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FACTORS INFLUENCING PARTICIPATION IN RICE DEVELOPMENT PROJECTS: THE CASE OF SMALLHOLDER RICE FARMERS IN NORTHERN GHANA

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Abstract: *Participation in rice development project is an important platform for joint learning and technology transfer. The present study quantifies the factors influencing participation in rice development projects among smallholder rice farmers in Northern Ghana. A total of 400 rice farmers selected through multi-stage sampling technique were interviewed. The result shows a significant variation in the demographic and institutional characteristics among the farmers by participation in rice development projects. Participation in rice development projects in Northern Ghana is influenced by age of the household head, marital status, access to off-farm income, market price of rice, knowledge of rice varieties and access to credit and the interactive term education and farm size. The packaging of agricultural technologies by research institutions and agricultural development organizations should focus on making them more receptive to farmers through effective training and demonstrations in order to boost participation, adoption, production and farmers' income.*

Key words: Participation, Rice Development Project, Northern Ghana, Smallholder, Probit

INTRODUCTION

Rice is increasingly becoming a strategic crop in most African countries as it contributes a major part of the diet of many in Africa. Population increase and urbanization has contributed largely to the consumption of rice in Africa. In sub-Saharan Africa, West Africa is the leading producer and consumer of rice and widely produced in Cote d'Ivoire, the Gambia, Guinea, Guinea Bissau, Liberia, Burkina Faso, Senegal and Sierra Leone (WARDA, 1996; NISER, 2002). Presently, per capita consumption of rice in Ghana is estimated at 25 kg per person per annum. Rapid growth in consumption has further worsened the rice self-sufficiency status of country. Despite the observed growth in rice production, the current level of production is still unable to meet domestic demand which is increasingly being met by surging rice imports (MoFA/SRID, 2011). Enhancing domestic supply of rice has become an urgent policy issue in Ghana and sub-Sahara African economies.

Rice is an important crop to the economy of Ghana. Presently, the crop occupies 11 percent of total area under cereals representing about 5 percent of the total arable land area. In 2010, a total volume of 491,603 MT of rice was produced in the country (SRID/MoFA, 2011). The crop is ranked as the second most important staple crop as it compete strongly with the traditional coarse

grains and roots and tubers crops in the food production and consumption baskets of the country (SRID/MoFA, 2011a). The rice industry also has an important implication on the livelihood outcomes of the millions of actors within the industry.

Low soil fertility, lack of credit access and use of inadequate improve technologies have contributed to the low productivity of rice in Northern Ghana which controls about 70% of the total area under rice production (SRID/MoFA, 2011a). The low productivity has an implication on food security in the region. Northern Ghana has witnessed myriads of rice development projects over the years to address the major challenges faced by these farmers. Notable amongst the interventions include the Rice Sector Support Project (RSSP) where the Savanna Agricultural Research Institute (SARI) was tasked with varietal selection, Seed production, poly-aptitude rice, cover-crop and improved cropping systems. The other interventions include the Ghana compact of the Millennium Challenge Account (MCA) basically sought to increase the production and productivity of high-value crops and staple food crops, and enhance the competitiveness of the farmers in local, regional, and international markets (MiDA, 2008); Lowland Rice Development Program (LRDP), Inland Valley Rice Project (IVRDP), the USAID Emergency Rice Initiative, Gbewa Rice Project (GRP), Northern Rural Growth Program (NRGP) and the Multinational Nerica Rice Dissemination Project (MNRDP). The primary focus of these interventions was to assist smallholder rice farmers with technologies coupled with management practices that will boost production as well as improve on their livelihoods and welfare status.

Despite the many interventions of rice development projects in Northern Ghana, many of the farmers are still producing at the sub optimal level due to the differences in the level of engagement and technology uptake (Wiredu et al., 2010). Low participation in any agricultural development projects could be due to inability of the project to meet the production needs of farmers. A farmer may not participate in rice development project if the marginal utility derive from participation is lower than the cost incurred. Some districts have benefited from many interventions relative to other districts. Participation is a necessary condition for adoption of technology but not a sufficient condition. However, the present study examines the socio-economic and institutional factors that influence participation of smallholder farmers in rice development projects in Northern Ghana using the probit model. The findings of the study will inform policy in addressing these factors as entry points in promoting farmers' participation in rice development project. The study will also add to the limited empirical studies on factors influencing farmers' participation in agricultural development projects especially in Northern Ghana.

