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Impact of Subsidized Farm Technology on Paddy Farming in Nigeria: Case Study of Kano State, Nigeria

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Abstract

The world has been experiencing different kinds of incentives for farmers not only in developing countries but also the developed nations commitments on supporting food productions due to growing populations and fear of famine precisely developing countries as warned by food international agencies has become a debatable issue among professionals and policymakers. Though, Nigeria provides different kinds of incentives to boost rice productions, yet, the country's paddy farming is below expectation despite abundant fertile land. This study examined subsidized farm technology in paddy farming in Kano State, Nigeria. The study employed two stage sampling technique and a total of 300 paddy farmers were selected as sample of the study, and Ordinary Least Square estimator models were used in the analysis. From the findings, the level of education, farming experience and farm size were among the top factors that influence paddy farming production in the study area. Also, the subsidized fertilizer, tractor services, credit offered by financial institutions, and extension services were found statistically significant in paddy farming. The study found many farmers could not access qualified extension services, tractors and credits from financial institutions. These challenges are the major factors contributing to the farming system's remaining subsistence in the study area. The situation may worsen the efforts of the Nigerian government on food self-sufficiency and poverty alleviation. Thus, the study recommends government address the problem of inadequate qualified extension personnel and ease ways for farmers to access credit from financial institutions.

Keywords: Access, Farming, Paddy, Subsidy
JEL Classification: O10, O11. O13

Contribution to/Originality Knowledge

1.0 Introduction

The farming systems in developing countries are characterized by a large number of smallholders, low adoption of farm technology and inputs and limited income sources among others (Morris, et al., 2007; Sibande, Bailey, & Davidova, 2017). These challenges combined with the growth of population, and the increase of demand for foods inspired many developing countries to implement collective large-scale input subsidy programs (Mason & Ricker-Gilbert, 2014). The introduction of the Structural Adjustment Program (SAP) in the 80s by the World Bank led to the removal of subsidies in most of Sub-Saharan Africa (SSA) (Liverpool-Tasie, 2013; Ricker-Gilbert et al., 2013). Although many studies accepted the intensive use of chemical farm inputs can harm soil quality and nutrients. It also, affect agricultural productivity by distorting the farming activities of receiving farmers. It can lead to technical inefficiency by making farmers over-invest inefficiently use resources (Matthews, 2020; Vozárová et al.,

2020). However, professionals agreed that subsidies are vital if designed and implemented well to target specific groups of beneficiaries. It can improve lives, support innovation, and help build more strong communities by increasing generating income, productivity, and alleviating poverty from the sale of surpluses (Nindi, 2015; Sharma, 1982; Wang et al., 2019). Also, subsidies can influence agricultural behaviour through wealth effect (Omotilewa et al., 2019). Meanwhile, recently, the world is witnessing an increase of subsidy and commitments of many developing nations on farming. The agricultural input subsidy is not only subscribed to developing countries alone, but developed countries like the USA, China, and Russia among others are also implementing various kinds of farm subsidies aiming at improving food production, increase farmers' incomes, and minimization of negative externalities of agricultural production (Liang et al., 2019). All these was purposely to avoid revert to the global food price crisis in 2008 (Jayne & Rashid, 2013).

Paddy is one of the primary food crops globally. The increase of population, urbanization, income, and changing of family working structures leads to an increase demand for the crops. Asian countries are the major rice producers in the world. Countries like India, China, Indonesia, Thailand, and Singapore contributes about 90.4% of world rice production. While the USA, produces 5%, Europe produces 0.6% and Africa contributes only 4% (FAOSTAT, 2019). The paddy plays a substantial role in food security and poverty reductions in Nigeria (FAO, 2020). The demand for rice was projected to reach almost 36 million tons in 2050 against the demand of 7.1MT in 2017 under the paddy production of 4.7MT (Adeyemo, 2018). The paddy producing countries like Nigeria, Malaysia, China have been receiving different sorts of subsidy. However, for Nigeria, the quantity of rice produced is insufficient to compare the nature of consumption as indicated in Table 1.

