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Full Length Research Paper

Upland rice growing: A potential solution to declining crop yields and the degradation of the Doho wetlands, Butaleja district-Uganda

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The paper presents results of a study conducted among 360 small-scale paddy farmers in Butaleja District from February 2005 to February 2006, which demonstrated that paddy yields were significantly less than those reported for Upland rice varieties, which raises the question of the efficacy of paddy rice growing as an income-generating strategy, and resultant costs of degrading the Doho Wetlands. It proposes the promotion of Upland rice growing as an alternative that could not only raise incomes of local farmers but also prevent the further degradation of the Doho Wetlands (DW). Data was collected using questionnaires, interviews, focus group discussions and documentary analysis. It was established that rice yields were significantly ($p<0.05$) higher during the long rainy season (March to June) than during the short rainy season (August to October). The farmers within the Doho Rice Scheme (DRS) had significantly ($p<0.05$) higher yields than their counterparts the out-growers (OGS) and farmers in the seasonal Nambaale Wetland (NWF). Prior to the 1980s paddy rice growing significantly improved the household incomes of rural farmers in the area when yields of up to 1,000 kg/acre were attainable. However in the subsequent years, the contribution of rice growing to household incomes has sharply declined due primarily to the declining soil fertility levels, farmers' inability to control water use, use of low yielding varieties, and poor farming practices, thereby adversely impacting on the integrity of the Doho Wetlands. It was concluded that Upland rice cultivation offers a more viable alternative to paddy rice growing as an income generating activity, which could also ensure the conservation of the Doho and surrounding wetlands.

Key words: Paddy farmers, out growers, upland rice, wetland degradation, conservation.

INTRODUCTION

Rice (*Oryza* spp.) is the world's most important cereal considering the area under cultivation and the number of people who depends on it (FAO, 1995; Africa Rice Centre, WARDA, 2009). Rice is increasingly becoming important in the diet and farming systems in Africa. Madagascar is the leading producer of rice in Eastern and Southern Africa region (ADC, 2001; Luzi-Kihupi, 1998). It is estimated that by 2001, East African countries were producing 503,137 metric tons annually, which was below their estimated demand of 625,795 metric tons, primarily due to low crop yields. Tanzania which is the largest producer of rice in East Africa is estimated to produce slightly over 500,000 tons annually. In Uganda, rice growing gained prominence after 1970, following the establishment by Government of commercial farms in Kibimba (Bugiri district), Doho (Butaleja district) and Olweny (Lira district).

A major shift in the farming systems of poor rural farmers in Uganda over the past three decades has been directed toward the commercialization of rice production, as a strategy to reduce poverty in households. The prevalent view of many of those farmers is that agricultural utilization of wetlands could be improved. It is therefore, perceived as a prudent solution to their ever increasing demand for farmland (WID, 1999). Apart from a few Government Rice Schemes, rice growing in Uganda is still dominated by rural small-scale farmers living in areas adjacent to wetlands (ADC, 2001; MAAIF, 2008).

In the recent past, rice acreage has greatly expanded

because of the increased demand in urban areas, the changing food habits and, the decline in the production of traditional food crops, particularly bananas, cassava and finger millet (ADC, 2001; MAAIF, 2008; MOFPED, 2009). Since 2004, the Government has directly intervened to promote the cultivation of rice as a strategy to achieve the following objectives: (a) reduce household poverty,

(b) and to reduce rice imports in a country that is currently experiencing an upsurge in rice consumption, which lags behind production. The country spends close to US $90m on rice imports each year.

Given its value and potential, it is likely that rice growing in Uganda will greatly expand in the near future. Of the average 600,000 metric tons produced annually in East Africa in the period 1995-2000, about 90,000 tons were from Uganda (ADC, 2001). This upward trend in rice production has continued and it is estimated that in 2001, the country grew rice on 76,000 hectares, which gave an output of 114,000 tons. Since 2004 the output has more than doubled and, it was expected to reach 180,000 tons by the end of 2009, up from 135,000 tons in 2006, placing it amongst the most widely grown non-traditional food crops. In some parts of the country, rice acreage is increasingly competing with that of the traditional staple food crops, such as bananas, cassava, maize and finger millet. As a result of increased output, the consumption of imported rice has fallen by half since 2004 (Ministry of Trade and Industry, MOTI, 2008).