METHODOLOGY

Analytical Method

Study Area

Northern Ghana consists of Northern Region, Upper East Region and Upper West Region. The three regions share borders with Republic of Togo to the east, Ivory Coast to the west and Burkina Faso to the north. Within the country, the northern Ghana is bordered by Volta region to south east and Brong-Ahafo region to the south east (Figure 1). Geographically, the three regions are between longitude $8^{o}46'01.88"$ N and $10^{o}58'34"$ N and latitude $2^{o}45'45.40''$ W and $0^{o}32'59.95''$ E and covers a total land area of 97,666 km² with an estimated population of 3,317,478. The vegetation is a typical guinea savannah type, characterized by drought resistant grasses and trees. Northern Ghana plays an important role in agriculture and is normally referred to as the grain basket of the country. More than 80 percent of the inhabitants of northern Ghana

are full time farmers (MoFA/SRID, 2011). Most of the smallholder rice farmers in these regions have benefited from a lot of development projects aimed at increasing productivity and improving livelihoods.

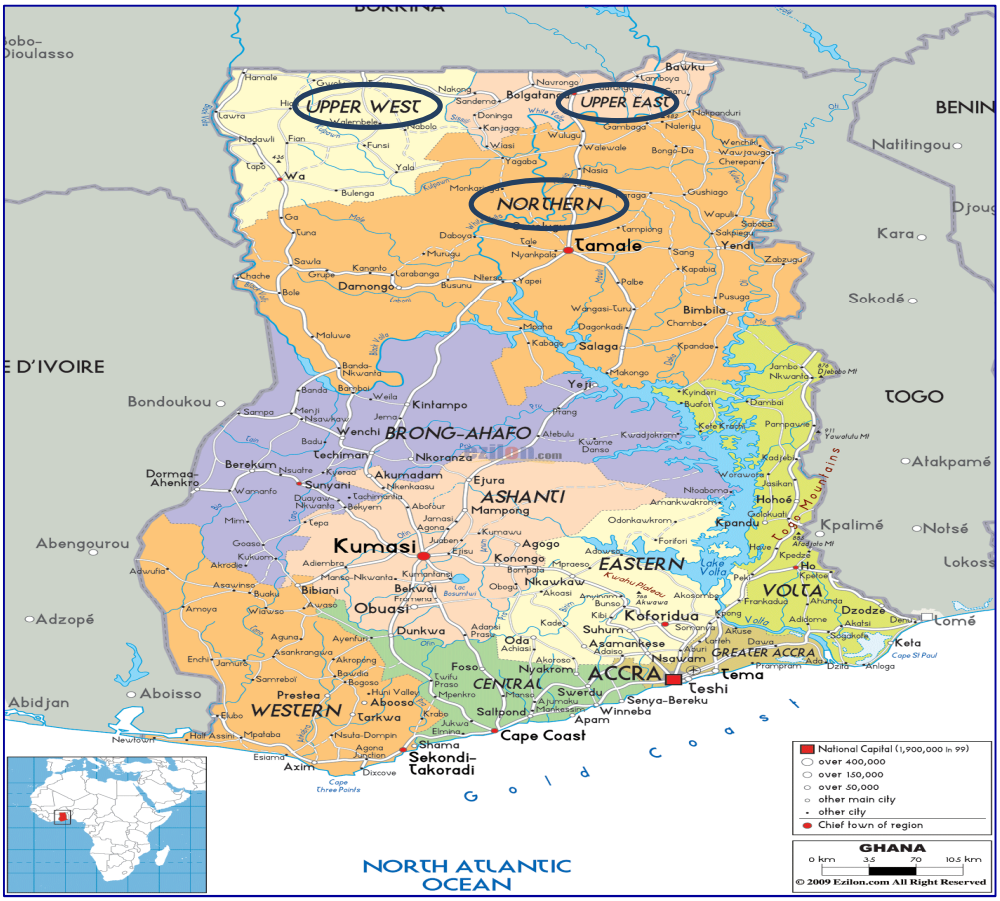

Figure 1: Administrative Map of Ghana

Sampling Technique and Data Collection

The study was conducted between March and April, 2012. The basic information for the analysis was obtained from primary data collected with the aid of a structured questionnaire. A total of 400 smallholder rice producers were systematically and randomly selected and interviewed (Table 1). The selection of the rice producers followed a multi-stage systematic random sampling technique. In the first stage, 10 districts were purposively selected in the three regions. Secondly, four (4) communities each were randomly selected from a list of rice producing communities in each of the selected districts. Within the selected communities, 10 rice producers were further selected randomly from a list of rice producers. In addition to the survey, key informants interviews and focus group discussion were conducted to augment the household survey.

Table 1: Sampling Frame

Region	Districts	Communities (4 per district)	Household (10 per community)
Northern	6	24	240
Upper East	2	8	80
Upper West	2	8	80
Total	10	40	400

Estimation of Participation in Rice Development Project

The individual's participation in Rice Development Projects (RDP) is dichotomous, involving two mutually exclusive alternatives. The individual either participates or does not. The framework for such analysis has its root in the threshold theory of decision making in which a reaction occurs only after the strength of a stimulus increases beyond the individual's reaction threshold (Hill and Kau, 1981). This implies that every individual when faced with a choice has a reaction threshold influenced by several factors.

