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Farmers adoption and propensity to abandoned adoption of sawah-based rice farming in the inland valley of central Nigeria

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Abstract

This paper describes a process of technology dissemination to rice farmers cultivating inland valleys in Nigeria. The sawah-based rice production technology is an adapted rice production technology system in Asia, which consists of leveled field surrounded by banks with inlet and outlet connecting irrigation and drainage canals, row transplanting of improved variety and fertilizer application. The sawah system has contributed substantially to the Green Revolution in Asia and is hypothesized to be the key to improve rice production in Africa. This paper presents views of twenty-four farmers who were participating or have ever participated in the sawah development project on why they will adopt sawah technology as well as the factors that may make them discontinue the adoption. Descriptive statistics was used to analyze the socio-economic features of the farmers. The results show that majority of the farmers are about 40 years of age with quranic form of education and have been farming for 22 years. The land tenure system is predominantly through inheritance and farmers cultivate 2.5 rice plots. The average years of sawah experience is about 5 years and 33 percent of farmers are currently using power tiller in their sawah basins. Meanwhile, the result of farmer's evaluation shows that after years of continuous efforts, the advantages of the sawah system over the traditional system, namely higher yield, better water and weed control, have been recognized and highly valued by participating farmers. Difficulty in water control for plot with sandy soil in flood-prone area, limited plot size due to land tenure system and high labour requirement that can be solved by the introduction of power tiller are major reasons that farmers gave as hindrances to the adoption of sawah technology.

Key words: Sawah rice production, farmer evaluation, technology dissemination, inland valley, Nigeria.

Introduction

The recent general trend of food prices in 2008 is that they are characterized by high and soaring prices. This increase, particularly for rice, a major staple crop, has a substantial impact on Nigeria, the second largest rice importing country of the world after Saudi Arabia [1]. Rice is a favorite staple diet of millions of Nigerians. Since the mid-1970s, rice consumption in Nigeria has risen tremendously at about 10% per annum. The increase in demand was partly the result of increasing population growth, increased income levels, rapid urbanization and associated changes in family occupational structures [2]. Per-capita rice consumption increased from 5 kg in the 1960s to 25 kg in the late 1990s [3]. Nevertheless, domestic production has never been able to meet the demand, leading to considerable importation every year and thereby putting strain on the precarious balance of payment position of the country. Nigeria spent USD 267 million on rice importation in 2006, and it is projected by local media that the import bill may hit USD 1.7 billion in 2008 [3]. Hinano [4] revealed that food importation has been a significant obstacle hindering economic development of sub-Saharan African countries. With the current crisis, the need for Nigeria to achieve self-sufficiency in rice becomes imperative.

Nigeria is reputed to have comparative resource advantage, in terms of favorable climatic, edaphic and ecological conditions, in the production of rice for self-sufficiency. In spite of this, inconsistent government policy on rice importation and production has harmed the rice production sector and failed to stop the expansion of rice importation [5]. Sakurai [6] indicated that with the current available technology, green revolution is possible in West Africa and concluded that infrastructure of irrigation facility, the key of success for the green revolution of Asia, is the prerequisite for achieving green revolution in Africa as well. Wakatsuki [7] argued that in order to realize green revolution in Sub-Saharan Africa, it is essential to improve rice-growing environment by promoting lowland sawah eco-technology. Fashola *et al.* [8] noted that the sawah system offers the best option for overcoming the constraints of rice production in Nigeria, namely poor soil fertility, poor water management and poor varieties. It is because the sawah system utilizes the inland valleys which are reported to be high in fertility and through appropriate water management fertility can be sustained and enhanced for rice production. The term sawah refers to leveled rice field surrounded by banks with inlet and outlet for irrigation and drainage. Several authors reported that the sawah system has increased yields and enhanced soil nutrient and water conservation [8-10]. The basic elements of the sawah

system include improved irrigated rice basins, seedbed preparation, transplanting and spacing of seedlings, fertilizer application and most importantly, appropriate water management. With proper water management, efficiency of fertilizer application would largely increase and lead to high yield of rice [11]. By promoting the sawah-based rice production to wetlands where rice is not traditionally planted, it is anticipated that Nigeria could produce up to 10 million tons of rice annually by year 2020 [12].

