membership		
Member	25	48.33
Non-member	35	51.67

Source: Field Survey, 2019

Table 1 also shows mean of 14.7 years of farming experience among the respondents, implying that the farmers were experienced and this has some positive implications for increased productivity. According to Nwaru *et al.* (2011), and Echebiri and Onu (2019), the number of years a farmer has spent in the farming business may give an indication of the practical knowledge he has acquired on how he can overcome certain inherent farm production problems. The mean household size was 6 persons per household. This is consistent with the findings of Iheke and Ukaegbu (2015). According to Iheke (2010), large household size is desirable and of great importance in farm production as rural households rely more on members of their households than hired workers for labour on their farms. Table 1 also showed that the majority of the respondents utilized funds from their personal savings to finance their farming operations. This could be because small-scale/resource poor farmers have limited access to financial services and often lack collateral that will qualify them for credit from formal lending institutions. This is consistent with Okojie *et al.* (2010). Also, 75% of the farm farmers do not have contact with extension agents, while 40% had access to extension visit. Lack of frequent and regular extension visits have the capacity of inhibiting the adoption of new innovations since majority of farmers find it difficult to access them. About 48.33% were members of farmers' cooperative societies. Iheke (2010) noted that cooperative societies/ farmers' associations serve as sources of good quality inputs, labour, credit, information and organized marketing of products. Onyenweaku and Ohajianya (2005) noted that members of cooperative societies have enhanced ability to adopt innovations than non-members.

Level of commercialization, innovation and performance of food crop farmers

Level of Commercialization

The level of commercialization of food crop farmers is presented in Table 2. The result indicates that 41.66% of the respondents had commercialization level range of 51 – 70. The mean commercialization level was 54.61. This implies a shift from peasant to market oriented production. Adoption of innovations leads to increased farm productivity which improves the commercialization behaviour of smallholder farmers. This will in addition enhance farmers' livelihood, reduce rural poverty, and increase food security.

Table 2 Distribution of the respondents according to Commercialization

Commercialization	Frequency	Percent
1-10	1	1.67
11-20	3	5.00
21-30	5	8.33
31-40	4	6.67
41-50	9	15.00
51-60	14	23.33
61-70	11	18.33
71-80	7	11.67
81-90	4	6.67
91-100	2	3.33
Total	60	100.00
Mean	54.61	

Source: Field survey, 2019

Food crop farmers' Level of Innovation

The frequency distribution of the level of innovation of food crop farmers is presented in Table 3. Results show that 28.34% of the food crop farmers had innovation level between 30.00 - 49.00. The mean level of innovation was 32.22. This level holds positive implications for improved productivity and performance of the farmers and it suggest that ample opportunities exist for the farmers to increase their level of adoption of innovations. Agricultural innovations also play a significant role in mitigating poverty, lowering per unit costs of production (Kassie *et al*. –2011), boosting rural incomes and reducing hunger (Maertens and Barrett, - 2013). According to Awotide *et al.* (2016), improved agricultural technology adoption has the potential to deepen the market share of agricultural output through which the smallholder farmers' resource use and output diversification decisions could be guided increasingly by their objective of profit maximization.

Table 3: Distribution of the respondents according to Innovation

Innovation	Frequency	Percent
0.00-9.0	12	20.00
10.00-19.00	7	11.67
20.00-29.00	8	13.33
30.00-39.00	9	15.00
40.00-49.00	13	21.67
50.00-59.00	4	6.67
60.00-69.00	5	8.33
70.00-79.00	2	3.33
Total	60	100.00
Mean	32.22	

Source: Field survey, 2019

Net Returns (Performance) of food crop farmers

The cost and returns from food crop production is presented in Table 4. The table showed that cassava and yam contributed 40.25% and 32.73% of total farm income respectively. This shows the importance attached to these crops in the study. Variable cost was estimated as 85.43% of the total cost incurred by the farmers. The major cost items were cost of labour (42.47%) and cost of planting materials (24.71%). The net return from food crop production was ₦246,200 indicating that food crop production is a profitable venture. Therefore, people should be encouraged to take up food crop farming as means of livelihood. It will equally stem the ever-escalating levels of unemployment and enhance food security.

Table 4: Distribution of the respondents according to Net returns (performance)

Items	Amount (₦)	Percentage share
Revenue		
Beans	23000	4.07
Cassava	227500	40.25
Maize	67500	11.94
Yam	185000	32.73
Vegetables	36550	6.47
Melon	25700	4.55
Total revenue	**565250**	
Cost		
Variable cost		
Planting materials	78850	24.71
Labour	135500	42.47
Fertilizer and agrochemicals	21000	6.58
Transportation	15700	4.92
Loading and off-loading	9000	2.82
Market charges	12500	3.92
Total variable cost	272550	85.43
Fixed cost	46500	14.57
Total cost	**319050**	
Net returns	**246200**	

Source: Field Survey, 2019

Relationship among commercialization, innovation and market performance

Table 5 shows the relationship among commercialization, innovation and market performance. Table 5 showed a significant positive relationship between commercialization and innovation at 1% level of significance with a coefficient of 0.4291. It equally showed a significant positive relationship between innovation and performance at 1% level of significance with a coefficient of 0.7173 and between performance and commercialization with a coefficient of 0.5323. These imply that as adoption of innovation increases, commercialization increases. Also, as adoption of innovation increases, the farmers' performance increases. Similarly, performance and commercialization increase together, *ceteris paribus*.