The present study adopts the probit regression model to quantify the factors that determine the participation of smallholder rice farmers in rice development projects. The fact that the dependent variable is a dichotomous one justifies the use of a binary model (i.e. probit model). The study adopted the probit model partly because of its ability to constrain the utility value of the decision to join variable to lie within 0 and 1, and its ability to resolve the problem of heteroscedasticity (Asante et al., 2011). Accordingly, the dependent variable, participation in rice development project (Y) assumes only two values: 1 if the farmer participates in RDP and 0 if a farmer does not participate. Accordingly,

$$Y = 1 \; if \; a \; farmer \; participates \; in \; RDP$$

$$Y = 0 \; if \; Otherwise$$

According to Akinola and Owombo (2012), given the assumption of normality, the probability that y_i^* is less than or equal to y_i can be computed from the normal cumulative normal distribution as follows:

$$P_i = P\left(Y = \frac{1}{X}\right) \quad (1)$$

$$P_i = P(y_i^* < y_i) \quad (2)$$

$$P_i = P\left(Z_i < \beta_0 + \beta_j X_{ij}\right) = F(Y_i) \quad (3)$$

$$P\left(Y = \frac{1}{X}\right) = F(XB) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{XB} e^{\frac{-(XB)^2}{2}} dx \quad (4)$$

$$X = (1, x_{1i}, x_{2i}, \dots\dots, x_{ki}) \quad (5)$$

$$\beta' = (\beta_0, \beta_1, \dots\dots\dots\dots, \beta_k) \quad (6)$$

Where y_i^* is the critical or threshold level of the index, such that if y_i exceeds y_i^*, the farmer participates in RDP, otherwise the farmer does not. $P\left(Y = \frac{1}{X}\right)$ is taken as the probability that the farmer participates in RDP given the values of explanatory variables X, and where Z_i is a random variable normally distributed with mean zero and unit variance, $Z_i \sim N(0, \sigma^2)$. The relative effect of each explanatory variable on the likelihood that a farmer will participate in RDP is specified as follows:

$$\frac{\partial P_i}{\partial X_{ij}} = \beta_{ij} * f(Z_i) \quad (7)$$

Where $f(Z_i)$ is the inverse of the cumulative normal function and β_{ij} are the estimated parameters.

Description of Explanatory Variables

Gender of household head is expected to capture the difference in farmers' willingness to participate in RDP between males and females with males expected to have a higher willingness to participate than females. Females are normally occupied with domestic activities such that they do not have enough time to participate. Age is expected to influence participation negatively. Younger household heads are more dynamic with regards to adoption of innovations than older household head (Enete and Igbokwe, 2009). It is expected that household head that are married will have a higher probability of participation. Married household heads are normally assisted by their spouses in production, processing and marketing decision making.

Experience farmers are less likely to participate in rice development project. Most of these farmers depend on their farming experience acquired over their productive years. Education is posited to have a positive effect on participation since it enables an individual to make independent choices and to act on the basis of the decision, as well as increase the tendency to co-operate with other people and participate in group activities (Enete and Igbokwe, 2009; Southworth and Johnston, 1967; Schultz 1945 and Ofori, 1973). It is also possible that education could increase the chances of the household head earning non-farm income. This could reduce the household dependency on agriculture and thus participation.

Household size is expected to positively influence farmers' participation. Household size serves as a form of family labour and complements the effort of the household heads on the farm. The availability of family labour provides the household head the opportunity to share responsibility and save time for other development activities. Also, larger households spend more on food and other household needs. The higher expenditure associated with larger households sizes tend to make them more resource constrained and hence the need for external support. Most researchers have found a positive relationship between farm size and participation or adoption (Adimado, 2001; Kheralla et al., 2001; Langyintuo and Mekuria, 2005). Household head with more land will require improve seed varieties that are more yielding. Most of these pieces of information are shared through development projects. Other studies such as Mussei et al. (2001), and Gockowski and Ndoumbe (2004) found a negative relationship between farm size and participation and adoption. The labour demand for working on a large area of farm makes farmers unwilling to participate in development activities.

Off-farm income is expected to be positively and negatively associated with participation. Household head that earns off-farm income may have little time to participate in any rice development activities due to the competing needs. Alternatively, household heads that earn off-farm income may invest in adoption of improved varieties to increase their production. Household head membership of an association/group increases access to information which is important to production and marketing decisions (Olwande, 2010). Most farmer groups engage in group marketing, bulk purchasing of inputs and credit provision for its members. It is therefore expected that household head membership of association/group will positively affect participation.

