



## **Socioeconomic Determinants of Rain-fed Rice Production among Small-scale Farmers in the Shama-Ahanta East District of Ghana**

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### **Author's contribution**

*The sole author designed, analyzed and interpreted and prepared the manuscript.*

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### **ABSTRACT**

Rice is considered as the second most important staple food crop in Ghana and it is produced mainly by small-scale farmers. Rice production in Ghana meets only 30 to 40 percent of the total demand. The need to increase local rice production is essential, hence this study was designed to identify and analyze the socioeconomic factors that influence rice production among small-scale farmers in the Shama-Ahanta East District of Ghana in order to enhance production. Using structured questionnaire, a multistage sampling procedure was used to collect data from 320 rice farmers. Data were subjected to descriptive and Tobit regression analysis. The results show a relatively low level output of 1.05 ton/ha among rice farmers, of whom 73% were males. Significant socioeconomic factors found to influence rice production include age, gender, educational level, household size, household income, and access to agricultural extension services. Training and empowering more agricultural Extension Agents and the development of policies to enhance female farmers involvement in rice production is recommended.

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## 1. INTRODUCTION

Rice is considered as the second most important staple food crop in Ghana after maize [1]. It is also the first and most imported cereal in the country and accounts for 58 percent of all cereal imports and also accounts for 5% of total agricultural imports in Ghana [2]. Rice is considered as the 5<sup>th</sup> most important source of energy in the diet of Ghanaians, accounting for nine percent of total caloric intake [3]. Statistics show that rice accounts for about 5% of the total annual crop area harvested and about 13% of the annual total cereal area harvested [1]. Rice production takes place in mainly in the Northern, Upper East, Western and Volta Regions of Ghana, which together produce 77% of the total national output [4]. Rice yield in Ghana has been fluctuating within the range of 1.7 and 2.7 tons per hectare and total output has also been increasing with 2014 production levels being more than double the 2007 production level [1].

Despite the increase in rice production in the country, supply meets only 30% to 40% of the total demand. This is due to the fact that rice production in Ghana is mostly done by smallholder farmers, most of whom have farms of less than one hectare (1 ha) in size [1]. The average yield of rice has been reported to be 1.7 ton/ha, which falls far below the potential yield of 3 ton/ha [4]. These smallholder farmers cultivate rice by using low level of agricultural technology such as low-quality seed with mixed varieties, under application of chemical fertilizers and use of outmoded harvesting and post-harvesting methods which lead to post harvest losses. This situation has created a wider gap between supply and demand for rice in the country. The

shortfall in local supply of local rice has created a gap which is filled imported rice. The data in Table 1 shows the quantities of rice imported to supplement local production to meet total demand between 2009 and 2014. Table 1 also shows that more than half of the total rice demand is imported.

The importation of rice increases government expenditure and in the year 2014, the average rice import bill of USD 450 Million was recorded by the government [4].

Because rice is a staple food for most Ghanaians, increasing its production is critical in reducing food insecurity in Ghana. It is thus essential to increase local rice production in the country to meet local demand and reduce government's expenditure on the importation of rice. Ghana has great potential of increasing its rice production level to meet the growing demand. The availability of fertile land for rice production, favorable rainfall pattern and the availability of human capital put Ghana in a good position to increase its local rice production [5]. To achieve this, the socioeconomic factors that significantly impact rice production by smallholder farmers need to be identified and analyzed to inform policy formulation and implementation in Ghana's rice production. Hence, the objective of this study is to identify and analyze the socioeconomic factors that influence rice production in the Shama-Ahanta East District of Ghana. Information will be useful to policymakers and rice stakeholders for understanding the factors affecting rice production sector for proper planning, development and implementation of rice production projects and interventions towards achieving food security.

