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DETERMINANTS OF ADOPTION OF IMPROVED RICE VARIETIES: EFFECTS ON OUTPUT IN VOLTA REGION

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Abstract
Adoption of improved rice varieties has become very important in Ghana especially in major producing regions like Volta. This is because rice yield is generally low in the country. This study investigated and analyzed the determinants of adoption of improved rice varieties. The study also analyzed the effects of adoption of improved rice varieties on rice output. Primary data was collected through semi-structured questionnaires from 177 farmers. The districts, communities and farmers were selected using simple random sampling technique. Analysis of data was carried out using the Heckman Sample Selection Model. From the results, 54% of the respondents used improved rice varieties while 46% did not. The results also show that age, the frequency of extension visits, farmers' experience, access to irrigation, business as a purpose of farming and access to credit are the main drivers of adoption of improved seeds. Again, factors that influence rice output are extension officers' visit to the farm, education, farming experience and access to irrigation facility. Adoption of improved rice varieties increases rice output. It is therefore recommended that farmers should be educated to adopt improved rice varieties. Institutions that are in charge of dissemination of improved rice seeds should target young farmers who have access to extension services, irrigation and are cultivating rice purposely for business.

Keywords: **Adoption, improved rice varieties, Heckman Sample Selection Model**

Introduction

The importance of rice as a staple crop to the human population cannot be underestimated. Rice has become a staple crop which plays a key role in reducing hunger particularly in Asia and in the developing countries which Africa is inclusive. Macauley *et al.* (2015) confirmed that rice has become a highly strategic and priority commodity for food security in Africa. This has made the consumption of rice to grow faster than that of any other major staple on the African continent because of high population growth, rapid urbanization and changes in eating habits (Seck *et al.,* 2013). Even though there is an increase in rice production in recent years across the African continent, local production has never been able to meet local demand, hence the continent has to rely on imports for its rapidly growing market demand.

In Ghana, rice is the major staple crop for its populace. It is cultivated in all the ten regions in Ghana with the Volta Region being the current highest producer (203,419Mt representing 30.71% of total production). Even though the Volta Region is the highest producer of rice in Ghana, the adoption of improved rice varieties by smallholder farmers is low. Recycling of own seeds is a common practice among farmers. Studies in China revealed that rice production has more than tripled between 1959-2009 due to the use of improved varieties which led to an increase in grain yield. According to Peng *et al.* (2009), this increase came from the development of high-yielding varieties and improved crop management practices such as nitrogen fertilization and irrigation.

The situation in Ghana is different. Increased rice production is usually achieved through increased planting area rather than the adoption of improved technologies. Thus, rice yields in Ghana are generally low. As compared to highest rice yield of

10Mt/ha recorded in Australia, Ghana recorded a yield figure of 2.75Mt/ha with Volta Region recording 4.56Mt/ha in 2015 production year.

Adoption is defined by Loevinsohn *et al.* (2012) as the integration of a new technology into existing practice. In other words, adoption means accepting new ways of doing things which is contrary to already existing practices. Smallholder farmers are not familiar with the cultivation of improved rice varieties. They are used to recycling of seeds or purchase of ordinary seeds from the market. Awareness and education are very important in technology adoption. As noted by Chekene *et al.* (2015), Saka *et al.* (2005), Hossain *et al*. (2006) and Ghimire *et al* (2015), age, household size, years of education, distance to farm, marital status, farmer's experience, farm size, sex and availability of extension services among others, are the socioeconomic determinants of adoption which the farmer must be able to take control of, otherwise, adoption of improved technology becomes difficult.

Although many educational programmes and field demonstration has been provided to farmers about the use of improved seeds and good agronomic practices in farming and its effects on outputs, a majority of these smallholder farmers do not adopt these improved seeds. Additionally, the forces of demand and supply have to pull farmers to produce rather than socioeconomic factors. The reason for this discrepancy remains unknown and this research seeks to find out the determinants of adoption of improved rice varieties and its effect on output.

Materials and Methods

Study Area

This research was conducted in Volta Region of Ghana. The Volta Region is located along the southern corridor of the country and it shares boundary with Republic of Togo. Ketu North and North Tongu Districts were selected for the study. Ketu North District is a newly curved district from Ketu Municipal. Ketu North District covers a total surface area of 423.8 square kilometers. It has a total population of 99,913 with 46.5% males and 53.5% females (GSS, 2014a). About 65.8% of the population is rural. Of the households engaged in agriculture, 98.1% are into crop farming (GSS, 2014a). Rice is one of the major crops cultivated in the district due to the fact that it has suitable climatic and environmental conditions.