Table 5: Estimated correlation coefficient of the relationship among commercialization, innovation and performance

	Commercialization	Innovation	Performance
Commercialization	1.0000		
Innovation	0.4291***	1.0000	
Performance	0.5323***	0.7173***	1.0000

Source: Field survey data, 2018. *** Significant at 1%

Factors influencing commercialization, innovation adoption and performance of food crop farmers
Determinants of Commercialization

The estimated regression coefficients of the factors influencing commercialization are presented in Table 6.

Table 6: Regression estimates of determinants of Commercialization

Variable	Linear	+ Exponential	Double log	Semi-log
Intercept	-470936.7	10.814	-1.567	-5452818
	(-3.09)***	(37.40)***	(-0.89)	(-5.83)***
Age (X_1)	-59811.59	-0.103	0.267	151173.2
	(-5.17)***	(-4.70)***	(5.09)***	(5.41)***
Education (X_2)	0.454	1.39e-06	0.199	60689.55
	(4.04)***	(5.78)***	(5.43)***	(3.12)***
Gender (X_3)	8.482	2.08e-05	0.507	202645.1
	(4.04)***	(5.20)***	(5.44)***	(4.09)***
Income (X_4)	13.965	3.6e-05	0.561	191883.6
	(5.62)***	(7.64)***	(5.91)***	(3.81)***
Experience (X_5)	1.288	1.92e-06	0.087	53109.16
	(2.76)***	(2.16)**	(3.14)***	(3.60)***
Labour (X_6)	42292.899	**3.35e-03**	0.332	242178.3
	(1.58)	**(1.21)**	(1.20)	(1.64)
Distance (X_7)	2673.217	-0.00824	0095	22232.54
	(1.12)	(-1.82)*	(1.55)	(0.68)
Cooperatives (X_8)	15506.71	0.00484	0.0082	16994.44
	(0.65)	(0.11)	(0.17)	(0.66)
Transport cost (X_9)	-1368.45	0.00182	-0.0156	-5670.6
	(-0.72)	(0.50)	(-0.41)	(-0.28)
Depreciation (X_{10})	-2726.392	-0.0067	-0.365	-135450.3
	(-2.37)**	(-3.09)***	(-3.14)***	(-2.19)
Credit (X_{11})	235.907	0.252	0.608	185025.3
	(2.93)***	(0.67)	(4.01)***	(2.22)**
Quantity sold (X_{12})	0.223	0.085	0.073	54912.64
	(4.31)***	(1.14)	(1.61)	(2.20)**
R^2	0.614	0.7143	0.671	0.5483
Adjusted R^2	0.593	0.6985	0.653	0.5234
F-ratio	8.83***	15.25***	6.99***	5.97***

Source: Field survey data, 2019. * Significant at 10%, ** Significant at 5%, * Significant at 1%, Figures in parenthesis are the t-ratios and + = lead equation**

Exponential functional form was chosen as the lead equation based on statistical and econometric criteria such as the magnitude of the coefficient of multiple determination (R^2), number of significant variables, conformity with *a priori* expectation of the signs borne by the coefficients of the variables, and overall significance of the functional form (F-ratio). The F-ratio (15.25) was significant at 1% which attests to the overall significance of the regression result. The R^2 value (0.7143) of the lead equation shows that 71.43% of the variations observed in the commercialization were accounted for by the explanatory variables included in the model. The coefficient of age (0.994) was negatively signed and significant at 1%. This indicates that age is indirectly related to commercialization. This is suggestive of the fact that the older the food crop farmer, the less his commercialization level. However, older farmers are less receptive and more conservative to try new and improved technologies which would facilitate commercialization. This is consistent with the findings of Onyenweaku *et al.* (2007). Moreover, Okoye *et al.* (2007), reported that older entrepreneurs are less willing to consider new techniques, and hence reluctant to change the status quo which might affect their commercialization. The results also show that the coefficient of education (1.39e-6) was positive signed and highly significant at 1%. This indicates that an increase in the level of education of the farmers can result in an increased level of commercialization of the farm enterprise. This is in line with *a priori* expectation as educated farmers are flexible and can adopt good changes and new improved technologies that can enhance their level of commercialization. The finding is in line with the observations of Onyenweaku and Nwaru (2005), who stated that the level of education of a farmer does not only increase his productivity, but also enhance his ability to understand, evaluate and adopt new production techniques.