**Table 1. Quantities of rice imported to Ghana to supplement local production (2009-2014)**

Year	Total local production (Mt)	Total import (Mt)	Total demand (Mt)	% imports
2009	235000	383945	618945	62.0
2010	295000	320143	615143	52.0
2011	278000	543446	821446	66.0
2012	332000	400316	732316	55.0
2013	393000	487523	880523	55.4
2014	434481	544080	978561	55.6

Source: FAOSTAT, 2014

## 2. MATERIALS AND METHODS

### 2.1 The Study Area

The study was conducted in five (5) communities out of the thirteen (13) communities in the in the Shama-Ahanta East District of Ghana. The five communities are Beposo, Dompim, Kobinanokrom, Kwakdwokrom and Ohiamadwen. The District is located on 5.037°N and 1.656°W, 280 km West of Accra and 130 km East of Cote D'Ivoire. The district is characterized by favorable and bimodal rainfall pattern of an average of 1800 mm which is conducive for rice production. According to the Geological Department of Ghana, the predominant soil type in the District is sandy-loam formed from underlying limestone and sandstone mixed with clay. According to the Ghana Statistical Service, the District has a population of 81,966 with a population growth of 3.2. This District was selected because of its high rice production status. Rice is the main crop produced by farmers in the selected communities and is produced on small scale basis. Despite the small-scale production of rice in the area, the District produced about 45% of the total regional production in 2013 [1]. The District continues to increase its rice output and currently contributes about 52% of the total regional output [4].

### 2.2 Sampling and Data Collection

A multistage sampling procedure was used to select respondents for the study. For the first stage, a purposive sampling procedure was used to select the district. For the second stage, a convenience sampling procedure was used to select the five communities while a simple random procedure was used to select 320 rice farmers as respondents for the study. The sample size was determined based on mathematical computation suggested by [6]. In calculating the sample size, an absolute precision of 5% was assumed, an estimated proportion of 30% was assumed and, a 95% confidence interval was assumed. Structured questionnaire was used to collect cross-sectional data through personal interviews with respondents.

### 2.3 Data Analysis

Data were subjected to descriptive analysis to obtain descriptive and inferential statistics such means, minimum and maximum values. Data were entered and analyzed by the QLIM

Procedure using SAS Enterprise Guide version 6.7. Socioeconomic determinants of rice production were analyzed using the Tobit regression analysis. Tobit regression was used because some of the explanatory variables are non-linear and hence using OLS would provide bias and inconsistent estimates since OLS assumes a linear structure on the data, and also OLS cannot address censoring or truncation problems. [7] suggests a maximum likelihood estimation method for estimating non-linear models. For this study, the parameters in the model are estimated by a Tobit regression. According to Tobin [8], and following [9], the standard Tobit model can be specified as:

$$y^* = X_i\beta + \varepsilon_i, \quad \varepsilon_i \sim N(0, \sigma^2), \quad i=1,2,\dots,n \quad (1)$$

Where:

- $y_i$  =  $y_i^*$  if  $y_i^* > 0$
- $y_i$  = 0 if otherwise
- $y_i$  = yield or output of rice measured as ton per hectare
- $X_i$  = vector of explanatory variables corresponding to the  $i^{\text{th}}$  individual
- $y_i$  = non-censored observed portion of the dependent variable when  $X$  is observed for the  $i^{\text{th}}$  individual.
- $y_i^*$  = censored portion of the dependent variable when  $X_i$  is not observed for the  $i^{\text{th}}$  individual.
- $E_i$  = is the error term.

The empirical model is specified as:

$$y^* = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + \varepsilon_t \dots \quad (2)$$

Where  $y^*$  is the latent dependent variable.

Based on review of existing literature, the explanatory variables used in the analysis were determined and are defined as:

- $X_1$  = Age of respondent (years).
- $X_2$  = Educational level of respondent (years).
- $X_3$  = Household size of respondent (number).
- $X_4$  = Rice farm size (hectare).
- $X_6$  = Household income (GH¢)
- $X_7$  = Respondent access to agricultural credit (access=1, otherwise=0)
- $X_8$  = Gender of respondent (male=1, female=0)
- $X_9$  = Output market price (GH¢)
- $X_{10}$  = Respondent access to land (access=1, otherwise=0)

X11 = Respondent access to agricultural extension services (access=1, otherwise=0)

### 3. RESULTS AND DISCUSSION

#### 3.1 Characteristics of Rice Farmers

The results in Table 2 show a relatively low level output of 1.03 ton/ha among rice farmers in the study area. Most of the rice farmers (73%) are found to be males. The low level of female participation in rice production could be attributed to poor access to land by female farmers in the study area. The relatively low rice output level could be attributed to the traditional practices which are widely used by farmers in the study area. It could also be attributed to inadequate investment in improved rice production practices due to low level of household income as shown by the results in Table 1.

