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Socio-economic factors influencing the adoption of sawah rice production technology in Nigeria

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Abstract

The study examined the socio-economic factors influencing the adoption of sawah rice production technology in Nigeria. The study was carried out in Bida area, Niger state, where the sawah rice production was disseminated by Watershed Initiative in Nigeria/Hirose Project through the support of the Japanese government. Simple random sampling technique was used to select rice growing farmers in the area covered by the project and primary data were collected through the use of a structured questionnaire on the objectives of the study. Descriptive statistics was used to analyze the socio-economic features of the farmers while the probit model was used to capture the socio-economic factors influencing the adoption of sawah rice production technology among rice growing farmers. The result of the probit model shows that four variables were statistically significant at various levels. These were membership of farmers association (t=2.91), educational level (t=1.65), length of residence in the village (t=2.11) and land ownership (t=1.91). All the significant variables were positively related to the probability of adoption except membership of farmers association that was inversely related to the probability of adoption of sawah technology.

Key words: Socio-economic, adoption, sawah system, rice, production technology, Nigeria.

Introduction

The drivers of the promotion of rice production and dissemination in Africa, according to Azuma [3], include the fact that rice is the most productive grain in a unit of arable land in Africa which can be grown three times within a year in most of African countries, and the ease of allocation crop rotation. Rice is an environmentally friendly crop and its production is sustainable. Rice is nutritionally rich with gluten and protein and can contribute to improve malnutrition in Africa. The production of rice introduces new cuisine with rich taste, and provides farmers with new sources of income. Nigeria is the largest country in West Africa, with the largest rice producing area in Africa.

The demand for rice in Nigeria has been soaring which was partly the result of increasing population growth, increased income levels, rapid urbanization and associated changes in family occupational structures. The average Nigerian now consumes 24.8 kg of rice per year, representing 9% of total caloric intake [9]. Currently, the per capita rice consumption in term of paddy per year has increased from 6.1 kg in 1960's to 45.2 kg (the average from 2001 to 2003) in Nigeria, while per capita import of rice increased form 2.8 kg in 1970's to 15.2 kg in 2003. In 2000, out of about 25 million hectares of land cultivated to various food crops, only about 6.37% was cultivated to rice. During this period, the average national yield was 1.47 tons per hectare. Though rice contributes a significant proportion of the food requirements of the population, production capacity is far below national requirements. To meet the increasing demand, the importation of milled rice was used to bridge the gap between domestic demand and supply. A major reason for this trend was adduced by The Expert Consultation on Yield Gap and Productivity Decline in Rice Production by FAO which recognized that there is a sizable rice yield gap between attainable and actual farm yield. In many developing countries, yield of paddy rice in irrigated area is only 4 to 6 tons per hectare, while the potential yield of modern rice varieties is 10 to 11 tons under tropical humid conditions. In Sub-Saharan Africa, rice yield is even worse with half of the world average, and there is a potentiality to improve rice yield considerably. Increasing rice yield and production requires not only genetic improvements for higher yield potential but also better management technologies and systems including institutions.

Toure [4] noted that the goal of increased productivity can be best achieved by coupling the most appropriate available technologies. Research institutions should provide appropriate and location-specific technological packages. The extension services should ensure farmers use correctly and systematically recommended technical packages. A farmer's ability to adopt those technologies depends on the linkages among research institutions, extension services and farmers. The impact of increased productivity of rice makes small farmers to be able to provide enough food for their families, and whatever surplus they have, they can sell it to markets. Moreover, these farmers can utilize the surplus labor force, which they may gain through increased productivity in the limited acreage of their farms in other areas of agricultural production, such as fruits and vegetables or livestock. This will provide them extra sources of income which will stimulate economic activities in rural areas such as retail, transportation and other service businesses.