The coefficient of gender (2.08e-6) was positive and highly significant at 1%. This implies that male food crop farmers are more market orientated in production than their female counterparts. The coefficient of income was also significant and positively related to the level of commercialization of the farm enterprise with a coefficient of 3.6e-06 at 1% level of significance. This indicates that there is a direct relationship existing between income and commercialization. Increase in income would enable farmers purchase improved inputs and modern farm tools that are energy-saving, leading to increased productivity and hence commercialization. This is in agreement with the findings of Okezie *et al.* (2012), who identified income as one of the driving forces of increased crop production. Experience was also found significant and positively related to the level of commercialization of the farm enterprise with a coefficient of 1.91e-06 at 5% level of significance. This indicates that there is a direct relationship existing and as such with an increase in experience, there is an increase in farm enterprise commercialization. This is in

agreement with the findings of Hailua *et al.* (2015), who identified experience as one of the major factors that enhance crop production/productivity.

Distance was also found significant and negatively related to the level of commercialization of the farm enterprise with a coefficient of -0.00824 at 10% level of significance. This indicates that there is an indirect relationship, and as such with an increase in distance, there is a decrease in commercialization. This is in agreement with the findings of Hailua *et al.* (2015), who identified distance with a negative and significant effect on the intensity of crop commercialization. Depreciation was significant and negatively related to the level of commercialization of the farm enterprise with a coefficient of -0.0067 at 1% level. This indicates that the higher the capital consumption allowance, the lower the level of commercialization. Increase in capital consumption allowance implies higher cost, and this discourages farmers from investing more in their farm operations especially with the limited resources at their disposal.

Determinants of adoption of Innovations

The estimated determinants of adoption of innovations are presented Table 7. The result showed that the coefficient of determination (Psuedo R^2) was 0.7052 which implies that 70.52% of the variation in adoption of innovations was explained by the variables included in the model. The Likelihood Ratio Chi^2 was 36.68 and significant at 1% level of significance indicating goodness-of-fit of the probit regresion model. The significant determinants of adoption were age of the farmer ($P<0.01$), gender ($P<0.01$), educational attainment ($P<0.01$), extension visits ($P<0.05$), income ($P<0.01$), access to credit ($P<0.01$), cost of innovation adoption ($P<0.05$) and membership of farmers association/cooperative society ($P<0.05$). The coefficient of age was significant at 1% level and negatively signed. This implies that probability of adoption of innovation decreases as the farmer gets older. This result agrees with Dhraief *et al.* (2018), Iheke and Nwaru (2014) and Mauceri *et al.* (2005). Iheke and Nwaru (2014) noted that older farmers become more risk averse in comparison to their younger counterparts. On the other hand, Mauceri *et al.* (2005) stated that younger farmers are typically less risk-averse and are more willing to try new technologies than older farmers who have an increased risk aversion and a decreased interest in long-term investment in the farm.

The coefficient of gender was significant at 1% and positively related to adoption of agricultural innovations. This implies that male farmers tend to adopt innovations more relative to their female counterparts. Iheke and Nwaru (2014) explained that this may be because of the lopsidedness of extension services; the major means of innovation diffusion, which favour male farmers more. The coefficient of educational attainment was significant at 1% and positively signed. This implies that probability of adoption of innovation increases with educational attainment. Empirical evidence show that the level of education of a farmer increases his ability to obtain, process and use information relevant to the adoption of a new technology (Obasi, 1991; Mignouna *et al.,* 2011; Namara *et al.,* 2013; and Iheke and Nwaru, 2014). Agricultural extension services play pivotal roles in the livelihood activities of rural communities by ensuring that the farmers have access to improved technologies. They serve as channel of diffusion of innovations. This explains the positive and significant relationship between extension contact and adoption of innovations. Availability and access to extension services has also been found to be a key aspect in technology adoption (Mwangi and Kariuki, 2015).

The coefficients of income and access to credit were both significant at 1% and positively related to probability of adoption of innovation. Adoption of innovation is associated with some costs and availability of fund help ease the farmer's financial and liquidity constraints. This explains the positive relationship between income and access to credit and adoption of innovations. This result is consistent with the findings of Iheke and Nwaru (2013), and Simtowe and Zeller (2006). The coefficient of cost of innovation adoption was negatively signed and significant at 5% level. This implies that as innovation increases, probability of adoption decreases with increase in the cost of adopting the technology, *ceteris paribus.* This conforms to *a priori* expectation. Adoption of innovations involves cost and as the cost increases, the less likely the farmers would be able to afford it.