The results also show an average age of 44.8 years and a low level of education (2.1 years) in the study area. The results suggest primary level education is the most common education attainment among farmers in the study area. This is confirmed by the report of the 2010 Population and Housing Census which indicates that less than 20% of farmers aged 11 years and older are educated [10]. The results further show relatively high household size of 5.6 people which is higher than the national average household size of 4.5 people [10]. The study found that rice farmers in the study area have low access to agricultural credit mainly due to lack of collateral and inadequate financial and local credit institutions. The real average output prices in the study area was found to be GH¢47.5 per 50 kg, which is relatively lower as compared to the national average of GH¢53 as at the time of data collection [11]. The relatively lower average output price could be attributed to the lack of storage facilities in the study area which forces farmers to sell their produce immediately after harvest. Access to agricultural extension service, which is critical for increasing farmers productivity has been found to be low. This could be attributed to the very low number of agricultural extension agents in the country. According to [4], the current extension to farmer ratio in Ghana stands at 1:1500, hence many farmers are not able to access extension services. It was revealed during the survey that most of the rice farmers in the study area are migrant farmers from the Volta region of Ghana who have settled in the area for over 20 years.

This indicates why there is low access to agricultural land in the area among the respondent rice farmers. Access to land is through rent/hiring and the high cost of renting/hiring land in the study area could contribute to the low access to land by rice farmers.

#### 3.2 Socioeconomic Factors Influencing Rice Production

The Tobit regression results of the socioeconomic determinants of rice production in the study area is shown in Table 3.

The coefficient of age is positively signed and marginally significant ( $p=0.10$ ). This positive relationship suggests that older farmers who are assumed to have more experience and skillful with regards to cultural practices involved in rice production are likely to produce more rice than younger farmers. This results is different from [12] who used OLS regression method and found no statistical relationship between rice production and age among rice farmers in Nigeria. Also, the results of [13] showed a negative relationship between age and rice production and argued that older farmers are less vigorous in their farming activities and hence obtain less output.

Educational level of household head was found to be significant ( $p=0.05$ ) and positively related to increased rice production among small scale rice farmers. This suggests that educated farmers are more likely to increase rice production than uneducated farmers. According to [14], improved human capital through education plays a major role in the acquisition and evolution of new ideas. This is similar to [15] who found that programs and interventions which aim at promoting technological change for increased output favor educated farmers. According to [12], educated farmers are more intelligent in the utilization of available production resources and are also able to adopt innovations in rice production.

Household size was found to be negatively related to rice productivity among small-scale farmers in the study area and the relationship was found to be significant ( $p=0.05$ ). The larger the family size, the higher the household expenditure on household needs such as food, healthcare and clothing. This reduces financial investments that goes into rice production. The reduced investment in rice production could adversely affect output level. This result is however, different from the results

**Table 2. Summary statistics of respondents**

Variable	Mean/Proportion	Std. deviation	Minimum	Maximum
Yield	1.03	0.30	0.63	1.50
Age of respondent	44.81	17.45	14.00	76.00
Household size	5.61	1.57	3.00	9.00
Educational level	2.11	1.68	0.00	6.00
Farm size	0.96	0.18	0.71	1.20
Household income	232.06	75.15	99.51	364.46
Access to credit	0.07	0.26	0.00	1.00
Gender of respondent	0.73	0.45	0.00	1.00
Output price	47.46	1.42	45.01	50.00
Access to land	0.06	0.23	0.00	1.00
Access to agricultural extension	0.13	0.34	0.00	1.00

**Table 3. Socioeconomic determinants of rice production**

Parameter	Estimate	Standard Error	t Value	Pr >  t
Intercept	1.6080	0.52890	3.04	0.0024
Age	0.0350	0.01042	3.31	0.0743*
Education	0.0051	0.00118	4.34	0.0671*
Household size	-0.0250	0.00980	-2.56	0.0110**
Farm size	0.3051	0.09410	3.24	0.0012***
Household income	0.0390	0.01182	3.29	0.0846*
Access to credit	0.0504	0.05860	0.86	0.3893
Gender	0.0351	0.00344	10.23	0.0307**
Output price	0.0160	0.01070	1.46	0.1444
Access to land	0.1050	0.07570	1.38	0.0166**
Access to extension	0.3793	0.05523	6.87	0.0001***