Table 1: Nigeria's Domestic Rice Production, Consumption and Importation 2008-2017

Year	Domestic Production (000) MT	Consumption (000) MT	Area harvested (hectares), 000
2008	2632	4220	2382
2009	2234	4350	1837
2010	2818	4800	2433
2011	2906	5600	2269
2012	3423	5700	2864
2013	3038	5800	2931
2014	3782	6100	3082
2015	3941	6400	3122
2016	4410	6700	3170
2017	4662	7100	3600

Source: Index Mundi (2019)

Kano State is one of the staple food crops produce and is one of the top paddy farming states in Nigeria with a large portion of unutilized land. It is also a state with the highest number of labor force among Northwest zone states with about 3,713,679 (NBS, 2017). The state enjoyed several forms of farm inputs subsidy from both federal and state governments. The most

common program is a large-scale input subsidy in the year 2012 Growth Enhancement Support Scheme (GESS). The program provided a 50% subsidy on two 50-kg bags of fertilizer (NPK and Urea) and a 90% subsidy on a 50-kg bag of improved seeds (typically maize and rice seeds) (Wossen et al., 2017). It was estimated in 2018 over 200, 000 paddy farmers have benefitted from over $ 167 million (60 billion naira) disbursed at zero interest from the Anchor program (Leadership, 2019).

It was against this backdrop, that this paper aimed at examining farm inputs subsidies provided by government to boost paddy farming are yielding a positive result or not. The results aid the government, NGOs, private partners, and policymakers in exploring more avenues for effective farm subsidies.

The paper consists five parts. The first consist introduction which explains the motivation of the study. This means issues that inspires the author to undergo this kind of research. Part two include literature review. This part reviewed previous studies conducted and established the existing gaps. Part three presents methodology of the study where sampling technique and sample size were all explained. Part four consist of results presentation and discussions, and lastly, part five explained the conclusions and recommendations of the study.

2.0 Literature Review

Various subsidized farm technology studies or subsidized farm inputs as named by some studies (Rehman, 2016; Sanchez, 2015) conducted in different regions and countries. Some were on food crops, some on subsidized farm inputs such as chemical fertilizer, hybrid seeds, tractor, water, power, and transport among others. However, some studies found a significant effect of subsidized farm technology (Kari, 2018; Michael et al., 2018; Mustapha & Said, 2016; Nasrin et al., 2018; Omotilewa et al., 2019). At the same time, some found insignificant results (Asfaw, Cattaneo, Pallante, & Palma, 2017; Mantau, et.al., & Syafrial, 2019; Minviel & Latruffe, 2017; Ragasa & Mazunda, 2018; Varela-Candamio, Calvo, & Novo-Corti, 2018). From the most recent studies, Wildayana and Armanto, (2019) analyzed the role of subsidized fertilizers on rice production and the income of farmers in various land typologies in South Sumatra province, Indonesia. The study used purposive cluster sampling. The Probit model was used. The results found that subsidized fertilizer increases paddy production by more than three times, while, the income of farmers can be increased only to about one and a half times. Similarly, Liang et al., (2019) assess agricultural subsidies of the cropping system from environmental and economic perspectives of Huantai in China over the period 1996–2012. A questionnaire was administered and a life cycle assessment (LCA) was used. From the results, agricultural subsidies are increasingly regarded as a catalyst for realising green environmental goals.

However, Wang et al., (2019) examined the socio-economic impacts of agricultural subsidy programs of farmers including co-payments in Bhutan, Korea. The study used a semi-structured questionnaire and interview. Data was collected in collaboration with policymakers, extension agents in January -February 2017 from six blocks representing two districts. 125 (61 females and 64 males). The sample size of household heads was selected through a two-step

random sampling method. A logit regression was used in the analysis. From the result, the agricultural subsidy program does not converge very well. The aims of the subsidy were defeated. Besides, Vozárová et al., (2020) evaluate the effect of EU agricultural subsidies in Slovakia. The data for the analysis were obtained from the Ministry of agriculture and Rural Development of the Slovak Republic. The logical methods, financial analysis, and multi-criteria TOPSIS were used in the analysis. From the findings, there is no statistically significant linear correlation between farms' performance results and the volume of subsidies per hectare of agricultural land for each legal form throughout the reporting period. The study is limited on economics method rather than a multidimensional analysis. Besides, Mantau, Hanani, & Syafrial, (2019) found the insignificant effect of subsidized fertilizers and seeds on farmer's income and productivity.

