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DETERMINANTS OF FARMERS' WILLINGNESS-TO-ACCEPT SEED PRODUCTION TECHNOLOGY AND THEIR POTENTIAL CAPACITY FOR RICE SEED PRODUCTION IN FEDERAL CAPITAL TERRITORY, NIGERIA

[1]Moradeyo Adebanjo Otitoju, [2]Gabriel Odewumi Olaifa, and [1]Yinka Mercy Obasanya
[1]Department of Agricultural Economics, University of Abuja, Nigeria
[2]Aquatic Bioresources Development Centre
National Biotechnology Development Agency, Ode Ajagba, Ondo State, Nigeria
Corresponding Author's Email: moradeyo.otitoju@uniabuja.edu.ng **Tel.:** 07063036013

ABSTRACTS
The study examined the determinants of farmers' willingness-to-accept rice seed production technology and their potential capacity for seed production in Federal Capital Territory, Nigeria using primary data collected from 220 rice farming households. Heckman two-stage selection model analysis revealed that willingness-to-accept rice production technology and the potential capacity to produce rice seeds were influenced by certain factors, the results showed that age of the household heads (z = -1.80), dependency ratio (z = -1.77), farming experience (z = 2.68) at 1%, rice farming experience (z = -3.02), income (z = 5.62), land ownership (z = 3.66), family labour (z = 2.28), hired labour (z = -3.11), training in rice farming/production (z = 2.71) and training in rice seed production (z = -2.76) were statistically significant and influenced rice production potential capacity among the rice farming households at in the study area. The study then recommends that proactive land tenure policies and training in agronomic practices are needed to enhance rice seed production capacity of the rice farming households in the Federal Capacity Territory, Nigeria.

Keywords: determinants, Heckman selection model, Potential capacity, Rice seed.

INTRODUCTION
Seed is a key input for improving crop production and productivity. It is the beginning of something which continues to develop or grow. Increasing the quality of seeds can increase the yield potential of the crop by significant folds and thus, is one of the most economical and efficient inputs to agricultural development (Food and Agriculture Organization [FAO], 2006). Seeds is the most cost-effective and most dramatic input with high return on investment among all yield-enhancing inputs in crop production. Productivity-enhancement has been made possible by 50% gains in crop agriculture by the use of improved seeds, while improvement in management, including timeliness, best use of fertilizer, crop protection measures and equipment improves the other 50% in yield (Adamu, 2000; Echekwu, 1999; Gupta, 1994; Joshua, 1999; Louwaars & Marrewijk, 1999; Shobowale, 1994). This productivity has to be maintained by farmers having access to viable seeds.

Farmers recycle most seeds from grain crops. The seed from self-pollinating crops such as rice tends to maintain most of its desirable attributes over many production seasons, while open pollinating crops like maize lose such attributes more quickly. Farmers thus tend to recycle rice seed over a long period of time and only occasionally demand new seed from outside to replace their seed. This low seed-replacement rate for certain crops discourages private firms from developing improved varieties for such crops (Nagarajan *et al.*, 2005).

One of the reasons for this is poor access to quality seeds by farmers, which is evident from the poor seed replacement rate (SRR) (FAOSTAT, 2012). It is worthy of note that apart from the production of improved seed varieties, the quality of the seed is also of paramount

importance in crop production. High quality seed is essential for good crop yields and good returns, and minimizes the likelihood of crop failure. In order to enhance the quality of the improved seed varieties before it is released to the ultimate farmers, it is a necessary condition for it to pass through seed certification process.

The development and use of high yielding seed varieties has been the technological force behind the reduction of rural poverty, successful Green Revolutions, and abundant food prices profitable for farmers and affordable to the populace in most developing countries, particularly China, India, Southwest Asia, the Pacific, and many parts of Latin America and the Caribbean (Joshua, 1999; Louwaars & Marrewijk, 1999). Due largely to increased awareness by farmers of the superiority of improved seeds over local (Echekwu, 2000), the demand for improved seeds rose so much that NSS was finding it increasingly difficult to satisfy the farmers. The ADPs had to complement the efforts of NSS in seed production. They started to produce their own improved seeds and to multiply on their own seed farms any improved seeds they could obtain from the NSS, the research institutes, and emerging private seed organizations (Cheema *et al.*, 1994).