The major rice producing areas in Uganda include the districts of Pallisa, Butaleja, Iganga, Lira, Bundibugyo and Gulu. The impact of rice cultivation on wetlands depends on wetland type, the intensity of drainage and agronomic practices including the use of fertilizers. Excessive use of fertilizers will cause eutrophication and adversely affect the ability of the wetland to maintain and improve water quality. Drainage for agriculture is particularly harmful to seasonal wetlands. It has been reported that 60% of the seasonal wetlands in Pallisa and Iganga districts have been lost as a result of this practice (MoNR, 1996). In Butaleja district, over 80% of the rice is cultivated in the Doho Wetland. The Doho Wetland is an important ecological flood plain for River Manafwa from the highlands of Bugisu, before it empties into Lake Kyoga, and eventually River Nile. It is also important for its biodiversity (Gumonye-Mafabi, 1989; Ecaat, 1991), and as a source of wetland products. These factors make Doho wetland a priority area for international conser-vation efforts.

Although guidelines have been developed for agricultural use of wetlands (WID, 2001; WID, 2006), these have not been widely implemented. This implies that as demand for farmland steadily increases over the years in Uganda, many rice farmers will be forced to cultivate in the wetlands. This in turn could adversely affect the present efforts to conserve and manage wetlands in the country. A study is critically needed to assess the impacts of rice growing on the ecological functions of wetlands.

Despite the commercialization of rice production with the establishment of rice schemes, the output continues to lag behind demand. For example, the Kibimba Wetland produces 20,000 tons of rice each year, accounting for 20% of the total rice production in the country. Declining paddy yields have been reported in many areas of the country (Wandulu, 1999; Ego, 2001), which implies that in future, it could become a less important strategy for reducing poverty in rural households in Uganda. However, no major study had been undertaken to assess the contribution of paddy growing to poverty reduction. This is particularly significant in view of the current efforts by government to eradicate poverty by transforming local subsistence farming to commercial agriculture (PMA, 2002; MAAIF/MFPED, 2002).

A careful appraisal of strategies available to government led to a shift in emphasis from paddy cultivation to Upland rice growing. The main reason for this shift is the growing concern over ways to prevent the fragile wetland ecosystems from further damage caused by paddy cultivation. Upland rice is easier to cultivate compared to traditional varieties that mainly grow in paddies, and responds well to low rainfall as long as it is well distributed during growing phase (WARDA, 2008). Uganda produces mainly three varieties of the New Rice for Africa (NERICA), namely NERICA 1, 4 and 10. NERICA 4 is popularly known as Upland rice. A variety known as NARIC 3 which is not only high yielding, producing yields of 1,250 to 1,500 kg/acre but also early maturing (90 to 110 days) has been developed by local breeders. Normally, local varieties take more than 120 days to mature with yields hardly about 800 kg/acre. In addition, NARIC 3 which has an attractive aroma, is less susceptible to birds, and yields heavier grains (MAAIF, 2008). The wastage is also less than 25% compared to 40% for the local varieties. As a result of the upsurge in Upland rice growing, Uganda's total area under rice cultivation is now threefold (180,000 ha) of what it was 10 years ago (60,000 ha).

The aims of this research, therefore were; (a) To demonstrate that paddy rice growing in the Doho Wetlands is no longer an effective income generating strategy for increasing household incomes of rural farmers, (b) That Upland rice cultivation could provide a more viable alternative to paddy cultivation as an income – generating strategy, and (c) Upland rice cultivation could also save the fragile Doho Wetlands from further degradation. Meanwhile, the specific objectives were to:

1. Assess the influence of season and farmer category on rice production yields of farmers in Doho Wetlands;
2. Compare incomes from rice growing of farmers from the Scheme, out-growers and those in outlying wetlands;
3. Assess rice production trends in Doho Rice;
4. Scheme and the outlying wetlands;
5. Identify and analyze the major factors that influence

rice production in the area;
6. Assess the viability of Upland rice growing as an alternative to paddy cultivation.