North Tongu District has a total land area of 1460 km square. The district has a population of 89,777 with 47.3 males and 52.7 females (GSS, 2014a). About 94% of the households engaged in agriculture are into crop farming (GSS, 2014a). Rice farming and fishing are the main occupations in the district. This is basically due to the presence of more fertile and better subsoil moisture (MoFA, 2016)

Data Collection and Analysis

The two districts of the study were selected using a simple random technique from 15 rice producing districts in the Volta Region based on 2015 production figures by MoFA (MoFA, 2016). In the order of decreasing production figures, the sampling frame districts from the MoFA records were Ketu North, Hohoe, Jasikan, Biakoye, Kadjebi, Nkwanta South, Nkwanta North, South Tongu, Krachi East, Krachi West, North Tongu, Kpando, Ho, Adaklu Anyigbe and South Dayi. The communities and farmers were also selected using simple random technique. The names of rice producing communities and farmers were obtained from the District Agriculture Office. A total sample size of 177 was used for the study

Descriptive statistics were used to analyze the demographic and socioeconomic characteristics of the respondents in the study area. The Heckman two-stage equation was adopted for the inferential analysis because of the nature of the dependent variable and the suspicion of the prevalence of selectivity bias problem.

Theoretical Framework

The main theory underpinning this research is the theory of Utility Maximization. This theory explains the satisfaction one derives from taking a decision. A farmer will adopt improved rice varieties only if he or she perceives that the benefit he or she will get from adopting is greater than the benefit he will get without adopting. This adoption decision is influenced by factors such as marital status, educational level, and distance from the house to farm among others.

Assuming U_1 and U_0 as the utility a farmer derives from adopting improved rice varieties and not adopting improved rice varieties respectively. The linear regression model for the utility (U_1) derived from a farmer's decision to adopt is expressed as a function of independent or explanatory variable X_1 and written mathematically as:

$$U_1 = \beta_1 X_1 + \mu_1 \qquad (1)$$

Consequently, the utility (U_0) a farmer derives from not adopting is written as:

$$U_0 = \beta_0 X_1 + \mu_0 \qquad (2)$$

Where X_1 is the independent or the explanatory variable (such as marital status, educational level, distance from the house to farm etc), β_1 and β_0 are parameters to be estimated for the decision to adopt or not to adopt improved rice seeds respectively, μ_1 and μ_0 are the error term or the random disturbance for adopting and not adopting respectively.
For a farmer to adopt, the expected utility of adoption must be greater than the expected utility derived from not adopting hence $E(U_1) > E(U_0)$

The probability of adopting improved rice varieties is given as:

$$P(U = 1 \mid X) = P[(X_i\beta_1 + \mu_1) > (X_i\beta_0 + \mu_0)] \qquad (3a)$$

$$P(U = 1 \mid X) = P[(X_i\beta_1 + \mu_1) - (X_i\beta_0 + \mu_0) > 0 \mid X] \qquad (3b)$$

$$P(U = 1 \mid X) = P[X1(\beta 1 - \beta 0) + (\mu 1 - \mu 0 > 0 \mid X] \qquad (3c)$$

$$P(U = 1 \mid X) = F(\beta 0 + \beta^* X_1 + \mu^*) > 0 \mid X] \qquad (3d)$$

$$P(U = 1 \mid X) = F\left|\beta 0 + \beta^*{}_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n\right| \qquad (3e)$$

P is a probability function, $\mu^* = (\mu_1 - \mu_0)$ is the error term, $\beta^* = \beta_1 - \beta_2$ is a vector of parameters to be estimated and F is the cumulative distribution function of μ^*. From equation (3e), the binary probit model which measures the effects of the explanatory variables (X_i) on the response probability (Y) can be stated as:

$$Y_i = (\beta_0 + \beta_1 X_{1i} + \ldots + \beta_{ni} X_{ni} + \mu_i) \qquad (4)$$

In analyzing the determinants of adopting improved rice varieties and its effects on rice output, the Heckman two-stage model was employed. This is due to the nature of the dependent variable and the suspicion of selection bias in the study in which this model is able to correct. The first stage of this model makes use of the probit model while the second stage is an ordinary least square (OLS) method.