Availability of credit and the associated cost of credit according to Sindi (2008) are crucial in the success of the agricultural industry. Access to credit serves as an incentive for farmers to increase their production and overcome the financial constraints in participating in development projects which also has a direct impact on their livelihoods. Market price of rice is posited to influence participation in RDP positively. Higher price serves as an incentive for farmers to increase their production and also seek innovative methods of meeting the demands of buyers. Rice development project provides farmers the opportunity to learn new and innovative farming methods. Farmers with knowledge of rice varieties that can be cultivated in any ecology have a higher probability of participation in rice development projects. Knowledgeable farmers are normally engaged in development projects to serve as linkage between farmers and agricultural development organizations. Finally, perception of soil fertility is likely to influence the probability of participation negatively. Household heads with perception of low soil fertility will participate more in any RDP that provides solution to their problems.

Empirical Model

The dependent variable used in this study is farmers' participation in rice development projects in northern Ghana. It is binary indicating whether or not a farmer has participated in any rice development projects. The set of explanatory variables hypothesized to influence farmers' decision to participate in rice development programmes includes age, gender (Gend), education (Edu), marital status (Mar), farming experience (Fmexp), farm size (FmSz), nativity (Nat), off-farm income status (Ofinc), household size (HHsiz), membership of association (Asoc.), access to credit (Cred), land tenure status (Lansta), perception of soil fertility (Pfert), market price of rice/kg (Pmkt) and knowledge of rice varieties cultivated in any ecology (KnVa). Specifically, the empirical model for determining the factors influencing participation in RDP is explicitly specified as follows:

$$Y = \beta_0 + \beta_1 Age + \beta_2 Gend + \beta_3 Edu + \beta_4 Mar + \beta_5 HHsiz + \beta_6 Nat + \beta_7 Fmexp + \beta_8 FmSz + \beta_9 Asoc + \beta_{10} Cred + \beta_{11} Ofinc + \beta_{12} Lansta + \beta_{13} Pmkt + \beta_{14} Pfert + \beta_{15} KnVa + \mu_i \quad (8)$$

Where, β_0 is the constant term$\beta_1, \beta_2, \beta_3, \ldots\ldots, \beta_{15}$ are the parameters of the respective explanatory variables in the model, and μ_i is the error term. The estimates for these parameters were obtained using the STATA SE software version 11. Appendix 1 shows the host of explanatory variables that are potentially expected to explain variation in participation in RDP and their *a priori* expectations.

RESULTS AND DISCUSSION

Characteristics of the Sampled Rice Farmers by Participation

The results in Table 2 show the characteristics of the rice producing households by participation status. Significant differences existed in age, marital status, household size, off-farm income status, credit status and land ownership status across the participation categories. Majority (70%) of the sampled rice producers had not participated in any rice development project since 2000. The mean age of the sampled rice producers was 44 years. The sampled rice producers that participate in rice development projects were about 6 years younger than non-participants. Younger households are more dynamic in terms of innovation adoption hence their desire to participate in rice development projects. Rice producers in northern Ghana are male dominated. About 94% of the sampled household heads were males. The gender distribution is similar across the participant and non-participant household heads. The results show that majority (96%) of the sampled rice producers were married. However, married non-participants household heads were 6% more than that of participant married household heads.

Educated farmers constituted about 22% of the sampled farmers. Rice producers that participate in RDP are more educated than the non-participant households. Education is expected to influence participation in RDP both negatively and positively. It may influence the producer's ability to participate in group activities as well as other non-farm income generating activities.

The average rice producing household in northern Ghana consisted of about 13 members. However, this was relatively higher among the participant households than non-participant household. Rice production is labour intensive. Household size serves as a form of family labour which is essential in the rice production systems. On the average, rice producing household head had 9 years of farming experience. There is no significant difference in the years of experience of participant and non-participants household heads. Farming experience is likely to affect the decision to participate in any rice development projects.

Access to off-farm income was relatively high among the participants household. Overall, 57% of the sampled rice producers were involved in off-farm income generating activities such as trading, artisanship, driving and civil servants. The result also indicates that 63% of the overall household heads had access to credit. Access to credit was relatively high among non-participant household heads.

Finally, on the whole, land ownership among rice producing households accounted for about 96%. The ownership of land is very crucial to participation and sustainability of technology adoption.

Table 2: Characteristics of Rice Producers by Participation

Characteristics	Participants	Non-participants	Overall	Prob.
Sample Distribution (Number, %)	119 (30)	281 (70)	400 (100)	-
Age (years)	40	46	44	0.00
Male (%)	95	94	94	0.60
Female (%)	5	6	6	0.60

Married (%)	91	98	96	0.00
Education (%)	24	21	22	0.46
Household Size (Number)	15	13	13	0.05
Farming experience (years)	12	13	9	0.73
Farm Size	9	9	9	0.47
Access to off-farm income (%)	66	53	57	0.03
Access to credit (%)	55	67	63	0.00
Land ownership (%)	98	100	96	0.26

Source: Estimation from Author's Household Survey Data (2012)

3.2 Participation in Rice Development Project

The probit model was used to estimate the parameters of the determinants of participation in RDP by smallholder rice farmers in Northern Ghana. The Pseudo R-squared value indicates that 13 percent of the variation in the participation in RDP by smallholder rice farmers is explained by the independent variables. The relatively small value may be due to measurement errors in the explanatory variables. The significant Wald chi-square value of 60.00 indicates that the explanatory variables jointly influence the farmers' participation in RDP (Table 3). Participation in RDP is significantly determined by age of the household head, education, marital status, access to off-farm income, market price of rice, knowledge of rice varieties, access to credit and the interactive term education*farm size. Numerically and statistically, market price is the most influential determinant of farmers' participation in any rice development projects.