Kos, Lensink, & Meuwissen (2023) assess the effect of social capital on farmers' adoption of subsidized seedlings and fertilizer for cocoa farmers in Ghana. The survey sample consists of 1503 farmers from 22 communities of Fanteakwa in 2016 from a randomly selected based on a full list of farmers made available by the cooperative management. Linear Ordinary Least Squares (OLS) regression, and logit regressions were used for analysing the results. The results show that adoption of subsidized fertilizer is positively correlated with farm capital. Jinbaani & Wale (2023) evaluates the effect of Ghana's fertilizer subsidy program on adoption intensity of Sustainable intensification practices (SIPs) and gross farm inputs among maize-growing farm households using a nationally representative dataset of 4365 maize-growing households for (2012/2013) and (2016/2017), and two-stage least squares with instrumental variables (2SL-IV) and endogenous switching regression (ESR) were employed in the study. The study finds that participation in the GFSP increases the adoption intensity in both SIPs and gross farm inputs. Fujimoto (2023) examines whether the Tanzanian subsidy for inorganic fertilizers and improved seeds encourages farmers to participate in the input and grain markets. The study used six waves from 2008–2009 to 2020–2021 of the National Panel Survey. The study used LH model. The study found that subsidized improved seeds is more significant to farmers income and livelihood.

Kitole, Mkuna, & Sesabo (2024) examine the impact of digitalization on agriculture transformation in Tanzania. The study employed a cross-sectional study design and selected the sample of 400 of farmers from different cooperative societies. Alternative methodologies like Two-Stage Least Squares (2SLS) and Instrumental Variable (IV) approaches were employed. From the findings to promote digital technology adoption among smallholder farmers, policymakers in Tanzania and developing countries should prioritize financial inclusion through supporting microfinance programs, subsidized technology access, integrate digital literacy, and enhance extension services among others. Also, Ricome, Barreiro-hurle, & Sadibou, (2024) assesses how access to subsidized fertilizer under the input subsidy programs (ISPs) is associated with changes in fertilizer and manure use and gross margin. The survey used 936 sample size using a stratified two-stage sampling procedure and endogenous switching regression were employed. The results shows that there is a positive association between access to subsidized fertilizer and nitrogen use but negative connection with a commercial nitrogen use.

The dissimilarity findings of various studies on farm subsidy proved the contentious debates on the significance of subsidies on-farm technology. There is scanty literature that examined the effect of subsidized farm technology (include more than fertilizer and chemical seeds) on paddy production. Likewise, most of studies conducted on food subsidy were based on a systematic review of previous articles (Hemming et al., 2018; Walls et al., 2018).

2.1 Theoretical framework

Economic methods indicates that the economic risk aversion stimuluses farmers' decisions on adopting organic fertilizers (Bowman & Zilberman, 2013; Stuart et al., 2014), most of these theories do not analyse farmers' behaviour change according to economic variables. Moreover, some studies, such as Mason and Ricker-Gilbert (2013), employed the theory of demand and supply in their explanation of the effect of farm input subsidies. Analysing farm household production choices were highlighted by the standard neoclassical theories. It was also emphasized by modern development economists (Mendola, 2007). This study is based on the household's production theory as numerous studies on the production decisions of farm households in developing countries were conducted in different areas of social science