Heckman Sample Selection Model
In a paper entitled "Sample Selection Bias as a Specification Error", Heckman (1979) noted that sample selection bias exists because there may be self-selection by the individuals or data units being investigated or sample selection decisions by analysts. To deal with sample selection bias, he used a two-stage model which is now called Heckman Sample Selection Model.
Adoption of improved seeds is a random decision and farmers self-select themselves. There are inherent or inbuilt efficiencies of farmers that might influence output but not necessarily technology adopted. The collection of the data and its analyses may be biased towards adopters or non-adopters based on researchers' preference. Therefore, Heckman two stage sample selection model which consists of a binary probit model in the first stage and the continuous outcome model in the second stage, is very appropriate for this analysis.

The first stage which is the binary probit model is used in this study for analyzing the socioeconomic factors that influence farmers' decision to adopt improved rice varieties and it is stated as:

$$Adoption(A) = \beta_0 + \sum \beta_1 X_1 + \mu_1 \quad (5)$$

β_1 is the parameter to be estimated from the probit model of the decision to adopt improved rice seeds and it is used to form the inverse Mill's ratio.

For farmers who adopt improved rice varieties, inverse Mill's ratio ($\lambda\gamma 1$) is given as:

$$\lambda_{\gamma 1i} = \frac{\phi \beta_i X_i}{1 - \Phi \beta_i X_i} \quad (6)$$

For non-adopters of improved rice seeds, the inverse mills ratio ($\lambda\gamma 0$) is given as:

$$\lambda_{\gamma 0i} = \frac{\phi \beta_i X_i}{1 - \Phi \beta_i X_i} \quad (7)$$

Where ϕ is the standard normal density function, Φ is the standard normal cumulative distribution function.

The outcome model at this stage is estimated using the Ordinary Least Square (OLS) coupled with the conventional inputs and the socioeconomic variables X, with which the inverse Mill's ratio is added. The outcome model is given as

$$Output = \alpha_i Z_i + \delta_{\mu\varepsilon} \lambda_{\gamma 1} + \varepsilon_i \quad (8)$$

Where $\delta_{\mu\varepsilon}$ is the covariance between the error terms of farmers' decision to adopt or not to adopt improved rice seeds in the selection model (μ) and outcome or output model (ε) with zero correlation between them. Z_i is a vector of explanatory variables added in the Outcome model and α_i depicts the coefficient in the outcome model.

The empirical model for adoption of improved rice varieties is given as:

$$\begin{aligned} Adoption_i &= \beta_0 + \beta_1 Age_i + \beta_2 MSD_i + \beta_3 HHS_i + \beta_4 Edyrs_i + \beta_5 ExtV_i + \beta_6 Cred_i + \\ &\beta_7 FBOAdv_i + \beta_8 FmExp_i + \beta_9 Bus_i + \beta_{10} AEAKm_i + \beta_{11} Irrig_i + \beta_{12} SoilFert_i + \mu_i \end{aligned} \quad (9)$$

The empirical specification of the outcome model

$$\begin{aligned} Adoption_i &= \alpha_0 + \alpha_1 Lab_i + \beta_2 Seed_i + \alpha_3 Fert_i + \alpha_4 Pcid_i + \alpha_5 Cap_i + \alpha_6 Age_i + \alpha_7 HHS_i \\ &\alpha_8 Edyrs_i + \alpha_9 ExtV_i + \alpha_{10} FBO_i + \alpha_{11} FmExp_i + \alpha_{12} AEAKm_i + \alpha_{13} Irrig_i \varepsilon_i \end{aligned} \quad (10)$$

Table 1: Definition, measurement and a priori expectation of explanatory variables

Variable	Definition	Measurement	Expected sign	
			Selection Model	**Outcome Model**
Lab	Labour used	Man/days	NA	+
Fs	Farm size	Acres	NA	+
Seed	Improved seed used	Kilogram (kg)	NA	+
Fert	Fertilizer used	Kilogram (kg)	NA	+
Pcid	Pesticide used	Litre (Ltr)	NA	+
Cap	Capital used	GH₵	NA	+
Age	Age	Years	−	−
FmExp	Farmers' experience	Years	+/−	+
MSD	Marital status	1= Married	+/-	NA
		0= Unmarried		
HHS	Household size	Number	−	−
Edyrs	Years of education	years	+	+
ExtV	Access to extension service	Number	+	+
FBO	Members of FBO	1= Yes, 0= No	NA	+
FBOAdv	Number of advice from FBOs	Number	+	NA
Bus	Farming for business purpose	1= Yes, 0= No	+	+
Food	Farming for food purpose	1= Yes, 0= No	+	+
Cred	Access to Credit	1= Yes, 0= No	+	+
AEAKm	Distance of farmers house to agric. extension officer	Number	−	−
SoilFert	Perception of soil fertility	1= High fertility	+/−	NA
		0= Low fertility		
Irrig	Access to irrigation	1= Yes, 0= No	+	+