The result indicates that age was negatively related with the probability of participation in RDP. A unit increase in the age of the household head leads to a decrease in the probability of participation by 0.01. The respective studies of Adesina and Forson (1995), Asante et al. (2011) and Gbetibouo (2009), established a positive relationship between age and adoption of improved agricultural technologies. According to them, older farmers are more experienced which allows them to assess the attributes of an improved technology relative to younger household head. However, the present study holds a contrary view. Younger household heads are more innovative in terms of technology adoption and are more likely to take risk than older household heads. The myriads of social networks available to older household heads that enhances their productive and commercial decisions are likely to reduce their probability of participation in RDP. The result is consistent with Ayamga (2006) who found that as age increases, the probability of a farmer to participate in microcredit programmes in Northern Ghana, decreases.

Education was negatively associated with the probability of participation in RDP. For household heads that are educated, the probability of participation in RDP was lower than uneducated household heads by 0.28. The result is contrary to the findings by Tambo and Abdoulaye, 2011; Enete and Igbokwe, 2009; Udoh et al, 2008; He-XueFeng et al 2007; Nzomoi et al. 2007; Damianos and Giannakopoulos 2002; Gamba et al. 2002; Igoden *et al.* 1990; Norris and Batie, 1987; Southworth and Johnston, 1967; Schultz 1945 and Ofori, 1973. According to them, education enhances access to information processing for technology uptake and higher farm productivity. The negative effect of education on probability of participation suggests the strong competing effect of diverting skills of household head to other off-farm employment opportunities (Martey et al., 2012). This could reduce household head dependency on agricultural development projects. The result is supported empirically by the fact that most of the study areas are accessible to major urban centres where employment is prevalent.

Table 3: Probit Estimates of Determinants of RDP in Northern Ghana

Explanatory Variables	Estimated Result of Probit Model		
	Coefficient	Robust Std Error	Marginal Effect
Age	-0.0284	0.0070	-0.0094***
Sex	-0.0812	0.3043	-0.0275
Education status	-1.0699	0.5282	-0.2808**
Marital status of household	-0.8069	0.4051	-0.3053**
Nativity	0.1650	0.2225	0.5252
Household size	0.0102	0.0086	0.0034
Years of farming experience	0.0096	0.0074	0.0032
Membership of association	-0.1296	0.1559	-0.0430
Farm Size	-0.0023	0.0090	-0.0008
Land tenure status	0.0883	0.2449	0.0293
Off-farm income	0.3705	0.1505	0.1206**
Market price	1.4563	0.4452	0.4830***
Access to credit	0.6229	0.1603	0.2210***
Knowledge of rice varieties & ecologies	0.3423	0.1534	0.1157**
Perception of soil fertility	-0.2161	0.1559	-0.0731
Education status*Farm size	0.0314	0.0155	0.0104**
Education*Age	0.0163	0.0113	0.0054
Constant	0.2913	0.7013	-
Number of Observations	400		
Wald Chi-square (15)	66.26		
Prob > Chi 2	0.0000		
Log Pseudo likelihood	-210.41733		
Pseudo R-squared	0.1358		

Source: Regression Estimation from Author's Household Survey Data (2012) ***p<0.001**p < 0.05 and *p < 0.10

Marital status was negatively associated with lower probability of participation. Married household heads were less likely to participate in RDP. The probability of participating in RDP amongst married household heads was 0.31 lower than single household heads. The result is contrary to expectation. Married household heads normally have lots of responsibilities which includes ensuring the well-being of the household members. These responsibilities may influence the household head to participate in development projects that will impacts positively in their income levels. Alternatively, unmarried household head according to the result have a higher probability of participation in RDP. The benefits associated with such projects as well as availability of time may be the germane motivation for this category of farmers in participating in such development projects.

The probability of participation was positively influenced by off-farm income. Household heads that earn additional income from off-farm activities are more likely to participate in RDP relative to those who do not earn off-farm income. The probability of participation by a household head that earn off-farm income was 0.11 higher than non-earners of off-farm income. The result is consistent with the findings of Tambo and Abdoulaye, (2011). Household heads that earn off-farm income are able to meet the financial demands associated with participation and adoption of

improved technologies. Sustainability of participation and adoption is highly dependent on farmers' income level (both on and off-farm).