The theory states that households buy commodities from the market which serve as inputs that are used in the processes of production. Precisely, a household combines fertilizer, certified seeds and other capital equipment to create a given level of agricultural output (Danlami et al., 2019). The theory sheds more light on peasant household behaviour in low-income settings with weak institutional arrangements and market failure. The abilities of households to manage risk have provided some of the explanations and empirical contributions based on various analytical frameworks (Mendola, 2007). Therefore, the model of the household production theory can serve as the basic framework for explaining farmers' utilisation of subsidized farm technology processes to improve paddy production. Therefore, assuming the utility function of the farm household is stated as follows: $U= f(\ SFT, SCS, STR, CRDT)$ U represents the paddy production, SFT refers to subsidized fertilizer, SCS, subsidized certified seeds, STR subsidized tractor and amount of credit received from financial institutions. In this context, the decision of the farmer is regarded as a double-stage optimisation problem. In the first stage, the farmer acts to minimise the cost of producing a pre-determined paddy output by using subsidized farm inputs. In the second stage, the farmer attempts to maximise utility and is regarded as a consumer. He tries to maximize satisfaction by consuming subsidized farm technology inputs to provide paddy production.

3.0 Methodology

3.1 Source of data

The demographic and farm profiles as well as paddy production were adopted and modified from previous studies (Davis et al., 2010; FAO, 2012; MDPI, 2017; Rapu, 2016). All these and other literature were explored in setting a well-structured questionnaire for this study and validated by the University Putra Malaysia Ethics Committee. The questionnaires were administered to paddy farmers in Bunkure, Kura, and Tudunwada local government areas of Kano state, Nigeria around February - April 2020. The questionnaire instrument entails

information on paddy farmer's demographic profiles, farm inputs, and subsidized farm technology. From the total Kano paddy farmers population of 90,000 registered with the Anchor program in 2019 (Dailytrust, 2019), a sample size of 421 was drawn. Initially, a sample size of 384 was obtained from the use of Creative Research Systems (2019) calculator sample size at 5 confidence intervals. The result was the same as a Krejcie & Morgan, (1970) 's result. Thus, to solve the problems of eventualities, like missing information and incomplete questionnaires, 10% of the estimated sample was added to the sample size to compensate for such events as suggested by Singh & Masuku, (2013). This matched the sample size suggested by social science researchers, such as Roscoe, (1975) who contended that a sample size in the range of 30 to 500 is recognized for empirical studies. The larger sample size usually gives more accurate mean values, decreases the rate of eventualities, and yields a better result (Albers & Lakens, 2018). However, after thorough screening the questionnaire returned, it was found a total of 300 was full completed and hitch-free from eventualities. Therefore, this study used 300 samples in the study.

The two-stage sampling method was used in this study. It is used when the sizes of the clusters are big, making it costly and tougher to observe all the units inside them. Thus, to obtain data, two or more sampling selection stages are needed (Hankin, 1984). In the first stage, six paddy communities were selected using a simple random sampling technique from the list of the twelve paddy villages in the local government areas. In the second stage, 70 paddy farmers were systematically selected from each of the selected communities with an additional one sample to one community making a total of 421 distributed.

3.2 Analytical model

The Ordinary Least Square model (OLS) was used in the analysis. It is a linear statistical regression technique used to analyse the relationship between a dependent variable and independent variables. It is usually used to solve real-life problems such as identifying factors that affect the dependent variables and is used in almost all fields of science, Engineering, Social, Economics, and Management Sciences (Mahaboob, Venkateswarlu, Narayana, Ravisankar, & Balasiddamuni, 2018). The model has been used by many studies on explaining the relationship between dependent variables and independent variables (Danlami, et al., 2016; Rizwan, Ping, Iram, Nazir, & Wang, 2019). However, the OLS model is guided by some assumptions, among them are; zero mean of the error variable (i.e. E (U) =0) Zero Covariability or relationship between the random error and the explanatory variable (i.e. Cov (Xj, U)) = 0, homoscedasticity of the variance of the error term and absence of perfect multicollinearity among the independent variables. The model can be written as follows:

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots\ldots\ldots\ldots\ldots \beta_k X_k + \varepsilon \quad (1)$$

The dependent variable y and the independent variables X_1, X_2..... X_k are observable random scalars. Meaning, they can be observed in a random sample of the population. While, β_0, β_1, β_2, β_k are the parameters to be measured and u is the error or unobservable random disturbance. Thus, this study adopted and modified the OLS model used by Danlami (2014), since the model

fit to be used as the quantity of paddy produce is determined relatively by demographic factors, farm factors, and subsidized farm technology.