There is a long history of rice research and production in Nigeria, and ironically Nigeria is still the largest importer of rice in the whole of Sub-Saharan Africa. Despite the potential for rice production and possible exportation, the potential has not been transformed into actual production [8]. Principal constraints identified in past studies are poor soil fertility, poor water management and poor varieties. With the improved and research break through of IITA and WARDA, the constraint of poor varieties has been eliminated. However, the existing improved varieties need improved water management and soil fertility conditions before the expected yield can be realized. The potential of sawah-based rice farming is enormous in West Africa in order to stimulate the long awaited green revolution [6]. This is predicated on the fact that the agro-ecological conditions of the core region of West Africa are quite similar to those of northeastern Thailand, which is one of the rice producing location in that country. Ten to twenty million ha of sawah can produce additional food for more than 300 million people in future. The sawah-based rice farming can overcome soil fertility problems through the enhancement of the geological fertilization process, conserving water resources, and the high performance multi-functionality of the sawah type wetlands. The term sawah refers to leveled and bunded rice fields with inlet and outlet connecting irrigation and drainage. Despite the predominance of rainfed agriculture in Nigeria, the sawah system use of inland valleys will enhance continuous cropping and less disruption of the production activities. Fashola *et al.* [5] noted that the sawah system offers the best option for overcoming constraints associated with rice production in Nigeria due to the utilization of the inland valleys which are reported to be high in fertility and enhances water management for rice production.

Sawah-based rice production took off through the establishment of a demonstration farm (1.5 ha) at Ejeti village in 2002. In 2001 three individual farmers participated in Sawah Package Program and the farmers increased to 16 and 36 farmers in 2003 and 2004 respectively. Watershed Initiative Nigeria (WIN) 2001 is operating the farm for multiplication of foundation seeds. In 2005, the farmers of the 'Sawah Package' have increased to 103 with four groups. From neighbouring villages rice farmers have applied for participation. All these farmers cultivate the inland valleys around their villages. However, there are some farmers who also practice sawah but do not cultivate inland valleys but floodplains [6]. The traditional and recommended sawah practices are shown in Figs 1 and 2. The rate of increase of farmers and farm size adopting sawah over a period of 5 years as well as the yield differentials in rice plots of adopters and non-adopters are presented in Figs 3 and 4.

Social scientists investigating farmers' adoption behaviour have accumulated considerable evidence showing that demographic variables, technology characteristics, information sources, knowledge, awareness, attitude and group influence affect adoption behaviour. This is predicated on the importance of farmers' adoption of new agricultural technology which has long been of interest to agricultural extensionists and economists.

Figure 1. Rudimentary/traditional sawah practice.

Figure 2. Recommended sawah practice.

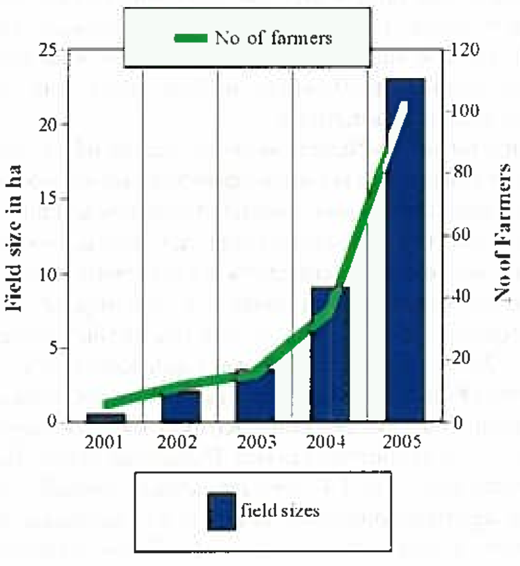

Figure 3. Rate of increase in farm size and farmers adopting sawah.