Market price was associated with a positive effect on participation in RDP. A unit increase in the market price of rice results in an increase in the probability of participation by 0.46. According to economic theory, output price is an incentive for farm households to supply more produce for sale which subsequently result in higher income. Studies by Olwande et al. (2010), Enete and Igbokwe (2009) and Omiti et al. (2009) support this theory. A major challenge of the farmer is to produce to meet the demands of the market. Recent agricultural development projects encourage farmers to perceive farming as a business and not a way of life. Higher market price guarantees the income of the household head. In order to take advantage of the market price, household heads may increase their technology uptake through participation in any RDP thereby increasing the volumes of rice production.

Access to credit is associated with a positive effect on participation in RDP. The probability of participation in RDP by a household head with access to credit was higher than those without access to credit by 0.22. The result is consistent with the findings by Asante et al., (2011); Nzomoi et al., (2007) and Mussei et al., (2001). Access to credit enables farmers to overcome their financial constraints associated with production and adoption of innovations. It also encourages group formation and learning.

Household heads with knowledge of rice varieties and ecologies were more likely to participate in RDP. The probability of participation by a household head with knowledge of rice varieties and ecologies was higher than those without knowledge of rice varieties and ecologies by 0.12. A knowledgeable farmer either by experience or education serves as a nodal point for technology transfer especially in on-farm demonstration trials. Most of these farmers are engaged by agricultural development and research organizations (like research institutions, Ministry of Food and Agriculture and Non-Governmental Organizations) to lead on-farm demonstrations. This approach makes technology and information dissemination more receptive to wide range of farmers.

Finally, the interactive term, educational status and farm size was positively associated with probability of participation in RDP. The marginal effect indicates that, the probability of participation in RDP by educated household heads with farm lands was 0.01 higher than non-educated household heads with access to farm lands. Educated household heads that have large farm size appreciate new technologies for increase in agricultural production. The implication of the result is that education alone is not a sufficient condition for household head participation in RDP.

CONCLUSION

Participation in rice development project is very crucial in addressing most of the production challenges faced by farmers in Northern Ghana. Age of the household head, marital status, access to off-farm income, market price of rice, knowledge of rice varieties access to credit and the interactive term, education and farm size significantly explains smallholder farmers' participation in rice development projects in Northern Ghana. Younger and single household heads with access to off-farm income and well informed on the rice ecology are more likely to participate in rice development projects in Northern Ghana. Higher market price is an incentive for farmers to seek improved technologies that ensures higher production to meet market demand. The present study contributes to the scanty literature and also provides the foundation

for quantitative analysis of factors influencing rice development project in Northern Ghana. It is recommended that government policy should aim at assisting farmers with credit to ensure group formation and joint learning for the sustainability of any development related rice project. Secondly, the Youth in Agriculture programmes (YIAP) must be strengthened and provided with both technical and financial support to ensure maximum participation in agricultural development projects and also serve as ambassadors for technology transfer. Finally, knowledgeable farmers must be identified and used in demonstrations trials of any rice improved technology as well as training programmes to ensure wider receptiveness amongst the farmers in general.

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REFERENCES

Adimado S (2001). Willingness to Pay for Research Findings: A Case Study of Pineapple Farmers in Ghana. Unpublished MPhil Thesis Submitted, Department of Agricultural Economics and Agribusiness, University of Ghana, Legon, Accra Ghana, pp. 38-50.

Asante, B.O, Afari-Sefa, V. Sarpong, D.B (2011). Determinants of Small-Scale Farmers' Decision to Join Farmer Based Organizations in Ghana. Afr. J. Agric. Res., 6(10): 2273-2279.

Ayamga M (2006). Factors influencing the Decision to Participate in Microcredit Programmes: An illustration for Northern Ghana. Ghana J. Dev. Stud., 3(2): 57-65.

Adesina, A.A. and Baidu-Forson, J. (1995). Farmers' Perceptions and Adoption of New Agricultural Technology Evidence from Analysis in Burkina Faso and Guinea, West Africa. Agricultural Economics 13:1-9.

Akinola A. & Owombo, P. (2012). Economic Analysis of Adoption of Mulching Technology in Yam Production in Osun State, Nigeria. Journal of Agriculture and Forestry, 2(1): 1-6.

Damianos D, Giannakopoulos (2002). Farmers' Participation in Agri-Environmental Schemes in Greece. Br. Food J., 104(31415): 261-273.

Enete A. A. and Igbokwe E.M. (2009). Cassava Market Participation Decision of Household in Africa. *Tropicultura*, 27, 3, 129-136

Gamba P, Ngugi C, Verkuijl H, Mwangi W, Kiriswa F (2002). Wheat Farmers' Seed Management and Varietal Adoption in Kenya. Mexico, D.F.: CIMMYT, Egerton University, Njoro, Kenya, and KARI, Nairobi, p. 22.