The sawah-based rice farming system was first introduced to Africa by the assistance of the Republic of China (Taiwan) during 1960s. The effort was then followed by Japan, Korea and China[13]. Among all the wetland environments, inland valley is regarded as having the highest potential for agriculture intensification and rice production. Based on the inventory data of inland valleys in West Africa [14], the potential inland valley area in Nigeria for small-scale irrigated sawah is between 6 to 7 million ha, which is about 7% of total land area, 10-12% of Guinea Savannah Zone and 63-74% of the Humid Forest Zone of the country [15]. In Niger State, there are 40,200 ha of land having potential for small-scale irrigated sawah development [16].

The Nupe farmers of the Niger State have a long established tradition in lowland rice cultivation, such that in the inland valleys of the Niger State, rice is cultivated in the rainy season, followed by crops such as cassava, sweet potato, okra, pepper and other vegetables in the dry season. Nupe farmers in the inland valleys practice the traditional random basin system based on the construction of small basins with small banks to retain rain and seepage water and poorly developed water delivery system. These small random basins are similar to the rudimentary sawah fields that existed in ancient Japan and primitive Indonesia and can be regarded as quasi-sawah fields [7]. Ishida *et al.* [17] identified seven forms of land preparation from these basins, namely Togogi or Togoko kuru, Togogi or Togoko naafena, Ewoko, Baragi and Gbaragi. There is a close relationship between each landform and microtopography. One of the main disadvantages of the traditional random basin is that the banks built are low and partly opened, therefore water is always flowing in the fields and no accumulation of soil nutrients can be expected. Even though the banks become higher later as weeds and clods are piled up during the weeding work and water flows become stagnant, this rice farming environment is still regarded as inadequate as the banks are not permanent and outflow of soil nutrients are not effectively checked [18, 19]. The major advantage of the traditional system is that it saves labor when farmers make mounds from the banks for off-season plantation. The sawah system is different from the traditional system in that the basins are larger in size, demarcated by permanent high banks, leveled and puddled. Direct sowing is performed in the traditional system whereas seedling, transplanting and spacing are the basic techniques in the sawah system. Water management under the sawah system is also more efficient and the effectiveness of fertilizer application is largely superior.

The sawah system was first introduced to the Bida region through on-farm adaptive research by International Institute of Tropical Agriculture (IITA) scientists on farmer's fields of Gara and Gadza inland valleys during 1986-1990. The research focused on the evaluation of varieties and fertilizers but not on technology transfer. Consequently, the sawah technology was not diffused among farmers during this period. During 1992 to 1995, Japanese scientists of Japan Society for the Promotion of Science (JSPS) and Association for International Collaboration of Agriculture and Forestry (AICAF) conducted on-farm demonstration experiments and participatory trials of the sawah system in Gadza inland valleys. Despite higher yields of the experimental sawah fields, the adoption by farmers was generally poor. Efforts to introduce the sawah systems to Nupe farmers were continued by Japanese scientists and local staff from Nigeria National Cereals Research Institute (NCRI) and Bida Agriculture Development Project (BADP). From 1998 to 2001, small demonstration sawah fields of 10 m^2 were made in 13 villages. In order to further promote the sawah system to farmers, a local NGO, Watershed Initiative in Nigeria (WIN) was established in 2001 with funding provided by the Japanese Ministry of Education. The real efforts for dissemination of sawah system took place in 2003 by WIN and the sawah system was re-introduced to five villages. The total area of sawah fields developed by farmers with the assistance of WIN increased from 10 ha in 2004 to 20 ha in 2005, and further increased to 35 ha in 2006. The number of participating farmers also increased from 3 in 3 villages in 2001 to 500 all over Nigeria in 2007. The sawah system succeeded to produce over 5 t/ha while the traditional system produced only 1-2 t/ha [8].

Methods

The study was carried out in Niger State, Nigeria. Twenty-four farmers who were participating or had ever participated in the sawah development project were interviewed during January 2005 for the evaluation of sawah system as compared with the traditional system. Qualitative method was adopted in order to derive a better understanding of the degree of acceptance of the sawah technology and the factors hindering their adoption of the system. Descriptive statistics were used to analyze the socio-economic variables of the farmers. Information gathered in the interviews was summarized in percentages to analyze the evaluation of sawah system by farmers. Among the informants, twelve of them had abandoned or given up to adopt the sawah system. Their reasons were summarized in table for discussion.

