WFL Publisher
Science and Technology
Meri-Rastilantie 3 B, FI-00980
Helsinki, Finland
e-mail: info@world-food.net

Journal of Food, Agriculture & Environment Vol.6 (3&4) : 387-390. 2008 *www.world-food.net*

Socio-economic factors influencing power tiller use among sawah farmers in Bida, Nigeria

Yinka Segun Ademiluyi [1], Oladimeji Idowu Oladele [2*] and Toshiyuki Wakatsuki [3]

[1] National Center for Agricultural Mechanization, Ilorin, Nigeria. [2] Department of Agricultural Economics Education and Extension, Botswana College of Agriculture, University of Botswana, P/Bag 0027, Gabaorone, Botswana. [3] Faculty of Agriculture, Kinki University, Nara, Japan. e-mail: oladele20002001@yahoo.com, segunncam@yahoo.com, wakatuki@nara.kindai.ac.jp

Received 17 April 2008, accepted 19 August 2008.

Abstract

This paper examines socio-economic factors influencing power tiller use among sawah farmers in Bida, Nigeria. This is based on the fact few units of power tillers were imported for lowland rice cultivation. The power tiller is a multipurpose hand tractor designed primarily for rotary tilling and other operations on small farms. The study was carried out in Niger state, Nigeria, and a list of rice farmers in the villages where sawah technology was disseminated was compiled with a total of 2064 farmers. The availability of power tiller is a prerequisite for the adoption of sawah rice production technology. A simple random sampling technique was used to select 200 farmers, and data were collected on their socio-economic variables and power tiller use. 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 use of power tillers among rice growing farmers. The results show that majority of the farmers are about 42 years of age with quranic form of education, belonging to at least one farmers group and have been farming for about 12 years. The land tenure system is predominantly through inheritance. The respondents are predominantly practicing sawah, and power tiller use among the respondents is about 85 percent. Important socio-economic characteristics that are of crucial concern in the introduction of power tiller to sawah adopting farmers are age, educational level, membership of farmer group, farm size, land tenure, practice sawah, location/distance of sawah plot and cost of power tiller use. The effect of each of these socio-economic characteristics and their interaction will determine the trend of continuous and future use of power tillers among the rice farmers.

Key words: Socio-economic factors, power tiller, sawah rice production, farmers, Nigeria.

Introduction

Rice is an important staple food in Nigeria. 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 [1]. The demand for rice has been increasing at a much faster rate in Nigeria than in other West African countries since the mid 1970s as rice is now cultivated in virtually all the agro-ecological zones in Nigeria. Despite this, the area cultivated to rice still appears small. 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.

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 [2]. 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.

Fashola *et al.* [3] noted that the sawah system offers the best option for overcoming the above stated constraints because it utilizes the inland valleys which are reported to be high in fertility and enhances water management for rice production.

Despite the predominance of rainfed agriculture in Nigeria, the sawah system use of inland valleys will enhance continuous cropping and less disturbance of the production activities.

Sawah is a multi-functional contracted wetland, which is a prerequisite for realizing the green revolutions as well as for pressing and even restoring ecological environments.

Wakatsuki and Masunaga [4] reported that the potential of sawah-based rice farming is enormous in West Africa in order to stimulate the long awaited green revolution. 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 center in the 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 such soil fertility problems through the enhancement of the 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 (Fig. 1).

Rudimentary/traditional sawah practice

Recommended sawah practice

Figure 1. Rudimentary/traditional and recommended sawah practice.

Sawah-based rice production started after preliminary basic research work on the suitability of inland valleys in Nigeria by Japanese researchers. A 1.5 ha field at Ejeti village was cultivated in 2001. There has been an increasing trend in the number of farmers adopting sawah, field sizes planted to sawah and yield from sawah plots as stated in Fig. 2.