Gbetibouo, G. A. (2009). Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability: The Case of the Limpopo Basin, South Africa. IFPRI Discussion Paper 00849 February 2009.

Gockowski J, Ndoumbe M (2004). The Adoption of Intensive Monocrop Horticulture in Southern Cameroon. J. Agric. Econ., 30: 195-202.

He-Xue F, Cao-Hu H, Li-Feng M (2007). Econometric analysis of the determinants of adoption of rainwater harvesting and supplementary irrigation technology (RHSIT) in the in the semiarid Loess Plateau of China. J. Agric. Water Manage., 89(2007): 243-250.

Hill L, Kau P (1981). Analysis of Purchasing Decision with Multivariate Probit. Amer. J. Agric. Econ., 53(5): 882-883.

Igoden, C., Ohoji, P., Ekpare, J., (1990). Factors associated with the adoption of recommended practices for maize production in the Lake Basin of Nigeria. Agricultural Administration and Extension 29 (2), 149–156.

Kheralla M, Minet N, Kachule R, Souce BG, Berry P (2001). Impact of Agricultural Market Reforms on Smallholder Farmers in Benin and Malawi, Research Report, Vol. 2, IFPRI.

Langyintuo A.S, Mekuria M (2005) Accounting for neighbourhood influence in estimating factors determining the adoption of improved agricultural technologies. A paper at American Agricultural Economics Association annual meeting, providence, Rode Island, pp.1-28.

Martey, E., Al-Hassan, R.M., Kuwornu, J.K.M. (2012). Commercialization of Smallholder Agriculture in Ghana: A Tobit Regression Analysis. African Journal of Agricultural Research. Vol. 7(14), pp. 2131-2141, 12 April, 2012

MiDA (2008). Inception Report for the Provision of Services of a Regional Implementation Consultant for the Agriculture Project, Northern Agricultural Zone. Prepared for the Millennium Development Authority (MiDA) Accra, Ghana.

Mussei A, Mwanga J, Mwangi W, Verkuijl H, Mungi R, Elang A (2001). Adoption of Improved Wheat Technologies by Small-Scale Farmers in Mbeya District, Southern Highlands, Tanzania. Mexico D.F.: International Maize and Wheat Improvement Centre (CIMMYT) and the United Republic of Tanzania.

NISER (2002). Assessment of the Economic, Social and Environmental Impacts of Rice Production in Nigeria with the Trade Liberation Framework, *A Research paper* 93 pp.

Norris, E., Batie, S., (1987). Virginia farmers' soil conservation decisions: an application of Tobit analysis. Southern Journal of Agricultural Economics 19 (1), 89–97.

Nzomoi J.N, Byaruhanga J.K, Maritim H.K, Omboto PI (2007). Determinants of technology adoption in the production of horticultural export produce in Kenya. Afr. J Bus. Manage., 1 (5): 129-135.

Ofori, I.M. 1973. Factors of Agricultural Growth in West Africa. ISSER, University of Ghana, Legon, Accra, Ghana

Olwande, J and Mathenge, M. (2010). Market Participation among the Poor Rural Households in Kenya. Tegemeo Institute of Agricultural Policy and Development.

Sindi, J.K. 2008. "Kenya's Domestic Horticulture Subsector: What drives Commercialization Decisions for Rural Households?" A Published MPhil Thesis for the Award of Master of Science Degree. Department of Agricultural, Food, and Resource Economics: Michigan State University.

Schultz, Theodore W. (1945). *Agriculture in an unstable Economy*. McGraw-Hill Book Company Inc., New York

Southworth, H. M. and Johnston, B. F. (1967). *Agricultural Development and Economic Growth*. Cornell University Press, U.K

SRID/MoFA, 2011. Crop Production estimates 2010. Published by Statistics, Research and Information Directorate of Ministry of Food and Agriculture, Ghana.

Tambo JA, Abdoulaye T (2011). Climate change and agricultural technology adoption: the case of drought tolerant maize in rural Nigeria. Mitig Adapt Strateg Glob Change. DOI 10.1007/s11027- 011-9325-7.

Udoh AJ, Idio A, Umoh E, Robson U (2008). Socioeconomic Factors Influencing Adoption of Yam Minisett Technology in South eastern Nigeria: A Probit Analysis. Indian Res. J. Exten. Edu., 8(2&3):1-5.

West Africa Rice Development Association – WARDA (1996). *Rice Trends in Sub-Sahara Afric*a, Second edition, WARDA, Bouake.

Wiredu AN, Gyasi KO, Marfo KA, Asuming-Brempong S, Haleegoah J, Asuming-Boakye A, Nsiah BF (2010). Impact of improved varieties on the yield of rice producing households in Ghana, Second Africa Rice Congress, Bamako, Mali, 22–26 March 2010.