Table 7: Probit regression estimates of determinants of adoption of innovations/technologies

Variable	Coefficient	Standard error	Z value
Intercept	1.197	0.473	2.53**
Age (X_1)	-5.722	1.002	-5.70***
Gender (X_2)	3.783	1.256	3.01***
Education (X_3)	1.869	0.647	2.89***
Farming experience (X_4)	-0.299	0.454	-0.66
Extension visits (X_5)	1.336	0.565	2.50**
Income (X_6)	4.556	0.996	4.58***
Access to credit (X_7)	4.703	1.154	4.07***
Cost of technology adoption (X_8)	-1.259	0.481	-2.60**
Membership of association/ cooperative society (X_9).	0.108	0.044	2.44
Diagnostic statistics			
Number of obs	60		
Likelihood Ratio Chi^2 (9)	38.68		
Prob > Chi^2	0.000		
Pseudo R^2	0.7052		
Log likelihood	-13.710799		

Source: Field survey data, 2019. ** Significant at 5%, *** Significant at 1%

Determinants of Performance

The determinants of performance of the food crop farmers are presented in Table 8. The semi-log functional form was chosen as the lead equation based on statistical and econometric criteri such as the magnitude of the coefficient of multiple determination (R^2), number of significant variables, conformity with *a priori* expectation of the signs borne by the coefficients of the variables, and overall significance of the functional form (F-ratio). The coefficient of multiple determination was 0.7288 which implies that 72.88% of the variation in performance of the food crop farmers was explained by the variables included in the model. The F-ratio was significant at 1%, which indicates goodness-of-fit of the model (overall significance of the regression result). The significant variables influencing performance (measured by the net returns/profit from farming) of the food crop farmers were gender, age, education, farming experience, cooperative membership, amount of credit received, and transportation cost.

Table 8: Regression estimates of the determinants of performance

Variable	Linear	Exponential	Double Log	Semi-log +
Intercept	8.745	1.672	1.275	1.362
	(1.73)*	(2.20)**	(3.56)**	(2.61)***
Gender (X_1)	2.238	0.431	0.454	4.320
	(1.50)	(1.91)*	(2.02)**	(2.87)***
Age (X_2)	-0.043	-0.081	-0.417	-4.151
	(-0.47)	(-2.38)	(-3.47)	(-3.27)***
Education (X_3)	0.397	0.308	0.309	0.444
	(2.41)**	(1.24)	(1.96)	(5.05)***
Experience(X_4)	0.109	0.035	0.046	4.709
	(1.11)	(2.33)**	(0.19)	(4.09)***
Marital status (X_5)	0.2916	0.067	0.150	0.428
	(0.72)	(1.10)	(0.55)	(0.23)
Household size (X_6)	0.452	0.422	0.354	-0.422
	(3.60)***	(1.89)*	(3.27)	(-0.026)
Cooperative membership (X_7)	2.154	0.000	0.434	42831.45
	(6.90)***	(3.54)***	(2.70)***	(3.86)***
Amount of credit (X_8)	0.104	0.019	0.321	1.786
	(0.58)	(0.74)	(1.28)	(4.86)***
Transportation cost (X_9)	-0.003	0.001	-0.557	-2.860
	(-0.66)	(0.87)	(-0.93)	(-3.16)***
Other marketing costs (X_{10})	0.004	0.000	0.021	0.116
	(2.31)**	(1.59)	(0.28)	(0.22)
R^2	0.6598	0.6952	0.5513	0.7288
R^{-2}	0.5922	0.6285	0.4967	0.6879
F-ratio	4.80***	4.81***	4.51***	5.39***

Source: Field survey data, 2019. * Significant at 10%, ** Significant at 5%, * Significant at 1%, Figures in parenthesis are the t-ratios and + = lead equation**

The coefficient of gender was significant at 1% level and positively related to performance of the food crop farmers. This implies that male farmers performed better than their female counterparts. The existence of gender differences in agricultural production has been documented (FAO 2011; Aguilar *et al*. 2014; Kilic *et al*. –2015; Mukasa and Salami '2015). Confirming this result, Gebre *et al.* (2021), reported that the maize productivity of male-headed households was 44.3% higher than that of female-headed households. This would invariably lead to higher incomes. They noted that among the reasons for women farmers lower productivity is the difference in the use of inputs such as, improved seed, fertilizer, and labor, and access to other resources influencing productivity such as, education, extension, and credit.

The coefficient of age was significant at 1% level and positively related to performance of the food crop farmers. This implies that performance decreases as the farmer gets older. This conforms to *a priori* expectation. It has been reported that the risk bearing abilities and innovativeness of a farmer, his mental capacity to cope with the daily challenges and demands of farm production activities and his ability to do manual work decreases with advancing age; and the more he or she is unable to combine his or her resources in an optimal manner given the available technology (Iheke *et al.,* 2013; Iheke and Nwaru, 2014; and Iheke and Onyendi, 2017). This would lead to decrease in efficiency with associated decrease in productivity and hence income. The coefficient of education was significant at 1% and positively related to the performance of the farmers. This implies that the higher the educational attainment of the farmers, the higher their productivity. This conforms to *a priori* expectation. According to Paltasingh and Goyari (2018) and Iheke and Nwaru (2014), education increases farmers ability to analyze and synthesize information thereby increasing rate of adoption of innovations, leading to enhanced farm productivity and efficiency.