NA=Not applicable

Empirical Results and Discussions

Summary Statistics of Discrete Variables

Table 2a shows the summary statistics of discrete variables. Out of 177 farmers interviewed, 63.3% were males whilst 36.7% were females. Approximately 33.9% were married whilst 66.1% were not. Also, the percentage of farmers who had access to credit is 48.6%. In addition to this, 91.0% of the farmers owned their farmlands. Out of 177 farmers, 17.5% cultivate rice for household consumption whilst 82.5% purposively cultivate rice as a business. About 36.2% of the farmers perceived that the soil fertility of their farmlands is high while 63.8% perceived that the soil fertility of their farmlands are low. Out of 177 farmers who were interviewed, 54.2% used improved seed and were considered as adopters, whilst 45.8% did not use improved seeds and hence were considered as non-adopters. From Table, it is clear that 66.1% of the respondents were married. The number of farmers who have access to irrigation facility is 117 representing 66.1% of the total respondents.

Table 2a: Summary Statistics of Discrete Variables

Variable	Frequency	Percentage (%)
Sex of Farmers (SexD)		
Male	112	63.3
Female	65	36.7
Marital Status (MSD)		
Unmarried	60	33.9
Married	117	66.1
Access to Credit (Cred)		
No	91	51.4
YES	86	48.6
Land Ownership Status		
Owned	161	91.0
Leased	16	9.0
Purpose of Farming (Food)		
No	72	40.7
Yes	105	59.3
Purpose of Farming (Business)		
No	31	17.5
Yes	146	82.5
Perception about Soil Fertility (Soil_Fert)		

Low	113	63.8
High	64	36.2
Adoption		
Adopters of improved rice seeds	96	54.2
Non-adopters of improved rice seeds	81	45.8
Access to Irrigation		
No	60	33.9
Yes	117	66.1

Source: Field survey (2016)

Summary Statistics of Continuous Variables

Table 2b illustrates the summary statistics of continuous variables. The mean age and farming experiences are 46.9years and 15.8years respectively. This implies that Ghana farming population are aging, as against Pasanen (2016) observation that 27% of Ghana's population are youth who fall within the age bracket of 15-24 years. The average distance from farmers' farms to extension officer, household size and number of times (that is, the frequency of extension officer's visit) extension officers' visit farmers are 2.9 kilometers, 5.8 members and 3.4 times respectively. The household size is slightly above the national average household size of 4, and 4.3 for Volta Region specifically (GSS, 2014b). The average number of years of education attained by respondents is 9, suggesting educational attainment to the Junior High School or Middle School Level. Averagely, adopters obtained rice yield of 3.37Mt/ha as compared to their counterpart non-adopters who were able to realize just 1.65Mt/ha. This suggests that the adoption of improved rice varieties can help farmers to increase yield and improve productivity in the study area.
Table 2b also evinces the percentage frequency distribution of conventional inputs namely labour, farm size, pesticides, fertilizer, capital and seeds. From the table, the average quantity of labour employed is 46.87 Mandays per 2.63acres of land. For 2.63 acres of land cultivated, farmers averagely planted 66.82Kg of seeds and spent Gh¢1, 353.05. For every 2.63acres of rice cultivated, farmers used 367.8Kg (3.67bags) of fertilizer and 3.17litres of pesticides. This implies that fertilizer application rate as indicated by Druilhe and Barreiro-Hurlé (2012) is still low in rice production.