Improved seeds often take a very long time to get to farmers, and adulteration has been reported in many communities. Consequently, many farmers have resorted to the use of local seed varieties that are readily available and relatively cheap. Therefore, most seed planted are mostly of low-quality judging from the poor seed handling techniques that characterized the farmers own seed production system especially when done without having separate seed production plot.

Rice farming households in Nigeria are generally poor primarily because the production resources are expensive and inadequately available to support rice production in commercial quantity. Consequently, the farmers operate small farm sizes (0.59 hectares per farmer and are unable to apply optimally farm inputs as recommended by research institutes (Nwanze, 2005). This results into low yield and low returns on investment. The inability of Nigeria rice sub-sector to meet the domestic demand could be attributed to low productivity, inefficiency in the use of resources, little or no access to improved seeds, disincentives from macro-economic environment and production in the hand of small-scale out growers who use traditional technologies (Federal Ministry of Agriculture and Rural Development [FMARD], 1995).

Despite programmes and policies on seed intervention launched in the past by successive governments, the problem of inadequate rice seeds still lingers hence the need to find a lasting solution to this seed problem by looking inward to the rice farming households themselves to produce seed and to examine their production potential and the area of training need to produce rice seeds at their own levels. Against this backdrop, this study seeks to examine the determinants of farmers' willingness-to-accept rice seed technology and their potential capacity in seed production in the Federal Capital Territory, Nigeria. The specific objectives were to:

i. to describe the socio-economic, farm-specific and institutional characteristics of the respondents in the study area
ii. to examine the determinants that influence farmers' willingness-to-accept seed production technology and
iii. to identify the factors influencing farm households' potential capacity for rice seed production in the study area.

On the basis of the stated objectives, the following null hypotheses were tested:

i. there is no significant relationship between the farmers' willingness-to-accept seed production technology and the socio-economic, farm-specific and institutional factors of the rice farming households in the study area.

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ii. there is no significant relationship between the rice farmers' seed production potential capacity and the socio-economic, farm-specific and institutional factors of the rice farming households in the study area.

MATERIALS AND METHODS

The Study Area

The Study Area: This study was conducted in the Federal Capital Territory. The Nigeria's Federal Capital Territory (FCT) is located in the middle of the country occupying a land area of 8,000 square kilometres, which is two and halftimes larger than Lagos, the former capital city of Nigeria. According to 2016 population census by National Population Commission (NPC), FCT population stands at 3,564,100. The FCT shares border on the northern side with Kaduna State, Niger state on the western side while Plateau state is located to the east and south-east boundary as well as Kogi State at the south-western corner. The FCT falls within latitudes 7° 25' N and 9° 20° North of the Equator and longitudes 5° 45' and 7° 39' East of the Greenwich Meridian.

Furthermore, the indigenous ethnic groups in the FCT include Gbagyi, Bassa, Gade, Gwandara, Koro and Ganagana while the predominant occupations include subsistence farming, fishing and blacksmithing. Other ethnic nationalities from different part of the country are also resident in the FCT, an outlook that positioned the city as a microcosm of the entire country. The city is divided among six area councils of AMAC, Kuje, Kwali, Abaji, Gwagwalada and Bwari with Federal Capital Development Authority (FCDA) assuming the central and overall administrative role.