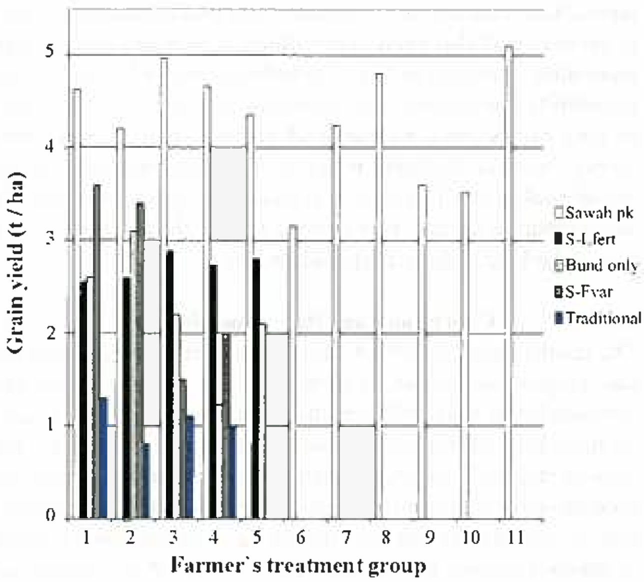

Figure 4. Yield from sawah plots in comparison with other treatments across villages.

Adoption of innovations refers to the decision to apply an innovation and to continue to use it [2]. A wide range of economic, social, physical and technical aspects of farming influences adoption of agricultural production technology. Recent adoption studies [1] have identified farm and technology specific factors, institutional, policy variables and environmental factors to explain the patterns and intensity of adoption. Adoption has been determined through variables such as gender, level of formal education, household size, farm size and wealth level. The involvement of farmers in technology development process is central for success in the adoption of farm technologies. The eventual decision of farmers to adopt or not will depend on their attitude to the innovation, farming experience, household size and visits by extension agents.

Methodology

The study was carried out in Niger state, Nigeria, and based on the activities of WIN among farmers for about 5 years. A list of rice farmers in the villages where sawah technology was disseminated was compiled with a total of 2064 farmers. A simple random sampling technique was used to select 206 farmers and data were collected on their socio-economic variables and adoption of sawah rice production system. Descriptive statistics was used to analyze the socio-economic features of the farmers while the probit model was used to capture the socio-economic factors influencing the adoption of sawah rice production technology among rice growing farmers.

The probit model: The probit model was used to analyse the adoption and non-adoption of sawah technology. The choice of explanatory variables (socio-economic characteristics) was based on literature on past adoption studies and the characteristics found among the respondents. The relationship between the probability of adoption variable Pi and its determinants q is given as:

$$P_i = \beta q_i + \mu_i,$$

where P_i=1 for $X_i \geq Z$; i=1,2 ......,n; q_i 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 a farmer adopts the sawah package and 0 if otherwise. The explanatory variables are: X_1=age in years; X_2=household size; X_3=length of residence in the village in years; X_4=household size involved in farming; X_5=dummy variable for educational level (educated=1, not educated=0); X_6=dummy variable for membership of farmers association (member=1, non-member=0); X_7=dummy variable for major occupation (farming=1, others=0); X_8=number of farm plots; X_9=farm size of upland rice (ha); X_{10}=farm size of lowland rice (ha); X_{11}=farming experience in years; X_{12}=dummy variable for land ownership (land owner=1, others=0).

Results and Discussion

Table 1 presents the socio-economic characteristics of adopters and non-adopters of sawah technology. The results were disaggregated based on the adoption status in order to highlight differentials in the characteristics studied among the two categories of the respondents. A greater proportion of the non-adopters were at least 40 years old while most of the adopters were in the age group of less than or equal to 40 years. There was a similar trend in terms of the household size, for the non-adopters majority had their household size of more than 10 members while the adopters had a few proportion above 5 members. Both the adopters and non-adopters had long years of residence in the villages of at least 10 years. The non-adopters had a greater proportion of their households involved in farming than the adopters while the proportions of educated farmers were similar for the respondents.

The trend of the result was similar in terms of the proportion of adopters and non-adopters with respect to their major occupation and number of rice plots. On the other hand, a greater proportion of non-adopters had large farm size planted with upland varieties than the adopters, although they had the same proportion planting lowland rice varieties. The patterns of membership in farmers associations, length of farming experience and land ownership were the same for the adopters and non-adopters.

