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加纳阿善堤地区农户参与稻田项目的决定因素研究

Determinants of Farmers Participation in Sawah Projects in Ashanti Region

摘要　本文对加纳阿哈福阿诺南区（Ahafo Ano South district）农户参与稻田项目的决定因素进行研究。稻田项目的实施，主要基于加纳稻米消费的扩张，导致了对生产自给的需求。为此，日本的一些机构在加纳的较低洼地区引入了稻米的生产。当然，在参与稻田项目的全部三阶段（1997—2001，2002—2004和2004—2009）的农户中，也存在着不同的问题。因此，在前两个阶段结束和第三个阶段接近完成的情况下，研究农户参与稻田项目的决定因素，从而促进项目逐步完善就显得尤为重要。

由于稻田开发项目主要集中在阿哈福阿诺南区，这一地区分布有主要的流域，因此，本研究也主要在此地区进行。受访者主要从5个村庄中随机抽取，这5个村庄涵盖了项目的所有3个阶段，共选取了225名农民，通过结构式问卷调查方式搜集了相关资料。论文运用描述性统计方法分析了样本农民的社会经济特点，同时运用Probit模型对影响农户参与稻田项目的决定因素进行了研究。结果表明，样本中多数农民为50岁以下男性，他们具有较高的教育水平，同时信奉基督教，但他们在低地种植水稻的经验不到5年，水稻种植面积不到5英亩，约有61%的接受访问者每户有5至10人，样本中参与项目的人数少于没有参加项目的人数。

从Probit模型的结果来看，确定模型拟合度的卡方值在1%的统计水平上显著，“参与稻田项目的持续性”（t＝5.02）和“村庄稻田项目的起始时间”（t＝—1.53）两变量分别在5%和10%的统计水平上显著。从文中也可以看出，在引进稻田项目的同时，也引进了适当的田间管理和水资源管理。为了确保农民参与稻田项目的可持续发展，也有必要对论文中基于项目3阶段分析所揭示的重要的社会变量给予政策上的重视。

关键词　农民　参与　稻田　内陆山谷　阿善堤地区
JEL分类：Q16，O33，O13

Abstract　This paper identified the determinants of farmers' participation in sawah projects in Ahafo Ano South district in Ghana. This is based on the fact that due to expansion in rice consumption In Ghana, there is need to ensure self sufficiency in production. In this regards, rice production in lowland was introduced by Japanese institutions. In all the 3 phases, farmers have been involved in developing sawah fields, however, there were problems observed. It is therefore important that after the completion of the first two phases and the third nearing completion, the determinants of farmers' participation in the sawah project be examined for the overall improvement of the sawah development programme.

The study was carried out in the Ahafo Ano South district in Ghana as all sawah development projects have concentrated on the Ahafo Ano South districts due to the availability of major watersheds in the area. Respondents for this study were randomly selected from 5 villages namely Adugyama, Biemso No 1, Biemso No2, Fediyeya and Attakrom that were covered by the 3 phases of the project. A total of 225 farmers were randomly selected from the 5 villages and data were collected through interview schedule based on a structured questionnaire. Descriptive statistics was used to analyze the socio-economic features of the farmers while the Probit model was used to capture the determinants of farmers' participation in sawah projects. The results show that majority of the farmers are male, below 50 years with high level of education and practice Christianity. They also have less than five years experience of rice production in the lowlands with less than 5 acres for rice fields, about 61 percent have between 5 and 10 persons per household and the proportion of those that participated is low compared with those that did not participate.

From the results of the probit model the Chi-square value used to determine the goodness of fit of the model is statistically significant at one percent level. The result also shows that 2 variables are statistically significant at 5% and 10% respectively. These are continuation with sawah (t = 5.02), and time sawah started in the village (t = —1.53). It is therefore important to explore the lowlands of the inland valleys from its use status. The introduction of the rice field with proper field management and the water management can be done as described in the paper. To ensure a sustainable participation of farmers in sawah development, important social variables identified in this paper based on the 3 phases of sawah projects should be given policy consideration.