An assessment of the impact of paddy rice growing on household incomes is critical to the formulation of effective interventions by various stakeholders that would ensure a balance between development and wetland conservation in Doho Wetlands as well as other areas of Uganda. Furthermore, one way of strengthening the management and conservation of wetlands is to investigate and gather accurate information on the impact of agriculture and other activities on their status.

The study area

The Doho Wetlands are part of an extensive network of wetlands in Butaleja district, which regulate the flow of water into Lake Kyoga (Figure 1). The area is 10 km from Mbale Town, between 33° 55′ to 34° 05′ E and 0° 50′ to 1° 00′ N and on an altitude of 1,050 to 1,100 m above mean sea level. The study sites were Nampologoma and Nambaale parishes, where most of the rice growing occurs.

The area experiences a tropical climate with average temperatures of 18 to 32°C (Langdale-Brown, 1960; Langdale-Brown et al., 1964). The rainfall amount varies between 1500 to 1750 mm per annum and is received within 120 days (Government of Uganda, 1967). However, higher rainfall amounts have been recorded in some years such as 1975 (Government of Uganda, 1967; Unpublished reports of Chinese experts, 1976). The rainfall pattern is bimodal with peaks in March to May and August to October.

The soils in the area have largely been described as sandy and are characterized by low organic content (Government of Uganda, 1967). However, areas along rivers have fertile clay soils largely derived from the volcanic soils of neighboring Mbale district (Langdale-Brown et al., 1964).

The predominant vegetation is grassland, wooded grassland and various types of swamps (Langdale-Brown et al., 1964). Species as *Acacia polycantha, Echinochloa pyramidalis, Sorghastrum rigidifolium, Pennisetum purperium*, *Hyparrhenia rufa and Borassus aethiopicus* are common. In the deeper waters, wetlands are dominated by papyrus (*Cyperus papyrus* L.), which form extensive single species stands. In areas with less water, there are seasonal wetlands, which have been reclaimed by the rice farmers.

Kachonga sub-county which surrounds the Doho Wetland has a population of 40,000 giving a density of 346 persons per km^2 (Government of Uganda, 2006). The high population density is exerting immense pressure on the existing land resources. The majority (>70%) of the farmers have an average farm size of less than two hectares per family. Household incomes are low (less than US $300 a year per family), and are mainly derived from the sale of rice (MAAIF, 2001; Government of Uganda, 2006).

METHODOLOGY

Yield survey

In order to establish rice yields of farmers, a field survey was conducted during the long (March to June) and short rainy (August to October) seasons of 2005. A total of 360 small-scale rice growers from Doho Rice Scheme (DRS), Out-growers Scheme (OGS) and the seasonal Nambaale Wetland (NWF) were involved in the study. One hundred and twenty (120) were randomly sampled from each category on the basis of the lists provided by the local leaders. Yields were established by:

1. Determining the number of bags of rice harvested by each farmer,
2. The weight (in kg) before milling at the trading centers.

Descriptive statistics were used to summarize the property of the data set, while inferential statistics were computed using Analysis of Variance (ANOVA).

Household questionnaire survey

The household heads or their spouses from each of the two study parishes answered a short questionnaire. In total, 110 (30.6%) were women and the rest were men. With the assistance of local leaders and research assistants, a random sample of 40 farmers was obtained from each of the 9 villages in the study parishes. The questionnaire consisted of 20 items that sought information on respondent's background, rice yields and incomes from rice. Descriptive statistics were used to summarize the property of the data set, while inferential statistics were computed using Analysis of Variance (ANOVA) and the Chi-square test (X^2).