Sampling Techniques

This study was conducted using multi-stage sampling technique. In the first stage, two (2) Area Councils was purposively selected, which are Gwagwalada and Abaji Area Councils. The choice of the two Area councils is due to the preponderance of rice farmers in this area of Federal Capital Territory. Secondly, two (2) agricultural extension blocks were randomly selected from each Area Council, making four (4) blocks. Thirdly, two (2) ADP cells were selected in each block, making eight (8) cells. From the cells, the list of the farmers was collected from the extension agents/officers or community facilitators available, to form the sampling frame. The required sample size will be determined adopting the equation developed by Yamane (1967) to compute the sample size based for each Area Council as stated below:

$$n = \frac{N}{1 + N(e)^2} \qquad \ldots(1)$$

where;
n = the sample size,
N = the population size
e = the level of precision (0.07),

The researcher using this formula is to ensure unbiasedness, as each cell had a fair representation even when random sampling will be used to select the respondents. As shown in Table 1, the sample size is 220. Primary data was collected from the respondents using well-structured questionnaire for the study.

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Table 1: Total Rice Farming Households population in the Area Councils of FCT

Area councils	Rice farming households	Sample size
Gwagwalada	221	106
Abaji	262	114
Kwali	218	-
Bwari	164	-
Kuje	137	-
AMAC	185	-
TOTAL	**1187**	**220**

Source: FCTADP, 2017

Heckman two-stage selection model was adopted to achieve objectives (ii) and (iii). This is purposely chosen because the objective being investigated involves two-stage decision process. The first stage verifies the discrete choice of the respondent on willingness to accept seed production technology or not to willingly accept. The second stage analyzes the potential capacity in hectare for rice seed production. The first stage of selection is explicitly stated thus:
Selection Model

$Sel_i = \alpha + \beta_i X_i + e$ …(2)

where;

Sel_i = 1 if the respondent is willing to accept rice production technology, 0 = otherwise.

The second stage regression model is stated thus:

$Y_i = \alpha + \beta_i X_i + e$ …(3)

where;

Y_i = the potential capacity in hectrage of farm size that can be used for rice seed production by the rice farming household (hectare). X_i are the independent or explanatory variables which are explicitly explained in Table 2.

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Table 2: Explanatory Variables in the Heckman stage two-selection Model

Explanatory Variables	**Parameter**	**Variable**	**Expected sign (*a priori* expectation)**
Socio-economic factors:			
Age (years)	β_1	X_1	+
Sex (Dummy 1 = male, 0 = female)	β_2	X_2	+
Household size (number of persons in the household)	β_3	X_3	+
School years	β_4	X_4	+
Literacy ratio in the household (no of educated person in the household)	β_5	X_5	+
Dependent ratio in the household	β_6	X_6	+
Farm-specific and institutional factors:			
Farm size (hectares)	β_7	X_7	+
Membership of farmers' cooperative societies (1 if yes, 0 otherwise)	β_8	X_8	+
General farming experience (years)	β_9	X_9	+
Rice farming experience(years)	β_{10}	X_{10}	-
Income (Naira)	β_{11}	X_{11}	+
Access to credit (Dummy 1 if have access, 0 otherwise)	β_{12}	X_{12}	+
Extension contacts (Number of visits	β_{13}	X_{13}	-
Land ownership (Dummy 1 if owned by the household, 0 otherwise)	β_{14}	X_{14}	+
Family Labour use (man-days)	β_{15}	X_{15}	+
Hired Labour use (man-days)	β_{16}	X_{16}	-
Training in rice farming (1 if yes, 0 otherwise)	β_{17}	X_{17}	+
Formal training in rice seed production (1 if yes, 0 otherwise)	β_{18}	X_{18}	-

The null hypotheses (i) and (ii) were tested using Z-test statistic embedded in the Heckman two-stage selection models at 10%, 5% and 1% levels of significance.

RESULTS AND DISCUSSION

Socio-economic, Farm-specific and Institutional Factors of the Respondents

The mean age of the household head is 48.40 years, which implies that the respondents (rice farming household heads) are younger rice farmers that are within the economically active age. This agrees with the study of Chavanapoonphol, Battese and Chang (2005) that found out that Thailand rice farmers were within the active age range and also agrees with Otitoju (2008, 2010). The average years of schooling as revealed by this study is 7.92 years. This implies that the majority of the respondents attempted secondary school. Educational level is a very important variable because it could lead to awareness of the possible advantages of modern farming techniques thereby increasing their level of willingness-to-accept rice seed technology and their potential capacity to produce rice seed in the study area.