Key words　Farmers, Participation, Sawah Rice, Inland Valley Lowlands, Ashanti Region
JEL: Q16, O33, O13

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1. Introduction

Rice consumption has expanded in West Africa (WARDA, 2000), but the financial balance of those countries suggest that self sufficiency in rice production is more preferable (FAO, 2004) . African rice is grown partly by natural flooding and river flooding in African-type lowlands but mostly (over 80%) is planted in uplands or hydromorphic condition, and no sawah systems have been developed unlike in Asia. Since Westerners introduced higher yielding Asian rice varieties into Africa in the 15th century and after, African rice is now grown in only about less than 5% of land and Asian one is planted in almost all parts of the continent. But because cultivation method is still the traditional system, that is, planting rice in upland farms, the mean yield including irrigated rice has remained about 1. 6 t/h in the past 30 years. In Asia, while upland rice is grown by shifting cultivation in some regions, lowland sawah based rice farming is the main system used now in coupling with high yielding varieties and various fertilizations. Therefore, the mean yield of tropical Asian rice is now more than double of that in West Africa (Wakatsuki, 2001) .

Sawah fields are the system adaptable to a lowland ecosystem but require eco-technological skills, including those for minimum changing of topographical and ecological features, such as both land leveling, bunding and irrigation/drainage systems. The eco-technological skills for sustainable water management based on the maintenance, improvement, and proper operation of the systems are also important. But in tropical Africa, this type of farming technology, which is essential to lowland use, has not traditionally developed at all. This is why lowlands in Africa have mostly been left unused. In other words, rice and other crops have been grown at the cost of forests in uplands (Wakatsuki, 2001) .

The term sawah refers to leveled rice field surrounded by bund with inlet and outlet connecting irrigation and drainage. The term originates from Malayo-Indonesian①. Paddy field is almost equivalent to sawah for Asian scientists. However, the term paddy fields refers to just a rice field including upland rice field in West Africa. Therefore in order to avoid confusion between the terms rice plant, paddy, and the improved man-made rice-growing environment, the authors propose to use the term sawah (Wakatsuki, 2002) .

Inland valley bottoms and hydromorphic fringes cover about 50 million hectares in West Africa (Windmeijer and Andriesse, 1993), of which about 10 million hectares have potential for small-scale irrigated sawah based rice farming. In Ghana, potential area for small-scale irrigated sawah in inland valley watershed is estimated for 700, 000 hectares, 3% of total land area, 1—3% of Guinea Savanna Zone and 3—5% of Forest Zone. If flood plain is included, total potential area for irrigated sawah may reach to one million hectares in Ghana. Applying sawah rice producing technology is one of the solutions (Wakatsuki, 2001) . The Ghana government has constructed 22 large-scale irrigation facilities with rice grown as a major crop on 12 fields of them (Kranjac-Berisavljevic, 2001) . The irrigated rice farm in Ghana is late-started, comparing other West African countries (WARDA, 2000) . However, the irrigation facilities do not work enough (JICA, 1997) . Both of the government and farmers can not maintain them. They received the assistances from foreign aid donors. The government can not invest to construct big irrigation projects any more, because of financial difficulties under IMF recommended SAP policy (Yerfi- Fosu and Heerink, 1996) .

Sawah is sustainable rice cultivating system (Tabuchi and Hasegawa, 1995), consisting of land management and irrigation. The land management is leveling, bonding, puddling and transplanting. This technique leads to high yields (Becker, 2001), sustainable production and irrespective of fertilizer use (Asbonteng, 2001) . In Ghana, rice is cultivated under three systems, namely, rainfed upland conditions, irrigated conditions, and rainfed lowland conditions in inland valleys. Production under rainfed upland conditions has been very risky due to unreliable rainfall, shallow and erodible soils of low fertility. Also, production under the big irrigation scheme has not been very encouraging. The numerous small inland valleys found scattered across the country where the control water is the main problem offer the best rice ecology. The valley bottom rice development project was initiated in 1989 to develop sustainable technologies for integrated soil, land and water, and crop management in the production of rice and other crops in the inland valleys. Although, considerable progress has been made in addressing some of the researchable constraints, there is the need to devise simple and low cost and environmentally friendly system for managing the inland valleys that can be adapted by the resource poor farmers. The Asian experience in Sawah development, which looks at not only the valley bottoms but also total watershed, is worth applying in the inland valleys in Ghana.