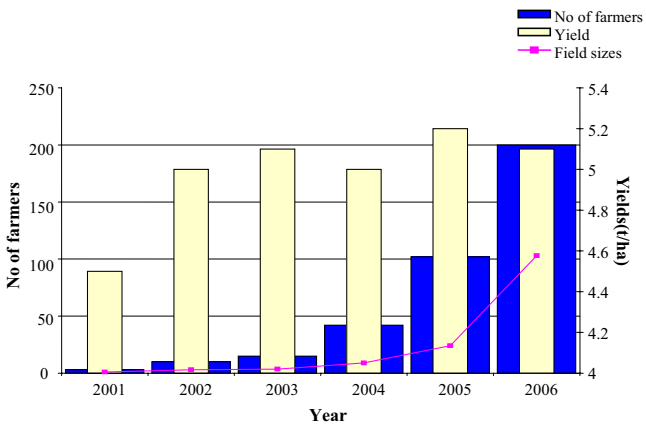

Figure 2. Rate of increase in number of farmers, field size and yield on sawah.

Majority of farmers growing rice in Nigeria use direct sowing as method of planting. The direct sown paddy gives about 20% less yield than the transplanted paddy but at less expense. However with the sawah rice production technology farmers grow paddy by transplanting method to get a higher yield. Puddling is an important field operation carried out for transplanting paddy as it makes transplanting easier, creates favourable physical and microbiological condition for plants growth, mixes the fertilizer thoroughly and suppress weeds. Pudding is generally done by power tillers which can be repeated to get the desired quality of pudding.

Based on the foregoing, power tillers were re-introduced into Nigerian agriculture by importing few units for paddy cultivation. The power tiller is a multipurpose hand tractor designed primarily for rotary tilling and other operations on small farms. While in operations, an operator walks behind to maneuver it. It is also known as a garden tractor, hand tractor, walking tractor or a two-wheel tractor. Implements initially offered with the power tillers included rotavator attachment, trailer and in some cases a plough and ridger. Power tiller is the only power-driven tool that is effectively being used for sawah activities currently in Nigeria. It is less sophisticated and not too expensive. It can be used for a variety of land preparation activities. Some of these include ploughing, puddling, levelling and transportation among other things. It can also be used as a power source for stationary machines such as threshers and millers. The small size and low weight of power tiller make them suitable for use in soft ground conditions. It is reinforcing rather than disturbing the soil pan [5].

Power tiller has a mounted plough which easily brakes and inverts/turns the soil, after land has been cleared of vegetation and stumps. Ploughing can be done either under semi-moist or flooded conditions. In puddling/leveling the power tiller performs an operation where soil is being pulverized with (indirect puddling) or without initial (direct puddling) ploughing of the field. Puddling is done using the power tiller mounted with a rotavator. Under this operation, ploughed/unploughed land is further pulverized into a fine textured medium under flooded condition before transplanting of seedlings is done.

The levelling is reinforcing rather than disturbing the soil pan. This is done to reduce the slope/gradient to the barest minimum to ensure uniform distribution of water across the field [6]. The power tiller has an average lifespan of 4-5 years depending on how it is used/handled. The power tiller has a longer life span if it is used solely for land preparation on paddy fields. Most land preparation activities should be conducted only under moist conditions. It can effectively cultivate over 40-50 ha of land per season and can work for about 8 hrs per day. The power tiller can plough 0.5-1.0 ha of land a day and can puddle 1.0-2.0 ha of land over the same period depending on the operators experience, size and shape of the field. However, after every four hours work, a one hour break is necessary for the machine.

A power tiller of 5 to 12 hp can develop a sufficient drawbar power for various farm operations and can easily replace bullock pairs. Thus it is a suitable unit for farmers having up to 4 ha cultivable land [7].

Not only is the power tiller technology relatively new but also during the past few years their retail prices have increased about 2-3 times as it presently costs 5000–7000 USD and this is high investment which an average farmer with 3-5 ha holding cannot afford. Lack of promotional measures, non-availability of well matched implements which would enable the farmers to fully replace the manual and poor after-sales service facilities also accounted for slow development of power tiller.