Focus group discussions (FGDs)

FGDs were conducted from November to December 2005. The focus was to obtain information on rice yields, household incomes and, the trends and problems of rice growing in the area. Participants in these discussions were drawn from various community interest groups such as women, Local Council Officials, elders and the youth. In total, three FGDs were held in each of the two parishes.

Interviews

Interviews were conducted with 4 informants in the parishes as well as the Assistant OC Doho Rice Scheme, two members of the agricultural extension staff, three local leaders and one member of the Wetlands Inspection Division. The focus was to obtain information on yields, household incomes and the trends and problems of rice production in the area. In addition to obtaining new insights, interviews constituted new sources of information from field officers, and helped in the triangulation of data collected from other sources. Responses were recorded and then coded for analysis.

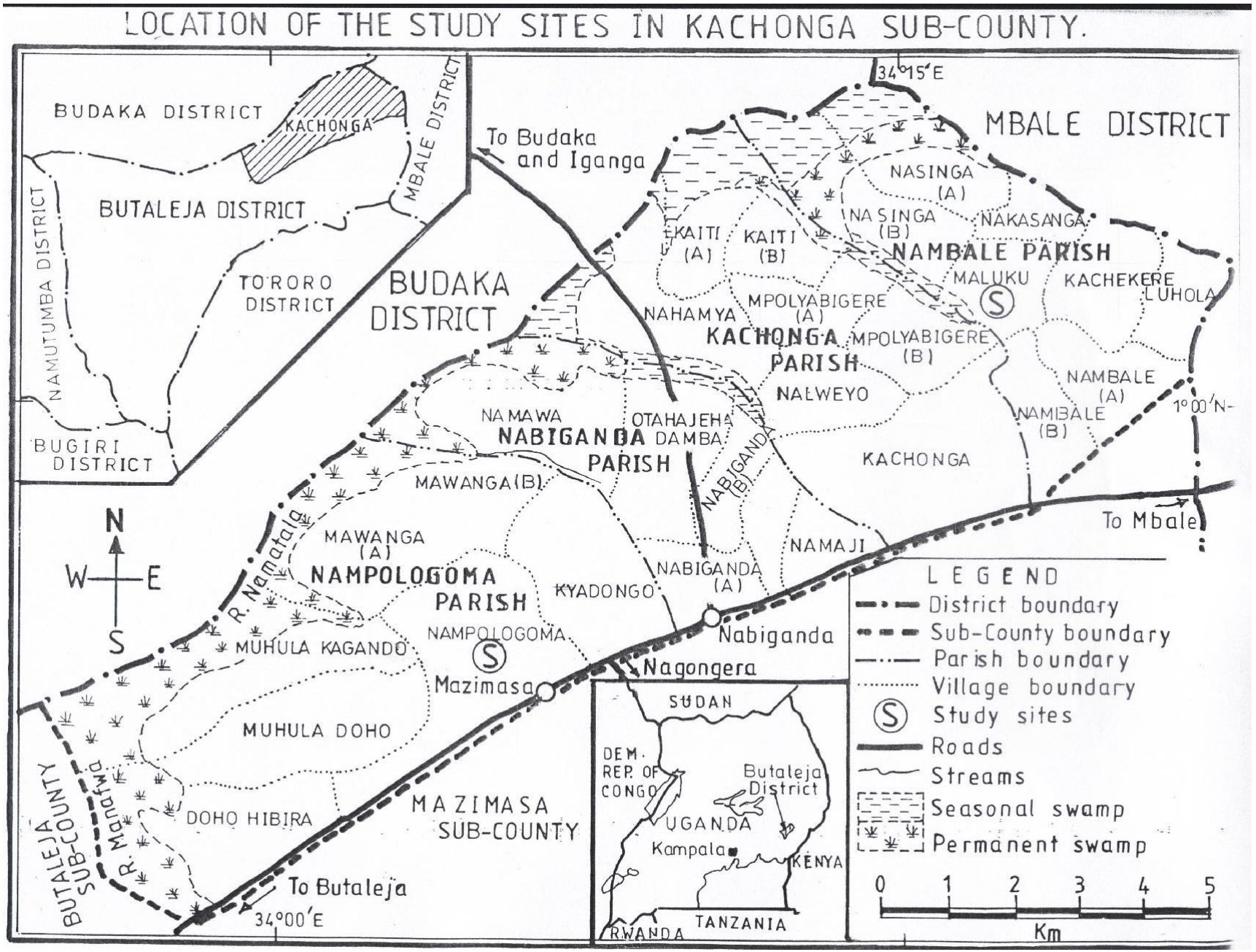

Figure 1. Map of the study area.