Table 1 presents the 3 phases of the sawah development process in Ghana from 1997 till date and up to 2009. The phases were described in terms of the duration, institutions involved, budget size and the target as well as the way to develop the inland valleys and enhance sustainable rice production. Central to all of the phases is the participation of farmers in order to ensure the continuity of the sawah development process. The collaborated study program of Japan International Cooperation Agency (JICA) and Crop Research Institute of Ghana (CRI) ran at the northern Ashanti region of Ghana. The sawah field development with the farmer' s participation was proven (JICA, 2001) . After the study collaboration had ended, the program was transferred to Soil Research Institute of Ghana (SRI) . Afterwards, Inland Valley Rice Development Project (IVRDP) of African Development Bank (ADB) was planned, and now it is progressing (MOFA, 2004) . The main goal of sawah projects in West Africa by Japanese institutions is the development of sustainable production systems of the whole watershed, which allows intensification and diversification of the lowland production system and stabilizing improved production systems on the upland. Furthermore, the projects would assist the development of a tool for land use planners and decision maker for integrated watershed development. Table 1 also presents the features of the 3 phases of sawah development process in Ghana.

Table 1 The characteristics of 3 phased projects in Ahafo Ano South district in Ghana

	Phase 1	Phase 2	Phase 3
The project name	Integrated Watershed Management of Inland Valleys in Ghana	Sawah project	Inland Valley Rice Development Project
Term	1997—2001	2002—2004	2004—2009

① The English term, Paddy or Paddi, also originates from the Malayo-Indonesian term, Padi, which means rice plant. The term, Paddy, refers to rice grain with husk in West Africa. Most of the paddy fields in the Asian countries correspond to the definition of the term sawah.

(Continue)

	Phase 1	Phase 2	Phase 3
Conducted by	JICA - CRI	SRI — Shimane Univ. Kinki Univ.	MOFA - ADB
Budget size	$0.45 million	$ 0.17 million	$20 million
Main target 1	Training Ghanaian Agric researchers	Study for sustainable sawah development	Nationwide sawah development, 200 km2 in the country
Main target 2	Examining farmers' participated sawah development	Technical support and maintenance the machinery for farmers	Paddy yield 45 Mg/km2, total production 80, 000 Mg for poverty reduction in rural area
The way to develop	Employment for constructing sawah field / Food for work	Food for work + 3 years support with financial aid	Group based loan + technical support
Sawah area developed	less than 10ha	10—20ha	Over 100ha (Objective)
Main problem	training farmers, especially the first year	farmers' incentive, sharing the production	site selection, no presence of machinery

JICA: Japan International cooperation Agency. CRI: Crop Research Institute of Ghana. SRI: Soil Research Institute of Ghana. MOFA: Ministry of Food and Agriculture of Ghana. ADB: African Development Bank (Source: Wakatsuki, 2001)

In all the 3 phases farmers, have been involved in developing sawah fields, however, there were problems observed. It is therefore important that after the completion of the first two phases and the third nearing completion, the determinants of farmers' participation in the sawah project be examined for the overall improvement of the sawah development programme. The main objective of this study is to identify the determinants of farmers' participation in sawah projects in Ahafo Ano South district in Ghana. Specifically the study considered the socio-economic characteristic of farmers in the villages covered by the project and examined their participation behavior.

2. Methodology

The study was carried out in the Ahafo Ano South district in Ghana. Ghana is located on West Africa's Gulf of Guinea only a few degrees north of the Equator on Latitude: 5 degrees, 36 minutes north, Longitude: 0 degrees, 10 minutes east. Half of the country lies less than 152 meters (500 ft.) above sea level, and the highest point is 883 meters (2, 900 ft.). The

537-kilometer (334-mi.) coastline is mostly a low, sandy shore backed by plains and scrub and intersected by several rivers and streams, most of which are navigable only by canoe. A tropical rain forest belt, broken by heavily forested hills and many streams and rivers, extends northward from the shore, near the Cote d'Ivoire frontier. This area, known as the "Ashanti," produces most of the country's cocoa, minerals, and timber. North of this belt, the country varies from 91 to 396 meters (300—1, 300 ft.) above sea level and is covered by low bush, parklike savanna, and grassy plains. The climate is tropical. The eastern coastal belt is warm and comparatively dry; the southwest corner, hot and humid; and the north, hot and dry. There are two distinct rainy seasons in the south May-June and August-September; in the north, the rainy seasons tend to merge. A dry, northeasterly wind, the Harmattan, blows in January and February. Annual rainfall in the coastal zone averages 83 centimeters (33 in.). All sawah development projects have concentrated on the Ahafo Ano South district. Kumasi is a major town neighboring the project sites and major watersheds in the area.