There are many factors affecting the use and development of tractors, such as agricultural conditions, farming requirements, management scale, economic conditions, technical level of manufacture and farmer's experience. In consideration of Nigeria's agricultural conditions, small tractors are more adaptable. Small tractors are suitable to agricultural conditions and farming requirements in most areas. In Nigeria, management scale limits are field size while in paddy fields, land leveling limits the field size, using large and medium tractors on small-farm sizes is

uneconomical. As the small tractors have the advantage in size, light-weight and good maneuverability, small tractors are suitable to the level of mechanical knowledge and management in rural areas. The structure of small tractors is simple and this makes the operation, maintenance and repair easy. Usually repair is done by the operator himself on the spot. Operators need not go technical schools for years, as a small tractor can be operated after going through a training course of short period. Walking tractors are suitable to the features of vast paddy field. The wheel performance is the key point in determining the performance of walking tractors in paddy fields. Experience shows that walking tractors used in paddy field area have to meet the need of ploughing, rotary cultivation and transportation. Iron wheels equipped on walking tractors are more economical than high-lug tires. However, iron wheels of various types used for draft operation in paddy field have a high rolling resistance coefficient which is 0.2-0.3 in the flooded paddy field with a plow layer of medium depth. Therefore, power loss due to rolling resistance of tractor in plowing operation is over 30%. Additionally, slip loss is above 25%. Maintenance of the power tiller is set of simple compulsory operations specified in the relevant documents, which if carried out properly will keep the machine available throughout the service life [8]. Maintenance can be preventive or curative/breakdown. These include cleaning after daily operation, re-tightening of the tines bolts and other soil engaging part of the power tiller, daily checking of water and fuel level after the daily operation and the changing of engine oil after the machine has worked for 48 hrs or 6 days since it has no engine oil filter.

Methodology

The study was carried out in Niger state, Nigeria, a list of rice farmers in the villages where sawah technology was disseminated was compiled with a total of 2064 farmers.

The availability of power tiller is a prerequisite for the adoption of sawah rice production technology. A simple random sampling technique was used to select 200 farmers and data were collected on their socio-economic variables and power tiller use. 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 use of power tillers among rice growing farmers.

The probit model was used to analyse use of power tillers. 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: $Pi = \beta qi + \mu i$, where $P_i=1$ for $X_i \geq Z$; i=1,2 .....,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 μi. The dependent variable Pi is a dichotomous variable which is 1 when a farmer uses power tiller and 0 if otherwise. The explanatory variables are: X_1 = age in years, X_2 dummy variable for educational level (educated = 1, not educated = 0); X_3 = dummy variable for membership of farmer group (member = 1, non-member = 0); X_4 = farm size in ha, X_5 = farming experience in years, X_6 = dummy variable for land tenure system (land owner = 1, others = 0), X_7 = tenure period in years, X_8 = household size in number of persons, X_9 = dummy variable for practice sawah (yes = 1, no = 0), X_{10} = length of sawah practice in years, X_{11} = location/distance of sawah in kilometers, X_{12} = cost of use in Naira.

Results and Discussion

The socio-economic characteristics of the respondents covered in this study are presented in Table 1. This combines their personal and farm characteristics. The table shows that majority of the farmers are about 42 years of age with quranic form of education, belonging to at least one farmers group and have been farming for about 12 years. The land tenure system is predominantly through inheritance, while those who rent land have an average period of about 3 years as the tenancy period. Among the respondents, about 5 persons are involved from each household in farming an indication that respondents have large family sizes. The respondents are predominantly practicing sawah and the average distance of sawah plots to settlement is 3.5 km while length of practice is 4.6 years. Power tiller use among the respondents is about 85 percent, through hiring and provision by the sawah project.

From the results of the probit model presented in Table 2, 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 8 variables are statistically significant at 5%. These are age (t = 2.75), educational level (t = 2.79), membership of farmer group (t = -2.52), farm size (t = 2.02), land tenure (t = 1.82), practice sawah (t = 3.38), location/distance of sawah plot (t = -2.14) and cost of power tiller use (t = -2.36).

It can be deduced that the younger the farmers the more the use

Table 1. Socio-economic characteristics of respondents.

Socio-economic/farming characteristics	Description
Age	Mean = 41.96
Educational level	Predominantly Quranic
Membership of farmer group	Predominantly members
Farming experience	Mean = 12 years
Land tenure system	Predominantly Inheritance
Tenancy period	Mean = 2.92 years
Household size involved in farming	Mean = 4.6 persons
Length of sawah practice	Mean = 4.6 years
Cost of use	Mean = 15,000 in Naira
Location/distance of sawah plot	Mean = 3.5 km
Practice sawah	Predominantly sawah based
Power tiller use	85 percent of respondents usage

Table 2. Parameter estimates from probit regression model.