The coefficient of farming experience was significant at 1% and positively related to performance of the farmers. This implies that the higher the experience of the farmers, the greater their performance. Nwaru (2004) and Iheke and Onyendi (2017), reported that the number of years a farmer has spent in the business of farming may give an indication of the practical knowledge he has acquired on how to overcome certain inherent farm production problems. Years of farming experience has been noted as one of the factors that enhance productivity among farming households (Ajibefun *et al*., 2002 and Oni *et al.,* 2009). The coefficient of membership of cooperative society was significant at 1% level and positively related to performance of the food crop farmers. This implies that being a member of a cooperative society enhance the performance of the farmer. Spielman *et al.* (–2010), Francesconi and Heerink (–2011), Abebaw and Haile (–2013), Abate *et al*. ('–2014), and Francesconi and Ruben (2012) reported that agricultural cooperatives improve farm productivity through their influence on the adoption of productivity-enhancing technologies and by improving farm productivity. Cooperative membership improves the commercialization behavior of smallholder farmers (Bernard and Spielman –2009; Markelova and Mwangi –2010). Commercialization improves farm productivity and farm income at micro level. Cooperatives help their members to get greater access to agricultural inputs and provide credit services to member farmers that ease production constraints. Agricultural cooperative is widely considered as a vital foundation that can help smallholder farmers to overcome the constraints that hinder them from taking advantage of their business as it empowers economically weak farmers by enhancing their collective bargaining power, and thereby reduces the risks that they face in the market (Woldu *et al*., "2013).

The coefficient of transportation cost was significant at 1% and negatively related to performance. This implies that performance decreases with increase in the cost of transportation. According to Adamapoulus (2006), high cost of transportation increases the cost of transporting final goods and intermediate inputs used in farming - these inputs include; chemical fertilizers, pesticides, processed seeds, fuel, energy - across regions. Higher freight costs operate as barriers that distort the efficient spatial distribution of production because they prevent regions from specializing in the goods in which they possess a comparative advantage. This explains the negative relationship between transportation cost and performance. According to Tunde and Adeniyi (2012), bad conditions of the road affect cost of transportation of agricultural produce, which in turn affect the rural farmers' income. On the other hand, Ajiboye and Afolayan (2009), noted that improved transportation will encourage farmers to work harder in the rural areas for increased production, add value to their products, reduce spoilage and wastage, empower the farmers and have positive impact on their productivity, income, employment and reduce poverty level in the rural areas since it will be easier to move inputs and workers to farm and products to markets and agro-allied industry.

Conclusion

The study shows that adoption of agricultural innovations by farmers has positive effect on their productivity and increased productivity leads to commercialization among smallholder farmers. These will boost the overall performance of the farmers by increasing farm income and enhancing farmer livelihood, reducing rural poverty, and increasing food security. It is therefore recommended that policies that would enhance farmers' adoption of innovations such as strengthening the agricultural extension system which serve as channel for diffusion of innovations, and policies that will grant them access to credit and agricultural inputs should be implemented for increased productivity and commercialization. There is also need for free and affordable educational policies that will enable the farmers' access and process information on innovations that will enhance productivity and commercialization. Farmers are encouraged to form groups/cooperatives to be able access information, inputs and resources, thereby enhancing economics of scale.

References

Abate, G. T, Francesconi, G. N. and Getnet, K. (2014). Impact of Agricultural Cooperatives on Smallholders' Technical Efficiency: Empirical Evidence from Ethiopia. *Ann Public Coop Econ*, 85(2):257–286. doi:10.1111/apce.12035

Abebaw, D. and Haile, M. G. (2013). The Impact of Cooperatives on Agricultural Technology Adoption: Empirical Evidence from Ethiopia. *Food Policy*, 38: 82–91. http://dx.doi.org/10.1016/j.foodpol.2012.10.003

Adamopoulos, T. (2006). Transportation Costs, Agricultural Productivity and Cross-Country Income Differences. Meeting Papers 663, Society for Economic Dynamics. Accessed May 13, 2021.

Adenegan, K. O., Olorunsomo, S. O. and Nwauwa, L. O. E. (2013). Determinants of Market Orientation among Smallholders Cassava Farmers in Nigeria. *Global Journal of Management and Business Research Finance*, 13(6): 1-12.

Aguilar, A., Carranza, E., Goldstein, M., Kilic, T. And Oseni, G. (2014). Decomposition of gender differentials in agricultural productivity in Ethiopia. The World Bank, Africa Region, Poverty Reduction and Economic Management Unit, Policy Research Working Paper 6764.