$$y = \beta_0 + \Sigma_{j=1}^{1}\beta_j DMR_i + \Sigma_{j=1}^{2}\beta_j FRM_i + \Sigma_{j=1}^{3}\beta_j SFT_i + \varepsilon \quad (2)$$

y represents the quantity of paddy produced per hectare of land (kg), β is a vector of parameters that relate the independent variables with the dependent variable. DMR signifies the demographic profile of farmers which includes; age, level of education, family size, and income (naira). Then FRM, specifies farm factors that entail, farm size, and farming experience. SFT is the subsidized farm technologies that include government subsidy on fertilizer, certified seed, pesticides, tractor services, extension services, and amount of credit received and the error term.

However, equation 2 above was broken into the following:

$$y = \beta_0 + \Sigma_{j=1}^{1}\beta_j DMR_i + \Sigma_{j=1}^{2}\beta_j FRM_i + \varepsilon \quad (3)$$

Here, both demographic and farm factors were examined at the first estimation to find their effect on paddy production.

$$y = \beta_0 + \Sigma_{j=1}^{1}\beta_j DMR_i + \Sigma_{j=1}^{2}\beta_j FRM_i + \Sigma_{j=1}^{3}\beta_j NSR + \varepsilon_i \quad (4)$$

NSR indicates the number of subsidy inputs received

$$y = \beta_0 + \Sigma_{j=1}^{1}\beta_j DMR_i + \Sigma_{j=1}^{2}\beta_j FRM_i + \Sigma_{j=1}^{3}\beta_j SFT + \varepsilon_i \quad (5)$$

SFT indicates the summation of subsidized farm technology

$$y = \beta_0 + \Sigma_{j=1}^{1}\beta_j DMR_i + \Sigma_{j=1}^{2}\beta_j FRM_i + \Sigma_{j=1}^{3}\beta_j FTL + \varepsilon_i \quad (6)$$

From equation 5. The subsidized farm technology was broken into various subsidies received. Thus here, FLT indicates subsidized fertilizer.

$$y = \beta_0 + \Sigma_{j=1}^{1}\beta_j DMR_i + \Sigma_{j=1}^{2}\beta_j FRM_i + \Sigma_{j=1}^{3}\beta_j CTS + \varepsilon_i \quad (7)$$

CTS means subsidized certified seeds

$$y = \beta_0 + \Sigma_{j=1}^{1}\beta_j DMR_i + \Sigma_{j=1}^{2}\beta_j FRM_i + \Sigma_{j=1}^{3}\beta_j EXT + \varepsilon_i \quad (8)$$

EXT indicates subsidized extension services

$$y = \beta_0 + \Sigma_{j=1}^{1}\beta_j DMR_i + \Sigma_{j=1}^{2}\beta_j FRM_i + \Sigma_{j=1}^{3}\beta_j TRC + \varepsilon_i \quad (9)$$

TRC refers to subsidized tractor services

$$y = \beta_0 + \Sigma_{j=1}^{1}\beta_j DMR_i + \Sigma_{j=1}^{2}\beta_j FRM_i + \Sigma_{j=1}^{3}\beta_j CRD + \varepsilon_i \quad (10)$$

CRD indicates subsidized credit

4.0 Results and Discussions

This part was divided into three parts. The first part, explains the full sample table of 421 respondents. In the second part diagnosis tests of normality, multicollinearity, and heteroscedasticity results to ensure the assumptions of OLS were met appropriately. Then lastly, the results of subsidized farm technology were presented.