Results and Discussion

Farming characteristics: 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 informants are about 39.79 years of age with quranic form of education and have been farming for about 22 years. The land tenure system is predominantly through inheritance. Among the respondents, about 3.4 persons are involved from each household in farming and the average household size is 11.32 persons. The respondents cultivate 2.48 rice plots and have an average of 5.10 years of experience of

Table 1. Socio-economic characteristics of farmers.

Socio-economic/farming characteristics	Description
Age	Mean = 39.79
Education level	Predominantly Quranic
Farming experience	Mean = 21.90 years
Land tenure system	Predominantly Inheritance
Number of rice plot farmed	Mean = 2.48 plots
Household size	Mean = 11.32 persons
Household size involved in farming	Mean = 3.4 persons
Length of sawah experience	Mean = 5.10 years
Power tiller use	33 percent of respondents usage

Table 2. Factors promoting adoption of sawah system among farmers.

Description	Percentage
Higher yield	95
Better water control	77
Better weed contro	50
Retain soil fertility	18
Earlier harvesting	14
Less work by using power tiller	9

Table 3. Factors on propensity for abandoned adoption of sawah system among farmers.

Description	Percentage
More labour needed for land preparation	73
Difficult to maintain larger basin	32
Dependent on power tiller	23
More water needed	18
Difficult water management	14
More work for transplantation	14

sawah practice. Power tiller use among the respondents is about 33 percent, through hiring and provision by the sawah project of WIN.

Evaluation of the sawah system: The evaluations of the sawah system by the twenty-four farmers who have experienced the system in different ways are presented in Tables 2 and 3. The sawah system was highly valued by farmers. The basic components of the sawah-based rice production, namely higher yield, better water control and better weed control were well acknowledged by informants. The benefit of better soil nutrient retention is less recognized as it requires a longer time for farmers to be able to see the improvement. However, most of the informants could correctly describe that it was because of the water retention of the sawah basin that the effectiveness of fertilizer application increased that led to a higher yield. Regarding the disadvantages of the sawah system, the major concern of farmers was the higher labor requirement for land preparation. The NGO WIN introduced the power tiller, a hand driven two-stroke engine machine, to solve the problem of labor constraints in 2003 [20]. The introduction of the power tiller also enhanced water management. However, because of a limited capacity to service the power tiller by the NGO, some informants revealed that they could not expand their sawah fields any further. Informants reflected that sawah basins need more water than traditional basins but none of them thought there would be a problem of insufficient water even if more sawah basins were developed.

The reasons of farmers not to adopt the sawah system are summarized in Table 4. These farmers mostly participated in the on-farm demonstration experiment during 1986-1990 and the making of 10 m^2 demonstration plots during 1992 to 1995. The mostly mentioned reason is related to the difficulty in water control as the sandy soil makes maintenance of high and thick banks of sawah basin difficult. The second reason is the limited plot size. The average size of irrigated rice plot in inland valley of the area is just about 2,973 m^2 [21]. Oladele and Wakatsuki [22] reported that it is more difficult for farmers to obtain access to wetland plots than in the past. Attention should be paid to these obstacles for the further development of the sawah technology.

Table 4. Reasons for abandoned adoption of sawah system among farmers.

Sawah experience	Reasons for giving up on sawah
Practiced on family land only	Limited plot size
	Having other occupation so no time and labor for sawah
	Difficult water control for his own plot due to sandy soil
Participated in the on-farm demonstration experiment	Difficult water control due to flooding
	Cannot afford higher labor cost
	More soils are needed for banks
	Limited plot size
	Dispute of water use
	Difficult water control due to larger plot size
	Fulani cattle destroy banks during dry season.
	Prefer to modify traditional system to retain water

Conclusions and Recommendations

This study described the dissemination process of the sawah system in central Nigeria and the views of farmers who were participating or have ever participated in the sawah development project on why they will adopt sawah technology as well as the factors that make them discontinue the adoption of sawah system. After years of continuous efforts, the benefits of the sawah system have been acknowledged by farmers. The major constraint of high labour requirement is being solved by the introduction of power tiller. For the further expansion of the sawah system, attention should be paid to the obstacles brought by the limited plot size and the problem of sandy soil in flood-prone area. It may require some changes in the utilization of land and water in the inland valley which should be tackled in the long-term basis.

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