Table 2b: Summary Statistics of Continuous Variables

Variables	Minimum	Maximum	Mean	Standard Deviation
Age (years)	23	67	46.58	8.95
Farming experience (years)	3	34	15.77	8.13
Distance of farmers house to agric. extension officer (Km)	0.5	27.5	2.95	6.32
Household size	1	13	5.80	2.642
Years of Education	0	19	9.24	4.74
Extension Visits	0	9	3.36	2.222

Yield of Adopters (Mt/Ha)	0.69	9.89	3.37	1.85
Yield of Non-adopters (Mt/Ha)	0.23	7.31	1.65	1.20
Labour (Mandays)	10	124	46.87	21.66
Seed (Kg)	20	160	66.82	29.59
Fertilizer (Kg)	0	2650	367.80	350.67
Capital (Gh¢)	14.26	5726.36	1353.05	936.15
Pesticides (Litres)	0	11.20	3.17	2.14
Farm size (acres)	0.50	7.41	2.63	1.32

Source: Field survey (2016)

Socioeconomic Factors Influencing Adoption of Improved Rice Varieties

The results from the probit equation estimated from the Heckman Sample Selection Model are shown in table 3a. The use of Heckman model was justified, as Rho (0.71) is significantly different from zero. This is supported by the chi-square value of 944.18 which is statistically significant at 1%. The high significance of Chi-square statistic suggests that the models are adequate in explaining the determinants of the adoption of improved rice varieties as well as rice output. From the table, lambda is significant at 5%. Also, it has a positive sign implying that farmers who adopted improved rice varieties had relatively higher output compared to their counterparts, non-adopters.

Age, years of education, number of extension officers' visits, credit access, farming experience, business purpose of farming and access to irrigation facility are all statistically significant. While age, years of education, credit access, farming experience and business purpose of farming are statistically significant at 5% each, and the number of extension visits is statistically significant at 1%. Also, access to irrigation facility is significant at 10%. The coefficients provide the direction (either positive or negative) to which the explanatory variable is related to the dependent variable in the selection equation. As a probit model, the coefficients which is the same as the marginal effects after estimation measures the probability (Donkor *et al.,* 2016).

Age does not meet the a priori expectation. The negative sign for farming experience suggests that younger farmers are more likely to adopt improved rice varieties than older ones. Younger farmers are adventurous and risk lovers and are prepared to try something new. When the farming experience increases by one year, the probability of adopting improved rice variety will decrease by 0.10. When the years of education increases by one year, the probability that a farmer will adopt improved rice variety will increase by 0.08 (8%). Education, as noted by Onyeneke (2017), has positive effects on farmers' likelihood of adopting improved rice varieties. Education capacitates a farmer in adopting innovations.

From Table 3a, the positive sign for extension visits meet the a priori expectation, implying that when a farmer receives one additional extension visits, his or her probability of adopting improved rice variety will increase by 0.29 (29%). This is rational, as the mandate of agricultural extension officers are to provide technical advice and training to farmers on how to use and the importance of using improved seeds. This confirms the findings of Kudi et al. (2010). Extension service delivery is an important source of information on improved agricultural production technologies, and hence farmers having significant extension contacts are much aware of the technologies for adoption (Onyeneke, 2017).

Table 3: Determinants of Adoption of Improved Rice Varieties

Variables	Coeff	Std. Err	P-Value
Age	0.0744**	0.0323	0.0210
MSD	-0.2057	0.2928	0.4820
HHS	-0.0804	0.0611	0.1880
Edyrs	0.088**	0.0370	0.0130

ExtV	0.2934***	0.0946	0.0020
Cred	0.7142**	0.3191	0.0250
FBOAdv	-0.0174	0.1058	0.8700
FmExp	-0.0980**	0.0400	0.0140
Bus	0.6510**	0.2823	0.0160
AEAKm	0.0328	0.0251	0.1910
Irrig	0.6985*	0.3614	0.0530
SoilFert	-0.1359	0.2632	0.6060
_cons	-2.6417	1.0915	0.0160
Mills			
lambda	555.3579**	227.0604	0.0151
Rho	0.7080		
Sigma	784.4154		
Number of observation	177		
Wald chi2(19)	944.18		
Prob>chi2	0.000		

Note: *, **, and *** implies significance at 1% and 5% and 10% respectively.

Source: Field Survey (2016)

Credit access, business purpose of farming and access to irrigation meet the a priori expectations. Farmers who have access to credit, farmers who cultivate rice mainly to sell and farmers who have access to irrigation facility respectively have a probability of 0.71, 0.65 and 0.70 more than their counterparts with contrasting cases. Improved rice varieties are much expensive than the local or conventional ones, and hence farmers who have access to credit are able to afford and buy them. According to Chekene and Chancellor (2015), farmers who have access to credits are fast adopters of improved rice variety technology. Also, there are complementary inputs or agronomic practices that accompany improved rice varieties and hence farmers having access to credit are able to acquire or employ or use these inputs. This is in line with the findings of Kudi et al. (2010). It is not surprising to observe that farmers who cultivate rice as a business venture happen to have higher probability of adopting improved rice varieties. Farmers who cultivate rice for sale know the importance of using improved rice varieties. They are aware that improved rice varieties command market premium and hence are prepared to plant them rather than the local ones.