Socio-demographic characteristics of paddy farmers

Table 2 presents the characteristics of paddy farmers in Bunkure, Kura, and Tudunwada local government areas of Kano state. From the data received about 43% were youth who are between 18-35 years old. At the same time, 46% are between 36-60 years old respectively of both subsidized and unsubsidized farmers. The majority of farmers in the study areas are within the labor force, as only 9% and 17% were above 61 years old respectively of both subsidized and unsubsidized farmers. The majority of the respondents (83%) were male, while only 17% were female. This low participation of women is attributed to the culture and traditions of the study areas. The women involved in farming are usually on support services such as planting, harvesting, and grinding crops. The average age of farmers is 42 years old. This is contrary to the assertions that only old age was left in farming in developing countries. The educational level of the respondents shows the majority have attended secondary school. It has found about 40% attended secondary schools for both subsidized and unsubsidized farmers respectively. Of the entire respondents, only 8% were graduates and about 15% were unschooled. Besides, the family size of the entire respondents has shown on average, each farmer has seven family sizes. This means, about 43% of the respondents have ranged between 6-10 family sizes. The income status of the respondents shows that the majority of them are low-income earners (76%). Moreover, average, the respondents have 10 years' experience in paddy farming. The majority of paddy farmers used small farm sizes (65%) less than 2 hectares. The small size of the farm led to the low production of paddy in the study area. It has shown about 53% produced 10001kg. The majority of farmers about 71% registered with the paddy farmers' association. However, the subsidized farmers registered with the farmers' association (78%) more than unsubsidized farmers (47%).

Table 2: Socio-Economic Characteristics and Farm Factors of the Respondents

Variable	Subsidized farmers		Unsubsidized paddy farmers		Total	
	Frequency	%	Frequency	%	Frequency	%
Demographic factor						
Age distribution					42*	
18-35	95	41.30	35	50.00	130	43.30
36-60	114	49.56	23	32.86	137	45.70
61 and above	21	9.13	12	17.14	33	11.00
Total	**230**	**100.0**	**70**	**100**	**300**	**100**
Gender						
Male	187	79.57	61	87.14	248	82.70
Female	43	20.42	09	12.86	52	17.30
Total	**230**	**100.0**	**70**	**100**	**300**	**100**

Level of Education						
Unschooling	35	15.21	10	14.29	45	15.00
Primary school	57	24.78	14	20.00	71	23.67
Secondary school	93	40.43	28	40.00	121	40.33
Sub degree	27	11.74	11	15.71	38	12.67
Graduate	18	7.83	07	10.00	25	8.33
Total	**230**	**100.0**	**70**	**100**	**300**	**100**
Family size (number)	7*				7*	
1-5	66	28.69	11	15.71	77	25.67
6-10	98	42.61	32	45.71	130	43.33
11-15	43	18.70	14	20.00	57	19.00
16-20	18	7.83	09	12.86	27	9.00
21 and above	05	2.17	04	5.71	09	3.00
Total	**230**	**100.0**	**70**	**100**	**300**	**100**
Annual farming income (naira)	1070993*		604982*		932743*	
Low income	166	72.00	62	88.57	228	76.00
Middle income	52	22.61	06	8.57	58	19.33
High income	12	5.22	02	2.86	14	4.67
Total	**230**	**100.0**	**70**	**100**	**300**	**100**
Farm factors						
Farming experience (Years)					10*	
1-5	51	22.17	17	24.29	68	22.67
6-10	67	29.13	33	47.14	100	33.33
11-15	63	27.39	14	20.00	77	25.67
16 -20	44	19.13	04	5.71	48	16.00
21 and above	5	2.17	02	2.86	7	2.33
Total	**230**	**100.0**	**70**	**100**	**300**	**100**
Farm size (hectares)					2.0*	
0.1-2.0	147	63.91	47	67.14	194	64.67
2.1-4.0	69	30.00	17	24.29	86	28.67
4.1 above	14	6.09	06	8.57	20	6.67
Total	**230**	**100.0**	**70**	**100**	**300**	**100**
Farmers' association						
Registered	179	77.83	33	47.14	212	70.67
Unregistered	51	22.17	37	52.86	88	29.33
Total	**230**	**100.0**	**70**	**100**	**300**	**100**
Quantity of paddy per hectares (kg)	11175kg*				10650Kg*	
1501-10000	114	49.57	44	62.86	158	52.70
10001-18500	67	29.13	14	20.00	81	27.00
18501-27000	33	14.35	08	11.43	41	13.70
27001-above	16	6.80	04	5.71	20	6.70
Total	**230**	**100.0**	**70**	**100**	**300**	**100**