The average household size is 7.15, which implies that the head of rice farming households in the study area might have advantage of family labour availability if many

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household members participate in farming. However, the implication of large household size is that it will increase household consumption expenditure which would compete with provision of resources for production because of limited financial resources within the household. According to Okoruwa and Ogundele (2006) large family size does not necessarily translate to higher use of family labour because some of the young able bodied family members may prefer other jobs than farming. This findings of an average households of 7 people/persons agreed with the findings of Oni (2014).

The average number of literates in the households of the sampled respondents is 3.75 as shown in Table 3. This implies there is at least 3 literates in every household in the study area. There is tendency of easy influence any programme or training dealing with decision on willingness-to-produce rice seed in the study area. The average number of dependents in the sampled households is 3.60, which implies that about 3 dependents are in every sampled household in the study area. The mean farm size was 2.59 hectares (Table 3). This implies that most of the farmers were small-scale farmers as indicated by the average farm size in the study area. The average income of the respondents is ₦117,710.00.

Table 3: Socio-economic, farm-specific and institutional factors of the rice farming households

Factors	Mean	Minimum	Maximum
Age of the household head (Years)	48.40	21.0	76.0
Education of the household head (Years of schooling)	7.92	0.00	16.0
Household size (Numbers)	7.15	1.00	16
Number of literates in the household	3.75	1.00	13
Number of Dependents in the household	3.60	1.00	11
Farm size (Hectare)	2.57	0.45	7.2
Income of the household head (Naira)	117,710.00	5500.00	501,550.00

Source: Computed from field data, 2019.

Factors Influencing Farmers' Willingness-to-Accept Rice Seed Production Technology and the Potential Capacity in Rice Seed Production in The Federal Capital Territory

The factors influencing farmers' willingness-to-accept rice seed production technology and the potential capacity to produce rice seed among rice farming households were analysed effectively by deploying Heckman two-stage selection model because of its two-stage decision process. The first stage of the decision process is on factors influencing farmers' willingness-to-accept rice seed production technology and the second stage is the determinants of the rice farming households' potential capacity in rice seed production in the study area. From Table 4, the Wald Chi-square value is 1638.25, which is significant at 1% level of probability. The Wald Chi-square value is 1638.25, which was highly significant ($P < 0.0000$), suggesting the model has a strong explanatory power. The determinants considered in the model are socio-economic characteristics (age of the household head, gender of the household head, education level of the household head, household size, literacy ratio, dependency ratio, farming experience of the household heads. rice farming experience and average income); farm-specific factors (farm size, land ownership family labour and hired labour) and institutional factors (farmers' association, access to credit, extension visit, training in rice farming/production and training in rice seed production).

The level of acceptance of rice seed production practices affects the availability of seed to rice farming households, hence the need to know the factors that influence the willingness-to-accept appropriate rice seed production practices among the rice farming households in the Federal Capital Territory. Gender of the household heads, rice farming experience and land ownership are the factors that were significant at 1%, 10% and 5% levels of probability and had relationship with the willingness-to-accept rice seed production practices.

Table 4 revealed that gender of the household heads as being important in influencing the willingness-to-accept (WTA) rice seed production practices. This implies that a unit increase in male-headed household will increase the probability of willingness-to-accept (WTA) rice seed production practices by 0.230597 (23.1%) at 1% level of significance. This shows that male-headed households are more willing-to-accept rice seed production practices than female-headed rice farming households in the Federal Capital Territory.

Surprisingly as shown in Table 4, rice farming experience of the household was negatively and statistically related to willingness-to-accept rice seed production practices at 1% level of significance. This is at variance with the a priori expectation. This implies that holding other factors constant, a unit increase in the rice farming experience of rice farming household heads will bring a decline in their willingness to accept rice seed production practices by 0.0079737as shown in Table 4.