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Appendices

Appendix 1: List of Explanatory Variables

Explanatory Variables			
No	**Variable**	**Specification**	**Expected Sign**
1	Gender	1 if male and 0 if female	+/-
2	Age	Age of household head in years	+/-
3	Education level	Number of years of formal education	+
4	Household size	Number of members of household	+
5	Marital status	1 if married and 0 if not married	+/-
6	Nativity	1 if a native and 0 if not a native	+
7	Years of experience	Number of years of farming experience	+
8	Total land size	Total land size available to household head	+
9	Access to off-farm income	1 if household head earn off-farm income and 0 otherwise	+
10	Membership of association	1 if household head belongs to association and 0 otherwise	+/-
11	Land tenure status	1 if household head owns land and 0 otherwise	+/-
12	Access to credit	1 if household head have access to credit and 0 otherwise	+/-
13	Output price	Ghana cedi/Kilogram	+
14	Knowledge of rice varieties and ecologies	1 if household head is knowledgeable and 0 otherwise	+/-
15	Perception of soil fertility	1 if household head perceives soil to be rich and 0 otherwise	+
16	Output price		-
Interactive terms			
17	Education status and farm size	Education status*Farm size	+
18	Education status and age	Education status*Age	+

Appendix 2: Probit Regression Result

```
Probit regression                                 Number of obs   =        400
                                                  Wald chi2(17)   =      66.26
                                                  Prob > chi2     =     0.0000
Log pseudolikelihood = -210.41733                 Pseudo R2       =     0.1358
```

ricprj	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
sex	-.0811821	.3042991	-0.27	0.790	-.6775974	.5152333
age	-.0283755	.0070484	-4.03	0.000	-.04219	-.0145609
edu	-1.069902	.5281561	-2.03	0.043	-2.105069	-.0347354
mari	-.8068535	.4050682	-1.99	0.046	-1.600773	-.0129344
exp	.0096007	.0073815	1.30	0.193	-.0048668	.0240683
natv	.1649853	.2224882	0.74	0.458	-.2710835	.6010541
hhsiz	.0102055	.0085843	1.19	0.234	-.0066195	.0270305
ofam	.3705296	.1505121	2.46	0.014	.0755314	.6655279
mem	-.1296256	.1558818	-0.83	0.406	-.4351484	.1758972
fmsz	-.0024904	.0090376	-0.28	0.783	-.0202038	.015223
tensys	.0883237	.24486	0.36	0.718	-.3915931	.5682404
pmkt	1.456321	.4451704	3.27	0.001	.5838027	2.328839
credit	.6228671	.1602806	3.89	0.000	.3087228	.9370113
knhyd	.3423418	.1533811	2.23	0.026	.0417204	.6429631
pcptnfert	-.2161162	.1559492	-1.39	0.166	-.521771	.0895385
Edufmsz	.031378	.0155451	2.02	0.044	.0009102	.0618458
EduAge	.0162787	.0112776	1.44	0.149	-.005825	.0383824
_cons	.2913194	.7013012	0.42	0.678	-1.083206	1.665844

```
. mfx

Marginal effects after probit
      y  = Pr(ricprj) (predict)
         =  .27162341
```

variable	dy/dx	Std. Err.	z	P>|z|	[95% C.I.]		X
sex*	-.0274913	.10511	-0.26	0.794	-.233503	.17852	.94
age	-.0094103	.00232	-4.06	0.000	-.013958	-.004862	43.8775
edu*	-.2807767	.10179	-2.76	0.006	-.480275	-.081279	.2225
mari*	-.3052959	.15835	-1.93	0.054	-.615665	.005073	.9625
exp	.0031839	.00244	1.30	0.192	-.001603	.007971	12.6025
natv*	.0525183	.06781	0.77	0.439	-.080378	.185414	.8825
hhsiz	.0033845	.00285	1.19	0.236	-.002208	.008977	13.365
ofam*	.120645	.04779	2.52	0.012	.026971	.214319	.565
mem	-.0429886	.05171	-0.83	0.406	-.144335	.058358	.635
fmsz	-.0008259	.003	-0.28	0.783	-.006702	.00505	9.0058
tensys	.0292913	.08119	0.36	0.718	-.129843	.188425	1.0075
pmkt	.4829689	.14702	3.29	0.001	.194812	.771126	.324765
credit*	.2210302	.05868	3.77	0.000	.106021	.336039	.2575
knhyd*	.1156981	.05243	2.21	0.027	.012934	.218462	.39
pcptnf~t*	-.0730779	.05343	-1.37	0.171	-.177801	.031646	.6625
Edufmsz	.0104061	.00517	2.01	0.044	.000276	.020536	2.14513
EduAge	.0053986	.00372	1.45	0.147	-.001897	.012694	9.165

```
(*) dy/dx is for discrete change of dummy variable from 0 to 1
```