Subsidized Farm Technology Profile

The respondents' access to subsidized farm technology is indicated in Table 3. It has shown about 77% of the respondents accessed different forms of farm subsidy. This includes purchasing fertilizer, chemical seeds, accessing tractor services, and credit offered by the banks at a low interest rate (0-5%). However, about 23% of respondents couldn't access any form of

subsidy from the government. The data shows about 52% accessed fertilizer, 44% accessed certified seeds, and 23% accessed tractor services. The small number of those who accessed tractor services was associated with the small size of the farm, using local farm tools and labour used is usually, human, animal, and family labour. In contrast, only 29% have contact with extension personnel and 34% accessed credit. This is connected with the majority of farmers who could not fulfil the credit requirements from the financial institutions. Moreover, the respondents were categorized on the number of subsidies accessed. From the table, the majority of subsidized farmers received either one two, or three subsidized inputs. At the same time, farmers who receive all of the subsidized inputs offered were 4%.

Table 3: Subsidized Farm Technology Profile

Variable	**Access**		**Not access**	
	Frequency	**%**	**Frequency**	**%**
Subsidized fertilizer	155	51.67	145	48.33
Subsidized certified seeds	132	44.00	168	56.00
Subsidized tractor services	68	22.67	234	77.33
Contact extension personnel	86	28.67	214	71.33
Access to subsidized credit	103	34.33	197	65.67
The number of subsidized farm technologies received				
Farmers received one subsidy input	60	26.09		
Farmers received two subsidy input	74	32.17		
Farmers received three subsidy input	58	25.22		
Farmers received four subsidy input	28	12.17		
Farmers received five subsidy input	10	4.35		
Total Farmers received a subsidy	**230**	**76.67**		
Total Farmers received a subsidy	**70**	**23.33**		

Ordinary Least Square Result

The data was confirmed to be normally distributed as indicated in Table 4. Nevertheless, to fulfil other conditions of OLS, the multicollinearity test was conducted to measure the extent of the connection among the independent variables. This provides an index that shows the increased level of variance of an estimated regression coefficient due to collinearity. The Vector Inflation Factor (VIF) of this study was approximately 2, which did not exceed the value of 5 as indicated in Table 4. This shows, that there was an absence of high correlation among the independents' variables and therefore 'β' (coefficient) is not inflated at all. Therefore, all the variables were engaged for further analysis. Also, a heteroscedasticity test was conducted through the Breusch – Pagan/Cook Weisberg test and established the constancy of random error variance. In this case, the t for heteroscedasticity was conducted to ascertain the constancy of random error variance. The result of the test shown: Ho: Constant variance Variables. The fitted values = 0.52.

Table 4: Multicollinearity test result

Variable	VIF	1/VIF
Age	2.98	0.336
Gender	1.15	0.867
Level of education	1.39	0.719
Family size	2.86	0.349
Income	1.25	0.799
Farm size	1.50	0.667
Farming experience (years)	1.69	0.592
Farmers' association	1.59	0.629
Subsidized fertilizer	2.01	0.496
Subsidized certified seeds	1.87	0.535
Subsidized tractor services	1.33	0.751
Subsidized credit	1.40	0.715
Extension services	1.20	0.830
Mean VIF	**1.69**	