The findings of this study as showed in table 4 revealed that land ownership was positively and significantly related to the probability of willingness-to-accept rice seed production practices at 5% level of significance. This implies a unit increase in land ownership of rice farming household heads will bring an increase in their willingness-to-accept rice seed production practices by 0.2266 (22.7%) as shown in Table 4. The implication of this finding is that household heads who are landowners are more likely to accept rice seed production practices than household heads that are land tenants. Land ownership is widely believed to encourage the adoption of new technologies (Daberkow & McBride, 2003). This agrees with the work of Oni (2014) and Otitoju and Oni (2017) in farmers' willingness to plant agroforestry trees in Ekiti State. Tenants can be assumed less likely than landowners to adopt new technological innovations, as the benefits may not necessarily flow to them, while land ownership is likely to influence the adoption decision.

Determinants of Rice Farming Households' Potential Capacity in Rice Seed

It is not enough to consider the factors that influence the willingness-to-accept appropriate rice seed production practices among the rice farming households without looking at the determinants of the rice production potential capacity among the rice farming households in the Federal Capital Territory. The findings of this study revealed that age of the household heads, dependency ratio, farming experience, rice farming experience, income, land ownership, family labour, hired labour, training in rice farming/production and training in rice seed production were the factors that influenced rice production capacity among the rice farming households in the study area.

The findings of this study revealed that age of the household heads is negatively and statistically related to the rice seed production potential capacity at 10% level of significance as showed in Table 4. This implies that younger rice farming household heads are more willing to use more land for rice seed production than the older ones.

Dependency ratio is negatively and statistically significant at 10% probability level in the rice production potential capacity. This implies that the dependency ratio of the rice farming households is inversely related to the potential capacity in rice seed production in the study area as seen in Table 4. It means a unit increase in the dependency ratio will decrease the rice

seed production potential capacity by 1.524 as shown in Table 4. It shows that the more the dependents in the rice farming households the less there are willing to use more land for producing rice seed in Federal Capital Territory.

Table 4 showed that farming experience of the household heads is positively and statistically related to the probability of the household willingness to produce rice seed at 1% level of significance. This implies that a unit increase in farming experience of the household heads will also increase the potential capacity for rice seed production by 0.0925 (9.25%) in the study area.

Surprisingly, rice farming experience of the household was negatively and statistically related to the potential capacity for rice seed production at 1% level of significance. This is at variance with the general farming experience. This implies that a unit increase in the rice farming experience of rice farming household heads will bring a decline in their potential capacity in rice seed production by 0.0882 (8.82%) as shown in Table 4.

Income was positively and statistically related to the potential capacity to produce rice seed at 1% level of significance as shown in Table 4. This implies that an increase in the income of the heads of rice farming households will increase the potential capacity by 0.0000152 (Table 4).

Land ownership was positively and significantly related to the potential capacity to produce rice seed at 1% level of significance (Table 4). This implies that a unit increase in land ownership of rice farming household heads will bring an increase in their rice seed production potential capacity by 1.313 as shown in table 4. The implication of this finding is that household heads who are landowners have production potential capacity than rice farming household heads that are land tenants.

Family labour was positively and significantly related to rice seed production potential capacity at 5% level of probability. This implies that a unit increase in family labour of rice farming households will increase the rice seed production potential capacity by 0.000236 in the study area as shown in Table 4. According to Busukuba *et al.* (2007), household size is normally seen as equivalent to family labour endowment. Moreover, in situations where hired labour is costly to monitor, households with a greater endowment of labour are not only placed to farm their land more intensively but also to conduct critical operations at the right time than is the case with households that are dependent on hired labour.

From the result in Table 4, hired labour of the respondents is statistically significant at 1% level of significance and had a negative relationship with rice seed production potential capacity. This means that an increase in hired labour decrease the rice potential capacity by 0.000032 (Table 4). This shows that family labour for production of rice seeds is always available so using hired labour may amount to waste of resources at the early stage of rice seed production in the study area.