Ajibefun, I. A., Battesse G. E. and Daramola, A. G. (2002) Determinants of Technical Efficiency in Small Holder Food Crop Farming: Application Of Stochastic Frontier Production Function. *Quarterly Journal of International Agriculture,* 41 (3): 225-240

Ajiboye, A. O. and Afolayan, O. (2009). The Impact of Transportation on Agricultural Production in a Developing Country: A Case of Kolanut Production in Nigeria. *International Journal of Agriculture and Rural Development,* 2(2): 49-51.

Akkoyunlu, S. (2013). Agricultural Innovations in Turkey. Working Paper No 2013/30| December, Swiss National Centre for Competence Research. Pp. 60.

Awotide, B. A., Karimov, A. A. and Diagne, A. (2016). Agricultural Technology Adoption, Commercialization and Smallholder Rice Farmers' Welfare in Rural Nigeria. *Journal of Agricultural and Food Economics,* 4(3): 1-24. https://doi.org/10.1186/s40100-016-0047-8.

Azad, S. A. K. (2015). High-Value Agriculture Products in Bangladesh: An Empirical Study on AgroBusiness Opportunities and Constraints. Dhaka University Institutional Repository, A Ph.D. Thesis submitted to the Department of Marketing, University of Dhaka.

Berhanu, G. and Moti, J. (2010). Commercialization of Smallholders: Does Market Orientation Translate into Market Participation?" Improving productivity and market success (IPMS) of Ethiopia Farmers. Project Working Paper 22. Nairobi, Kenya, ILRI.

Bernard, T. and Spielman, D. J. (2009). Reaching the Rural Poor Through Rural Producer Organizations? A Study of Agricultural Marketing Cooperatives in Ethiopia. *Food Policy*, 34(1):60–69. http://dx.doi.org/10.1016/j.foodpol.2008.08.001.

Dhraief, M.Z., Bedhiaf-Romdhania, S., Dhehibib, B., Oueslati-Zlaouia, M., Jebali, O. and Ben-Youssef, S. (2018). Factors Affecting the Adoption of Innovative Technologies by Livestock Farmers in Arid Area of Tunisia. *FARA Research Report*, 3 (5): 1-23.

Fan, S. (2011). Innovations, Policies, and Investments to Promote Smallholder Productivity in Africa. Paper Presented at the International Conference on Increasing Agricultural Productivity and Enhancing Food Security in Africa: New Challenges and Opportunities. Addis Ababa, Ethiopia. International Food Policy Research Institute; 2011.

FAO (2017). Food and Agriculture Organization. The Future of Food and Agriculture: Trends and Challenges. Food and Agriculture Organization of the United Nations, Rome, Italy.

FAO (2011). The State of Food and Agriculture. Women in Agriculture: Closing the Gender Gap for Development. ISBN 978-92-5-106768-0, http://www.fao.org/3/a-i2050e.pdf. Accessed May 13, 2021.

Francesconi, G. N. and Heerink, N. (2011). Ethiopian Agricultural Cooperatives In An Era Of Global Commodity Exchange: Does Organisational Form Matter? *Journal of African Econ,* 20(1):153–177. doi:10.1093/jae/ejq036

Francesconi, G. N. nd Ruben, R. (2012). The Hidden Impact of Cooperative Membership on Quality Management: A Case Study from the Dairy Belt of Addis Ababa. https://ssrn.com/abstract=2194296

Gebre, G. G., Isoda, H., Rahut, D. B., Amekawa, Y. and Nomura, H. (2021). Gender differences in agricultural productivity: evidence from maize farm households in southern Ethiopia. *GeoJournal,* 86: 843–864. https://doi.org/10.1007/s10708-019-10098-y

Gebremedhin, B., Jaleta, M. and Hoekstra, D. (2009). Smallholders, institutional services, and commercial transformation in Ethiopia. *Agric Econ*, 40(1):773–787. doi:10.1111/j.1574-0862.2009.00414.x

Gebremedhin, B. and Jaleta, M. (2010). Commercialization of Smallholders: Is Market Participation Enough? Contributed Paper Presented at the Joint 3rd African Association of Agricultural Economists (AAAE) and 48th Agricultural Economists Association of South Africa (AEASA) Conference, Cape Town, South Africa, September, 19-23.

Gebremedhin, B. and Jaleta, M. (2012). Market Orientation and Market Participation of Smallholders in Ethiopia: Implications for Commercial Transformation. Presented at the 28th Triennial Conference of the International Association of Agricultural Economists (IAAE), Foz do Iguaçu, Brazil, 18-24 August 2012. Nairobi, Kenya: ILRI.

Gertner, J. (2004). Mad Scientist. Fast Company, February 2004.

Goshu. D., Kassa, B. and Ketema, M. (2012). Is food

security enhanced by agricultural technologies in rural Ethiopia? *African Journal of Agricultural and Resource Economics*, 8(1): 58 – 68.