Table 1. ANOVA table showing the influence of planting season and farmer category on paddy rice yields.

Source of variation	Sum of squares	df	Mean squares	F-ratio
Farmer category	31,456,693	2	15,728,346.5	0.791NS
Season of planting	60,680,759	1	60,680,759	30.540*
Residual error	3,974,351	2	19,871,175.5	
Total	96,111,803	5		

NS Not Significant at p<0.05; *Significant at p<0.05. .

Document analysis

Six documents from the District Agricultural Office, Tororo and the Doho Rice Scheme headquarters were reviewed for information on production levels for different years. Documents selected from the many that were available included Annual Reports, Evaluation Reports and Project Progress Reports.

Workshops

Local leaders and research assistants in each parish organized 2 workshops of 30 randomly chosen participants, during which information on rice growing as an income-generating strategy was sought. The tools used during these workshops, which were conducted in the primary school, included problem-identification and ranking, resource mapping and trends analysis. Information obtained from different sources was triangulated to improve validity.

RESULTS

Socio-demographic characteristics

Majority of farmers 2002 (56.1%) had been growing rice for between 4 and 9 years, mainly cultivars K98 (61.9%) and K23 (18.1%), because of their comparatively higher yields and the ability to resist pests and diseases.

Nearly 60% (215) of the farmers reported that they grow rice once a year and most of these farmers grew rice on the seasonal Nambaale Wetlands. This is due to the unreliability of water supply, particularly needed by rice plants during their pre-anthesis stage of development. Farmers within the Doho Rice Scheme (DRS) are able to have two crops per year because they have a constant supply of water throughout the year

Rice yields in Doho wetlands

Results of a study of rice yields during the long and short rainy season for different categories of small-scale farmers (less than 2 acres) in the Doho Wetlands are summarized in Figure 2. Generally, the results showed no marked variations in rice yields among the different categories of small-scale farmers. This finding is also given in Table 1, the Analysis of Variance (ANOVA).

It was established that there were no significant ($p>0.05$) variations in rice yields among the different categories of farmers but the yields were significantly ($p<0.05$) higher during the long rainy season or Season I (March to June) than during the short rainy season or Season II (August to October). The farmers within the Doho Rice Scheme (DRS) had slightly higher yields than their counterparts the out-growers (OGS) and farmers in the seasonal Nambaale Wetland (NWF) during the first rainy season. A similar trend was obtained during the short rainy season except for the slight rise of yields among out growers (OGS). This is because of the availability of reliable water supply within the scheme during the short usually unreliable second rains. The OGS who are mostly upstream of the DRS are also able to access water for paddy rice growing.

Data from questionnaires (Table 2), interviews and focus group discussions corroborated these findings. Yields per acre varied between 11 bags (660 kg) and 15 bags (900 kg). Yields of out-growers were consistently higher than for the farmers within the Scheme and those in the outlying Nambaale wetlands. These yields are significantly lower than those reportedly obtained by growing Upland rice varieties (1,250 to 1,500 kg/acre).

A comparison of incomes of various categories of small scale rice farmers

In order to assess the income from paddy rice, the production costs were computed for various farmer categories, and these are summarized in Table 3. The costs of production are generally higher for out-growers and farmers outside the Doho Rice Scheme (DRS) because they include the cost of land hire. Other major contributors to the high costs of production include hire of the land and labor. The Nambaale Wetland Farmers (NWF) pay slightly less than out growers (OGS), perhaps due to the lower productivity of the land. Usually, medium (3 to 5 acres) and large-scale (more than 5 acres) rice farmers have reduced costs of production because they own the land and practice better farming techniques. Their incomes are therefore on average higher than for small-scale farmers.