Training in rice farming/ production had a positive and significant relationship with the rice seed production potential capacity at 1% level of significance. This implies that a unit increase in the training in rice farming or production will increase the potential capacity to produce rice seed by 1.3327 as shown in Table 4. This finding is in agreement with the study of Ajani (2000) who observed that training experience enhance farm productivity and efficiency in his study of resources productivity in food crop farming in Northern area of Oyo State Nigeria.

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Table 4: Determinants of willingness-to-accept (WTA) rice seed production technology and the potential capacity in rice seed production in Federal Capital Territory

Variables	Coefficient	Standard error	Z-value
WTA rice seed production practices			
Age	0.00378	0.00295	1.28
Gender	0.2316	0.0674	3.42***
Household size	0.00222	0.00817	0.27
Education Level	0.00193	0.00372	0.52
Literacy Ratio	0.07172	0.00833	0.86
Dependency Ratio	0.1884	0.1529	1.22
Farm Size	0.00572	0.01438	0.40
Farmers Association	0.04864	0.0411	1.18
Farming Experience	0.00464	0.00571	0.81
Rice Farming Experience	-0.00797	0.00453	-1.76*
Income	3.75E-07	4.03E07	0.93
Access to credit	0.00552	0.0696	0.08
Extension visits	-0.000484	0.0636	-0.01
Land Ownership	0.227	0.0918	2.47**
Family Labour	2.47E-06	1.5E-06	1.60
Hired Labour	-6.23E-07	1.88E-06	-0.33
Training on Rice Farming/Production	0.07886	0.665	1.19
Training on Rice Seed Production	-0.0460	0.0672	-0.69
Rice seed production potential capacity			
Age	-0.0369	0.0205	-1.80*
Gender	0.854	0.518	1.65
Household size	-0.01322	0.0260	-0.51
Education Level	-0.0709	0.0476	-1.49
Literacy Ratio	-0.05701	0.5016	-0.11
Dependency Ratio	-1.524	0.8589	-1.77
Farm Size	0.06852	0.0878	0.78
Farmers Association	0.2302	0.2566	0.90
Farming Experience	0.0925	0.0345	2.68***
Rice Farming Experience	-0.0882	0.0292	-3.02***
Income	0.0000152	0.00000290	5.26***
Access to credit	-0.1698	0.4598	-0.37
Extension visits	0.6489	0.4311	1.51
Land Ownership	1.333	0.3584	3.66***
Family Labour	0.0000236	0.0000103	2.28**
Hired Labour	-0.0000326	0.0000105	-3.11***
Training on Rice Farming/Production	1.3327	0.4919	2.71***
Training on Rice Seed Production	-1.0813	0.3921	-2.76***
Constant	-0.9278	1.3228	-0.70
Lambda	0.2166	0.090025	2.41**
Number of Observation = 220			
Censored observation = 74, Uncensored observation = 146			
Wald Chi-square (18) = 1826.96			
Prob > Chi-quare = 0.0000			

*, **, *** stand for 10%, 5% and 1% levels of significance
Source: Computed from field data, 2019.

Formal training in rice seed production: As revealed in this study (Table 4), training in rice seed production had a negative and significant with the potential capacity for rice seed production at 1% significance level in the study area. This implies that a unit increase in the formal training in rice seed production will bring about a decline in the rice seed production potential capacity by 1.0813 as shown in Table 4.

CONCLUSION AND RECOMMENDATIONS

The study concludes that land ownership and training in rice agronomic practices are very important factors that are useful in rice seed production in the Federal Capital Territory, Nigeria.

From the findings of this study, the following recommendations were made:

1. Proactive regulatory land use policies that will make rice farming households to participate in more secured land ownership systems should be put in place for land tenants to benefit so that they can be able to invest and use sustainable production strategies to maximize benefits.
2. In order to increase the farmers' willingness-to-accept rice seed production technology, the government and development partners are urged to increase support to rice farming households so that they can increase hectreage for rice seed production and increase their access to information about improved rice seed varieties.
3. Training on good agronomic practices necessary for rice seed production should be organized by the government and development partners in other to enhance the production of rice seeds in the Federal Capital Territory and other rice producing states or areas in Nigeria.

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