Moreover, the OLS results of eight models are shown in Table 5. It has been shown in each model standard error and P-value results were presented to indicate the effect on the paddy production. However, the variables that found insignificance were not indicated in the table. In the first model, (equation 3) demographic and farm factors results have shown the level of education, farm size, family size, and experience of farming significantly affect the amount of paddy produced in the study area. In the second model, the number of those who accessed subsidized farm technologies in various forms were added to the first model (equation 4). Age, level of education, farm size, and farming experience were the major demographic and farm factors that affect the paddy production. At the same time, the number of subsidies received has a significant effect at 1% on paddy production. Besides, in model three, the sum of all subsidies was tested as one variable, together with the demographic and farm factors (indicates in equation 5). The result has shown age was the only demographic factor that affected the production, while farm experience and farm size played a great role among the farm factors. It has shown, subsidize fertilizer, subsidized seeds, extension services, and tractor services were significant at 10%, 10%, 5%, and 1% respectively. While in models 4-8 each subsidized farm technology was assessed individually to explore its effect together with both demographic factors and farm factors (equation 6-10). From the results, age, family size, farm size, and farming experience play a vital role in paddy production. However, the level of education is only significant in the models of access to subsidized tractors and access to credit. The entire results indicate the significant effect of subsidized fertilizer, subsidized tractor services, access to extension services, and credit received from financial institutions on paddy production. The results is in line with a theory of production as this study was based on. The higher the provision of farm subsidies the higher the amount of farm outputs to be harvested. Also, the results are in line with the significant effect of the subsidy on crop production (Kari, 2018; Nasrin et al., 2018; Wildayana &Armanto, 2019). However, the result of the insignificant effect of subsidized certified seeds was contrary to some of the previous studies conducted. It was in

line with the findings of studies conducted (Ragasa &Mazunda, 2018; Vozárová et al., 2020; Wang et al., 2019).

Table 5: OLS Result, Effect of Paddy Production on Subsidized Farming Technology Results

Variable	**Model 1**		**Model2**		**Model 3**		**Model 4**		**Model 5**		**Model 6**		**Model 7**		**Model 8**	
Demographic factors	Std. error	P - value	Std. error	P-value	Std. error	P-value	Std. error	P - value	Std. error	P-value	Std. error	P-value	Std. error	P-value	Std. Error	P-value
Age			0.009	0.000 ***	0.022	0.000 ***					0.319	0.000 ***	0.005	0.001 ***	0.005	0.001 ***
Level of education	0.008	0.002 ***	0.179	0.000 ***									0.075	0.000 ***	0.008	0.002 ***
Family size	0.000	0.050 **					0.006	0.057 *	0.006	0.006 ***	0.006	0.071 **				
Farmer's income													0.103	0.000 ***		
Farm factors																
Farm size	0.193	0.000 ***	0.937	0.000 ***	0.120	0.000 ***	0.020	0.000 ***	0.959	0.000 ***	0.019	0.000 ***	0.372	0.000 ***	0.034	0.000 ***
Farm experience	0.004	0.024 **	0.029	0.000 ***	0.021	0.000 ***	0.004	0.002 ***	0.004	0.023 **	0.004	0.026 **	0.008	0.025 **	0.008	0.030 **
The number of subsidized farm technologies received			0.059	0.001 ***												
Subsidized farm technology																
Fertilizer					0.392	0.002 ***	0.495	0.076 *								
Certified seeds					0.337	0.059 *										
Extension services					0.332	0.047 **					0.503	0.000 ***				
Tractor services					0.372	0.001 ***							0.098	0.005 ***		
Access to subsidized credit															0.082	0.032 **

Significance levels * p < 0.1, ** p < 0.05, *** p < 0.01

5.0 Conclusion and policy recommendation

The growth of population and demand for paddy necessitated Nigeria's government to provide various incentives to encourage paddy farming. Yet, the country's rice farming is still below expectation as abundant land was left unutilized. This study examined the impact of different kinds of farm subsidies. The study found that farmers who received many subsidized farm inputs produce more of paddy production when compared to their colleagues who received less farm subsidies. Moreover, the results indicate many farmers are low-income earners who cannot invest heavily in farming. Furthermore, many farmers could not access qualified extension personnel and credits from financial institutions, as well as tractor services due to charges of hiring. These challenges continue to be contributing factors that will remain the farming system of the area to be a subsistence and produce low paddy production. The situation may worsen the efforts of the Nigerian government on food self-sufficiency and poverty alleviation. Therefore, the study recommends that; government at all levels address the problems of difficulties faced by farmers in accessing credit from financial institutions, and the issue of accessibility of tractor services prices to avoid the monopoly by higher-income earners as well as to expand the subsidize farm inputs to those who access little and to those who cannot access.

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