Log likelihood -318.0128, \*, \*\*, \*\*\* - significant at 10%, 5% and 1% respectively  
IAC 87.602

Number of observations 320  
Max. Absolute gradient 1.3003E-9

obtained by [9] who found a positive relationship between household size and rice yield and noted that farmers with increased family size obtained higher yield due to family labor supply which is usually not paid for.

The results show that the bigger the rice farm, the higher the productivity. This is in consonance with the research results of [16]. The bigger the farm size, the more likely a farmer will invest in improved practices to increase output or yield. Larger farm size has been identified as a motivation for farmers to increase investment in the farm to take advantage of economies of scale [17,18].

As expected, household income was found to positively relate to rice production and the relationship was found to be significant ( $p=0.10$ ). Increase in household income increases their purchasing power and this allows farmers to hire labor and buy inputs to help increase output without jeopardizing expenditure on other

household needs. This finding is in consonance with the results of previous studies [19,18] who found that increasing household income allows rice farmers in Nigeria to re-invest in innovations and technology for increased output. Creating enabling environment for the establishment of off-farm employment opportunities could offer rice farmers opportunities to earn off-farm incomes which could contribute to increased rice output.

The coefficient of gender was positively related to rice production among small-scale farmers and the relationship was found to be significant ( $p=0.05$ ). This implies that male headed households which produce rice in the study area are more likely to produce more rice than female headed households which produce rice. This could be attributed to the numerous challenges women farmers face in accessing agricultural resources such as land and improved technology. This result could also be attributed to the fact that women in rural households are

usually involved in multiple roles in the house and hence they have limited time to invest in rice production to achieve higher output levels. Previous studies by [20] and [16] found similar results and the authors argued that production and domestic responsibilities of women impinge on their time and mobility.

Access to Agricultural Extension services was found to be positively related to rice production in the study area and was found to be highly significant ( $p < 0.001$ ). This result was expected because access to extension service contribute to improve agricultural information availability to farmers and thus improve their productivity levels, particularly where farmers are mostly illiterates. Extension Agents teach farmers new methods of improving productivity and provide advice to farmers on how to solve production problems such as pest infestation and the correct application of inputs. This is similar to the findings of [21] who found a positive and significant effects of extension service in improving farm productivity among farmers in Bangladesh and stated that the more the extension access between extension agents and farmers, the higher the productivity. This is also similar to the findings of [22] among rice farmers in Nigeria and argued that farmer access to extension services reduces production inefficiencies and yield losses.

#### 4. CONCLUSION AND RECOMMENDATIONS

The study sought to identify and analyze the socioeconomic factors that influence rice production in the Shama-Ahanta East District of Ghana. Results of the study have revealed that socioeconomic factors such as age of household head, household size, farm size, educational level of household head and access to agricultural extension services as significant factors. This finding is important for the implementation of strategies and policies to increase rice yield in Ghana because it gives information to policymakers on which socioeconomic factors need to be targeted and influenced to achieve increased rice production. While this study does not offer a conclusive list of all the factors that influence rice production, it does offer a baseline for future research. It will be fruitful for future studies regarding other factors, including environmental, political and cultural factors that influence rice production.

The important role female farmers play to ensure food security at the household level cannot be

underestimated. It is thus, recommended that policymakers should implement policies which improve and enhance female rice farmers participation in rice production. This could be achieved by implementing policies which improve female farmers' access to land and other agricultural resources. Agricultural extension services are essential to productivity improvement among farmers of all categories. It is recommended that policymakers implement programs to ensure improved access to extension services by small-scale rice farmers to increase their productivities. This could be achieved by training existing extension agents and recruiting new agents. Policy interventions to establish storage facilities in the study area is essential and is recommended to help farmers to store their harvested rice for to attract higher future price by for small-scale rice farmers in Ghana.

#### COMPETING INTERESTS

Author has declared that no competing interests exist.

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