Hailua, G., Manjureb, K. and Aymutc, K. M. (2015). Crop Commercialization and Smallholder Farmers` Livelihood in Tigray Region, Ethiopia. *Journal of Development and Agricultural Economics*, 7(9): 314-322.

Iheke O. R. and Onyendi, C. O. (2017). Economic Efficiency and Food Security Status of Rural Farm Households in Abia State of Nigeria. *American Journal of Food Science and Nutrition,* 4(5): 52-58. http://www.aascit.org/journal/ajfsn

Iheke, O. R. (2010). Impact of Migrant Remittances on Efficiency and Welfare of Rural Smallholder Arable Crop Households in South Eastern Nigeria. Ph.D. Dissertation. Michael Okpara University of Agriculture, Umudike, Nigeria.

Iheke, O. R. and Amaechi, E. T. (2015). Effect of Land Fragmentation on Smallholders' Productivity in Imo State, Nigeria. *International Journal of Agricultural Science, Research and Technology in Extension and Education Systems*, 5(3): 195–201.

Iheke, O. R. and Ukaegbu, H. I. (2015) Effect of Poor Health and Farmers' Socioeconomic Variables on Total Factor Productivity of Arable Crop Farm Households in Abia State, Nigeria. *Nigerian Journal of Agriculture, Food and the Environment,* 11 (3): 141-146.

Iheke, O. R. and Nwaru, J.C. (2013). Innovation Adoption, Farm Productivity and Poverty Status of Rural Smallholder Farm Households in South-East, Nigeria. Invited paper presented at the 4th International Conference of the African Association of Agricultural Economists, September 22-25, 2013, Hammamet, Tunisia.

Iheke, O. R., Idu, M. A. and Uzochukwu, O. S. (2015). Assessment of Market Orientation among Smallholder Arable Crop Farmers in Abia State, Nigeria. *Taraba Journal of Agricultural Research,* 3(1): 57-63.

Iheke, O. R. and Nwaru, J. C. (2014). Impact of Innovation on Smallholders' Productivity and Poverty Status: The Case of Arable Crop Farmers in South-East, Nigeria. *Asian Journal of Agricultural Extension, Economics & Sociology,* 3(4): 301-318, 2014.

Iheke, O. R., Nwaru, J. C., and Onyenweaku, C. E. (2013). The Impact of Migrant Remittances on the Technical Efficiency of Arable Crop Farm Households in South Eastern Nigeria. Invited paper presented at the 4th International Confer of the African Association of Agricultural Economists, September 22-25, 2013, Hammamet, Tunisia.

Kassie, M., Shiferaw, B. and Muricho, G. (2011). Agricultural technology, crop income, and poverty alleviation in Uganda. *World Dev,* 39(10):1784 - 1795. http://dx.doi.org/10.1016/j.foodpol.2012.07.009

Kilic, T., Palacios-Lopez, A. and Goldstein, M. (2015). Caught in a Productivity Trap: A Distributional Perspective on Gender Differences in Malawian agriculture. *World Development,* 70: 416–463.

Maertens, A. and Barrett, C. B. (2013). Measuring Social Networks' Effect on Agricultural Technology Adoption. *Am J Agric Econ*, 95(2): 353–359.

Markelova, H. and Mwangi, E. (2010). Collective action for smallholder market access: evidence and implications for Africa. *Rev Policy Res.,* 27(5):621–640. doi:10.1111/j.1541-1338.2010.00462.x

Mauceri, M., Alwang, J., Norton, G. And Barrera, V. (2005). Adoption of Integrated Pest Management Technologies: A Case Study of Potato Farmers in Carchi, Ecuador; Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Providence, Rhode Island, July 24-27, 2005.

Mignouna, B., Manyong., M., Rusike., J., Mutabazi, S. and Senkondo, M. (2011). Determinants of Adopting Imazapyr-Resistant Maize Technology and its Impact on Household Income in Western Kenya: *AgBioforum*, 14(3), 158-163.

Mukasa, A. N. and Salami, A. O. (2015). Gender Productivity Differentials among Smallholder Farmers in Africa: A Cross-Country Comparison. Working Paper Series No. 231, African Development Bank, Abidjan, Côte d'Ivoire.

Mwangi, M. and Kariuki, S. (2015). Factors Determining Adoption of New Agricultural Technology by Smallholder Farmers in Developing Countries. *Journal of Economics and Sustainable Development*, 6(5): 208-216.

Namara, E., Weligamage, P. And Barker, R. (2003). Prospects for Adopting System of Rice Intensification in Sri Lanka: A Socioeconomic Assessment. Research Report 75. Colombo, Sri Lanka: International Water Management Institute.

NBS (2018) Demographic Statistics Bulletin 2017. National Bureau of Statistics, Abuja Nigeria. Pp. 26

Nigerian Population Commission (NPC) (2006) 2006 Nigerian Census Figures. Nigerian Population Commission, Abuja.