Variable	Regression coeff.	Standard error	Coeff./S.E.
Age	2.00198	0.00262	2.75536
Education	2.01452	0.01824	2.79609
Farmer group membership	-2.04330	0.08351	-2.51850
Farm size	2.00028	0.01378	2.02012
Farming experience	0.00286	0.00223	1.28510
Land tenure	1.02840	0.03485	1.81503
Tenure period	0.00878	0.02157	0.40716
Household size involved in farming	0.00203	0.00864	0.23510
Practice sawah	0.44803	0.13235	3.38529
Length of sawah practice	0.01233	0.01659	0.74370
Location of sawah	-0.04775	0.02233	-2.13832
Cost of use	-2.01225	0.03395	-2.36091
Intercept	-2.53420	0.15497	-16.35263
Pearson Goodness-of-Fit Chi Square	126.335		
DF	193		
P	0.000		

of power tiller on their plot and also the higher the level of education among farmers the more the use of the power tiller for productive purposes. There is an inverse relationship between the membership of farmers association and the probability of using power tillers. This indicates that farmers who are members of the farmers association have higher probability of using power tiller. This is because of high level of interaction among members of the same group and the ability to hire power tiller as a group. The group influence also affects the decision to use power tiller. As the farm size increases, the probability of using power tiller also increases as farmers would be able to cope with the farm power demand due to large size. Similarly, land tenurial right is positively related to use of power tillers, as land owners are more comfortable with the use of power tillers. On the other hand there is inverse relationship between distance to sawah plot, cost of use of power tiller and the probability of using power tillers. This indicates that an increase in any of these variables will lead to a decrease in the probability of using power tillers. This may be due to the fact that serious transportation problems are associated with far sawah plots due to the amount of labour they will have to put in. Similarly, the cost of use of power tillers is a prerequisite for its use. Therefore, if farmers cannot afford the cost, then the probability of power tiller use is low.

Conclusions and Recommendations

This study has demonstrated that the use of power tiller among sawah practicing farmers in Bida area, Nigeria, is highly beneficial in supporting their rice production activities. Important socio-economic characteristics that are of crucial concern in the introduction of power tiller to sawah adopting farmers are age, educational level, membership of farmer group, farm size, land tenure, practice sawah, location/distance of sawah plot and cost of power tiller use. The effect of each of these socio-economic characteristics and their interaction will determine the trend of continuous and future use of power tillers among the rice farmers. As the adoption of sawah rice production technology spreads among farmers in Nigeria, the consequent effect of socio-economic characteristics on the use of power - a major component of the technology should be given serious consideration.

References

[1]RICE WEB 2001. Rice is Life http://oryza.com/africa/nigeria/index.shtml

[2]Oladele, O. I. and Sakagami, J. I. 2004. Impact of technology innovation on rice yield gap in Asia and West Africa. Technology Transfer Issues http://www.tropentag.de/2004/abstracts/full/2.pdf

[3]Fashola, O.O., Oladele, O. I., Aliyu, J. and Wakatsuki, T. 2006. Dissemination of sawah rice technology to farmers cultivating inland valleys in Nigeria. Proceedings of the Asian Pacific Extension Network, 6-8th March 2006 Australia. http://www.regional.org.au/au/apen/2006/refereed/5/3223_fashola.htm#TopOfPage

[4]Wakatsuki, T. and Masunaga, T. 2005. Ecological engineering for sustainable food production and the restoration of degraded watersheds in tropics of low pH soils: Focus on West Africa. Soil Sci. Plant Nutr. **51**(5):629-636.

[5]Fasola, O.O., Ademiluyi, S.Y., Faleye, T., James, D. and Wakatsuki, T. 2007. Machinery systems management of walking tractor (power tiller) for rice production sawah in Nigeria. Journal of Food, Agriculture and Environment **5**(3&4):284-287.

[6]Gupta, J.P. and Kumar, S. 2001. Status of power tiller use in Bihar - A case study in Nalanda district. Agricultural Mechanization in Asia, Africa and Latin America **32**(1):19-22.

[7]Singh, A.K., Mishra, D., Sharma, P., Kavia, Z.D. and Pande, P.C. 1995. Tractor vs power: Projections for Indian arid zone. Agricultural Mechanization in Asia, Africa and Latin America **26**(1):16–20.