From the results of the probit model the chi-square value was used to determine the goodness of fit of the model. The value is statistically significant at one percent level. The result also shows that 4 variables are statistically significant at various levels. Three variables significant at 5% are length of residence in the village (X_3) (t=2.11), membership of farmers association (X_6) (t=-2.91), and land ownership (X_{12}) (t=1.91). Only educational level (X_5) (t=1.65) is significant at 10%. It can be deduced that the longer the farmers have stayed in the village the higher the adoption of sawah technology. This might be due to the fact that the same inland valleys they have been cultivating for years can give them better yield with the sawah technology. This will also influence their access and control of the size and location of inland valleys they can cultivate. There is a positive relationship between the membership of farmers association and the probability of adopting sawah technology. This indicates that farmers who are members of the farmers association have higher probability of adopting sawah technology. This is because of high level of interaction among members of the same group is a means of disseminating

Table 1. Socio-economic characteristics of adopters and non-adopters of sawah technology.

Variable	Adopters (n = 63)	Non-adopters (n =143)
Age		
Less than 30	6(9.52)	16(11.18)
30-40	29(46.03)	68(47.55)
41-50	16(25.39)	33(23.07)
Above 50	12(19.04)	26(18.18)
Household size		
Less than 5	9(14.28)	24(16.78)
5-10	25(39.68)	71(49.65)
Above 10	29(46.03)	95(66.43)
Length of residence		
Less than 10	0(0)	2(1.39)
10-20	11(17.46)	14(9.79)
Above 20	52(82.53)	127(88.81)
Household size involved in farming		
Less than 5	38(60.31)	86(60.14)
5-10	19(30.16)	47(32.86)
Above 10	6(9.52)	10(6.99)
Educational status		
Educated	59(93.65)	129(90.21)
Not –educated	4(6.3)	14(9.79)
Major occupation		
Farming	53(84.20)	128(89.51)
Non- farming	10(15.9)	12(8.39)
Number of rice plots		
Less than 5	21(33.33)	38(26.57)
5-10	39(61.90)	85(59.44)
Above 10	3(4.76)	20(13.98)
Farm size of upland rice		
Less than 5	29(46.03)	83(58.04)
5-10	25(39.68)	49(34.26)
Above 10	9(14.28)	11(7.69)
Farm size of lowland rice		
Less than 5	39(61.90)	102(71.32)
5-10	18(28.57)	36(25.17)
Above 10	6(9.52)	5(3.40)
Membership of farmers association		
Members	56(88.90)	120(83.91)
Non-members	5(7.9)	23(16.08)
Farming experience		
Less than 10	0(0)	6(4.19)
10-20	28(44.44)	41(28.67)
Above 20	35(55.55)	96(30.50)
Land ownership		
Owners	57(90.50)	109(76.22)
Non-owners	6(9.50)	34(23.78)

Table 2. Results of the probit model.

Independent variable	Regression coefficient	Standard error	t-value
Constant	-1.58	0 .82	-1.92*
Age	0.0032	0.00363	0.881
Household size	0.0029	0.00323	0.916
Length of residence in the village	0.0056	0.00269	2.11**
Household size involved in farming	-0.00029	0.00752	-0.038
Educational level	0.03286	0.01992	1.65*
Membership of farmers association	-0.28561	0.09833	2.91**
Major occupation	-0.05750	0.27926	-0.205
Number of farm plots	-0.00799	0.00823	-0.970
Farm size of upland rice	-0.00241	0.00668	-0.361
Farm size of lowland rice	0.01003	0.00908	1.10
Farming experience	0.00294	0.00334	0.881
Land ownership	0.05826	0.03043	1.91**
Chi –square (χ^2)	814.26		
Df	73		
N	206		
P	0.00		

innovation to the members. Farmers groups are sources of inputs to farmers and also exert peer influence on members to adopt innovation. Increase in land ownership status will increase the probability that a farmer will adopt sawah technology. Thus land owners will be more willing to adopt the technology than non-owners because the bund which is a major component of the sawah package will have to be retained after harvest in order to save labour for the next rice growing period, the control of which may be lacking with the non-land owners.

Conclusions and Recommendations

The results show that about a third part of the farmers sampled has adopted the sawah technology in the villages where the dissemination took off. Length of residence in the village, membership of farmers association, land ownership and educational level are factors that could be used to explain the preference for the sawah technology. It is therefore recommended that the organization responsible for the dissemination of sawah technology will pay more attention to these variables as more rice producing areas are covered.

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