The study sites are 40 kilometers northwest of Kumasi on the Kumasi - Sunyani main road in Ahafo Ano South District which is at the north-western part of the Ashanti Region. With the above description of location, study sites are in transitional forest belt of Ghana. Annual rain fall is around 1300 mm. It is said that Ashanti people settled in this area first. Biemso No. 1 (B1) is firstly settled by Ashanti natives. Then, they settled at the place that was named as Biemso No. 2 (B2). Adugyama village (AD) is most populated with 5602 villagers in 2000 (Ghana Statistical Service, 2002). Adugyama is officially named Dwinyama. But natives call it village as Adugyama. These three villages have migrant residential area that is called "Zongo" area. The villagers traditionally cultivate cocoa. Migrants came for as cocoa caretakers. Fedeyeya and Attakrom do not have "Zongo" area. Those are the villages for migrants allowed by native landowners.

Respondents for this study were randomly selected from 5 villages namely Adugyama, Biemso No 1, Biemso No2, Fedeyeya and Attakrom that were covered by the 3 phases of the project. A total of 225 farmers were randomly selected from the 5 villages and data were collected through interview schedule based on a structured questionnaire. Descriptive statistics was used to analyze the socio-economic features of the farmers while the probit model was used to capture the determinants of farmers' participation in sawah projects. The choice of explanatory variables (socio-economic characteristics) was based on literature on past studies and the characteristics found among the respondents. The relationship between the probability of use variable Pi and its determinants q is given as: $P_i = \beta_{qi} + \mu_i$, where $P_i = 1$ for $X_i > Z$; $i = 1, 2 \ldots\ldots, n$; qi is a vector of explanatory variables and β is the vector of parameters.

The probit model computes the maximum likelihood estimator of β given the non-linear probability distribution of the random error μ_i. The dependent variable P_i is a dichotomous variable which is 1 when farmers use wetlands and 0 if otherwise. The explanatory variables are: X_1 = dummy variable for Sawah continuation (continue = 1, stopped = 0), X_2 = dummy variable for sex (male = 1, female = 0); X_3 = Time sawah started in the village in years; X_4 = dummy variable for Residence status (native = 1, Migrant = 0) farming experience in years, X_5 = dummy variable for religion (Christian = 1, others = 0), X_6 = Age in years, X_7 = dummy variable for educational level (educated = 1, not educated = 0); X_8 = Farming Experience in rice in years; X_9 = dummy variable for Major occupation (farming = 1, others = 0); X_{10} = Household size as number of persons; and X_{11} = farm size in acres.

3. Results and Discussion

The results of the socio-economic characteristics of farmers from the project sites were summarized into frequency distribution tables. It shows that majority of the farmers are male as agricultural practice it is still dominated by men notwithstanding the description of women in agriculture in Africa as per excellence. Similarly, within the project sites, many of the respondents are natives, although appreciable number of migrants is involved in rice farming. This may be due to the fact that rice production is somehow alien to the farming system of Ashanti region. The trend has however changed due to large hectares of lowlands available and suitable for rice cultivation. Majority of the respondents are below 50 years. This dichotomy was used due to the perception among respondents that sawah production may be too tedious for farmers above 50 years. The level of education among respondents is high and thus many of the respondents are educated. The predominant religious practice among the respondent is Christianity.

Table 2 presents the results of the distribution of respondents based on their farming experience, household size and farm size. The implication of the distribution is that majority of the farmers have less than five years of rice production in the lowlands. This may be due to the fact that cocoa and other tree crop production predominates in the Ashanti region although the potential of the lowlands for rice production exits. The trend of the result may also be due to the fact that after the first phase of the sawah project among the respondents, the second phase started about the period indicated by the respondents.