Effects of Adoption of Improved Rice Varieties on Output

The main objective of this study was to look at the factors that influence farmers' decision to adopt improved varieties of rice seeds as well as analyze the effects of adoption on rice output. From Table 3b, the adoption of improved varieties proved to have a significant influence on rice output. The coefficient value of 555.36 is statistically significant at 5%. Since it is positive, it is in favour of the adopters (adopters were coded 1 and non-adopters were coded 0), implying a farmer who adopts improved rice varieties has 555.36Kg (5.55bags) of rice more than his counterpart who uses unimproved varieties. This confirmed the *a priori* expectation. It is in line with the findings of Bruce *et al.* (2014), Kudi *et al.* (2010), Awotide et al. (2012) and Wiredu *et al*. (2010).

The conventional inputs which were included in the output model and significantly influence rice output are fertilizer, capital invested in farming, seeds and farm size. Whilst fertilizer and capital are statistically significant at 1% each, farm size and seeds, are statistically significant at 5% each. All these four significant factors of the conventional inputs meet the a priori expectation. A unit increase in fertilizer, capital invested in farming, seeds and farm size results in 2.25Kg, 1.35Kg, 6.06Kg and 200.96Kg increase in rice output respectively. The positive direction of the effects of fertilizer and farm size on rice output confirmed the work of Asravor *et al.* (2015). Also, research by Donkor and Owusu (2014) revealed that rice output increases with increasing seed and their finding is confirmed by this paper. On the other hand, Akongo *et al.* (2016) observed an inverse relationship between seed and output noting that "the higher seeding rate is not adding to output". Years of education, number of extension visits, farming experience and access to irrigation significantly determine level of rice output. The level of significance for farming experience and access to irrigation is 5% each, whereas that of number of extension visits and years of education are 1% and 10% respectively. The direction of effects of all these factors meets the a priori expectations. From table 3b, if the number of years of education increases by 1, rice output will increase by 30.89Kg. Education plays a key role in technology adoption and hence results in an increase in output.

Extension officers' visit to the farm had a positive influence on output. The more the number of times an extension officer visits a farmer's farm, the higher the output the farmer obtains. Farming experience has negative effects on rice output. This implies that relatively younger farmers have lower output.

Table 3b. Effects of Adoption of Improved Rice Varieties on Output

Explanatory Variables	Coef.	Std. Err.	P>z
Lab	-3.2767	9.6579	0.7340
FS	200.9634**	91.2456	0.0160
Seed	6.0631**	2.5135	0.0450
Fert	2.2465***	0.3505	0.0000
Pcid	49.0836	48.4303	0.3110
Cap	1.3451***	0.2882	0.0000
Age	15.4189	23.7308	0.5160
HHS	-31.4769	48.2217	0.5140
Edyrs	30.8927*	15.9463	0.0710
ExtV	330.8199***	78.2321	0.0000
FBO	-257.3618	233.1154	0.2700
FmExp	-41.7372**	17.8865	0.0340
AEAKm	5.9102	17.6504	0.7380
Irrig	653.1377**	309.3912	0.0350
Lambda=Adoption	555.3579**	227.0604	0.0151
_cons	-1236.41	1206.41	0.3050

Note: *, **, and *** implies significance at 1% and 5% and 10% respectively.

Source: Field Survey (2016)

Conclusions and Recommendations

The underpinning difference between adopters and non-adopters of improved rice seeds is that, adopters are farmers with formal education who have access to extension officers' visit, with little or no experience with large farm size and are farming purposely for business. In conclusion, 54% of the total respondents have access to improved seed and hence were adopters. Additionally, output of farmers increased for farmers who used more of improved seeds, fertilizers and capital for farming. For farmers to obtain higher rice output, they need to adopt improved seed technology. Improved varieties are high yielding, resistant to diseases and draught.

Farmers should be encouraged to use improved rice seed, more fertilizers and increase their capital investment in farming. Institutions that are in charge of dissemination of improved rice seeds should target young farmers that have access to extension officers' visit and is cultivating rice purposely for business.

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