Nwaru, J. C., Iheke, O. R. and Onyenweaku, C. E. (2011). Impact of Migrant Remittances on the Welfare of Arable Crop Farm Households in South Eastern Nigeria. *Research in Human Ecology,* 18(2): 159- 166.

Nwaru, J.C. (2004). Rural Credit Markets and Resource Use in Arable Crop Production in Imo State of Nigeria. PhD Thesis Michael Okpara University of Agriculture, Umudike.

Nwibo, S. and Okorie, A. (2013). Determinants of Entrepreneurship among Agribusiness Investors in Southeast Nigeria. *European Journal of Business Management,* 5(10): 115-123.

Obasi, P. C. (1991). Resource Use Efficiency in Food Crop Production: A Case Study of the Owerri Agricultural Zone of Imo State, Nigeria .M.Sc Thesis, University of Ibadan, Ibadan, Nigeria.

Okezie, C. E., Sulaiman, J. and Nwosu, A. (2012). Farm – Level Determinants of Agricultural Commercialization. *International Journal of Agriculture and Forestry*, 2(2):1-5.

Okojie, C., Monye-Emina, A., Eghafona, K., Osaghae,

G. and Ehiakhamen, J.O. (2010). Institutional Environment and Access to Microfinance by Self-Employed Women in the Rural Areas of Edo State. NSSP Brief No. 14. Washington. D.C.: International Food Policy Research Institute.

Oni, O., Nkonya, E., Pender, J., Philips, D. and Kato, E. (2009). Trends and Drivers of Agricultural Productivity in Nigeria. Nigeria Strategy Support Program (NSSP) Report 001, International Food Policy Research Institute, Washington, D.C.

Onu, D. O. and Echebiri, R. N. (2019). Technical Efficiency and Returns to Scale Among Smallholder Cassava Farmers in Owerri West LGA of Imo State, Nigeria. *Nigerian Agricultural Journal,* 50(1): 10-16.

Onyenweaku, C. E. (1988). Rural Development through Stimulating the Adoption of Improved Technology by Farmers in Imo State. Paper presented at NTA/IMSU. Second Annual Seminar on Rural Development, Imo State University, Okigwe. Nov.1988. 12pp.

Onyenweaku, C. E. and Nwaru, J. C. (2005). Application of Stochastic Frontier Production Function to The Measurement of Technical Efficiency in Food Production in Imo State, Nigeria. *Nigerian Agricultural Journal,* 36: 1-12.

Onyenweaku, C. E. and Ohajianya, D. O. (2005). Technical Efficiency Of Swamp And Upland Rice Farmers in South Eastern Nigeria, *Journal of Sustainable Tropical Agricultural Research.* 14: 81-88

Onyenweaku, C. E., Okoye, B. C. and Okorie, K. C. (2007). Determinants of Fertilizer Adoption by Rice Farmers in Bende Local Government Area of Abia State, Nigeria. Munich Personal RePEc Archive (MPRA) Paper No. 26116. https://mpra.ub.uni-muenchen.de/26116.

Osmani, A. G. and Hossain, E. (2015). Market Participation Decision of Smallholder Farmers and its Determinants in Bangladesh. *Economics of Agriculture,* 62(1):1-17.

Paltasingh, K. R. and Goyari, P. (2018). Impact of Farmer Education on Farm Productivity Under Varying Technologies: Case of Paddy Growers in India. *Agric Econ,* 6 (7): 1-19. https://doi.org/10.1186/s40100-018-0101-9.

Simtowe, F. and Zeller, M. (2006). The Impact of Access to Credit on the Adoption of Hybrid Maize in Malawi: An Empirical Test of an Agricultural Household Model under Credit Market Failure. MPRA Paper No. 45

Spielman, D.J., Byerlee, D., Alemu, D. and Kelemework, D. (2010). Policies to Promote Cereal Intensification in Ethiopia: The Search for Appropriate Public and Private Roles. *Food Policy*, 35(3):185–194, http://dx.doi.org/10.1016/j.foodpol.2009.12.002.

Tunde, A. M. and Adeniyi, E. E. (2012). Impact of Road Transport on Agricultural Development: A Nigerian Example. *Ethiopian Journal of Environmental Studies and Management (EJESM),* 5(3): 1-7.

Woldu, T., Tadesse, F. and Waller, M. K. (2013). Women's participation in agricultural cooperatives in Ethiopia (No. 57). International Food Policy Research Institute (IFPRI). http://ageconsearch.umn.edu/bitstream/210967/2/Assefa-Women's%20Participation%20in%20Agricultural%20Cooperatives%20in%20Ethiopia-908.pdf. Accessed May 13, 2021.

World Bank (2008). World Development Report 2008: Agriculture for Development. World Bank, Washington, DC, USA.