With respect to the household size of farmers covered in this study, about 61 percent have between 5 and 10 persons per household. This may be due to the extended family settlement that is prominent among the respondents. Also of significant importance in this regards is the polygamous nature of families among the migrant farmers who have settled among the natives.

In terms of farm sizes, many respondents have less than 5 acres for rice fields. The farmers however indicated that the fields are not necessarily located in the same place. The non-contiguous nature of the rice field is an indication of the prevalent land tenure system in the study area. There is need for improvement in the area of land tenure system if sustainable sawah production will be enhanced.

Table 2 Farming experience, household size and farm size among respondents

Variables	Frequency	Percentages
Farming experience in rice cultivation (year)		
Less than 5	114	50.7
5—10	66	29.3
Above 10	45	20.0
Household size (person)		
Less than 5	49	21.8
5—10	138	61.3
Above 10	38	16.9
Farm size (acres)		
Less than 5	109	48.4
5—10	76	33.8
Above 10	40	17.8

(Continue)

The results of the deposition by farmers to sawah projects show that, over the 3 phases, the proportion of those that participated is low compared with those that did not participate. This is an indication that in the three phases different approaches have been used to enlist farmers' participation and guarantee their collaboration. Irrespective of these approaches the participation by farmers is crucial for the success of sustainable sawah development. Also, the proportion of those that continued sawah as a subset of those that participated shows that those that discontinued were more than those that continued. This may be due to the issues related to land tenure, securing inputs for the sawah development and the necessary technical back-stopping from scientists from agricultural research institutes.

From the results of the probit model presented in Table 3, the Chi-square value is statistically significant at one percent level, so these set of explanatory variables can explain the probability why farmers participate in sawah projects or not. The varying degree of importance of each of the explanatory variables is indicated by the t values which are (Coeff. / S. E.). The result also shows that 2 variables are statistically significant at significant at 5% and 10% respectively. These are continuation with sawah ($t = 5.02$), and time sawah started in the village ($t = -1.53$). It can be deduced that the more they continue with sawah the more they participate in sawah project. The continuation however is contingent on some other variables such as the availability of power tiller, provision of necessary technical back-stopping and the ability to secure land for long term use. The time sawah started is also significant due that the longer the period the more the participation among farmers as this will enable them to gain good knowledge and mastery of the techniques involved in the different stages of sawah development. Farmers in villages where the projects continued for long participated more than in villages where the project was recently introduced. Closely related to the significant variables is the education of the farmers. Education has been reported as a variable that determine farmers adoption of sawah technology among farmers in Nigeria (Oladele and Wakatsuki 2007).

Table 3 Parameter estimates from Probit regression model

Variables	Regression Coeff.	Standard Error	Coeff. /S. E.
Sawah continuation	0.51300	0.10211	5.02406
Sex	−0.07518	0.09687	−0.77609
Time sawah started	−0.04523	0.02955	−1.53067
Residence status	−0.02729	0.09458	−0.28848
Religion	0.04555	0.07786	0.58502
Age	−0.01672	0.03049	−0.54842

(Continue)

Variables	Regression Coeff.	Standard Error	Coeff. /S. E.
Education	0. 05535	0. 04142	1. 33619
Farming Experience in rice	0. 03769	0. 10571	0. 35655
Major occupation	−0. 08435	0. 11474	−0. 73515
Household size	−0. 00786	0. 00972	−0. 80880
Farm size	0. 00255	0. 00319	0. 79958
Intercept	−2. 558	0. 297	−8. 609
Pearson Goodness-of-Fit Chi Square	412. 721		
DF	213		
P	0. 000		

4. Conclusion

This study has demonstrated that farmers' participation in the 3 phases of sawah development in Ashanti region of Ghana is influenced by their continuation of sawah, the duration of the sawah project and to an extent the educational level of the farmers. It is necessary to enhance the food production base for food security in Ghana, due to future population increase. It is therefore important to explore the lowlands of the inland valleys from its use status. The introduction of the rice field with proper field management and the water management can be done as described in the paper. To ensure a sustainable participation of farmers in sawah development, important social variables identified in this paper based on the 3 phases of sawah projects should be given policy consideration. It might be useful for agricultural development in Ghana to encourage such practice, and to derive the lesson from a follow-up survey and a continuous observation.

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