It was established that there were no significant ($p<0.05$) differences in the rice yields but there were significant differences in the net incomes of the different farmers arising from the differences in the bags sold and the production costs (Table 3). The farmers in DRS earned much more from their rice than out growers (OGS)

Table 2. Mean rice yields and production costs for small-scale farmers in Kachonga Sub-county for the year 2005.

(a) The year 2005 – Season I Farmers category				
	Within the Doho Scheme	**Out-growers**	**Outside the Doho wetland**	**Entire population**
Yield/Acre (Bags) *	13.7	15.3	11.1	13.4
Bags sold*	13.0	14.4	10.6	12.7
Yield/Acre (Kg)	780	864	636	762
Gross Income (Shs)	468,000	518,400	381,600	455,700
Production costs (Shs)	291,800	343,800	345,700	327,100
Net Income (Shs)	164,200	174,600	35,900	124,900
(b) The year 2005 – Season II				
Yield/Acre (Bags) *	14.5	13.8	12.0	13.4
Bags sold*	13.9	13.0	11.6	12.8
Yield/Acre (Kg)	834	780	696	768
Gross Income (Shs)	460,000	442,500	417,600	440,033
Production costs (Shs)	291,800	343,800	345,700	327,100
Net Income (Shs)	168,200	98,700	71,900	112.933

*A bag is about 60 kg.

Table 3. One-way ANOVA table showing the influence of farmer category on yield, production costs and incomes of small scale farmers in Doho and the surrounding wetlands.

Between groups				
	Sum of squares	**df**	**Mean squares**	**F-Ratio**
Yield/Acre (Bags)	10,470	2	5,235	0.848 NS
Bags sold	8,230	2	4,115	6.549*
Yield/Acre (Kg)	29,628	2	14,814	0.654 NS
Gross Income (Shs)	730,312,333	2	365,1561,666	0.307 NS
Production costs (Shs)	374,188,000	2	187,094,000	1.416 NS
Net Income (Shs)	135,358,033	2	67,6790,166	5.740*

NS Not Significant at $p<0.05$; *Significant at $p<0.05$.

and those from the NWF.

Contribution of paddy to family welfare

On the contribution of paddy rice to family welfare, the majority of the farmers (45%) reported that income from rice is used for the welfare of their families, especially for buying food and clothing. Nearly 30% of the farmers reported that they use the income for paying fees for their children in secondary schools. Only 14% of the farmers stated that income from rice is used to pay for labor in rice fields in the subsequent seasons. This implies that most of the labor required during rice growing is provided by the family members.

Rice production Trends from 1970 to 2000 in the Doho and Nambaale wetlands

Data on rice production trends are presented in Table 4. Generally, rice yields have continued to decline for all categories of farmers. However, this decline is sharpest among farmers in Nambaale parish (NWF).

Farmers in the DRS and the NWF reported that before 1980, rice production levels were high with yields of between 25 to 30 bags per acre or 1,500 to 1,800 kg/acre. Rice growing spread to Nambaale parish from the DRS after 1980, but since then, there has been a steady decline in rice production levels and incomes. Despite the downward trend in rice production, the majority of the rice farmers (81%) reported that rice

Table 4. Perception of rice production trends within DRS and Nambaale Wetlands for the period 1970-2000 (n = 180).

Period	Yield in 60 kg bags/acre	
	Within DRS	Outside DRS
1970s	25-30	20-25
1980s	20-24	15-19
1990s	15-19	10-14
Currently	<15	<10

growing had in the past greatly contributed towards reducing poverty levels in their households. The situation is changing and their incomes from rice growing have sharply declined.

According to farmers, this decline in yield has been worsened by the increase in production costs. This has adversely affected small-scale farmers (less than 2 acres) in particular. However, despite the decline, rice production remains popular.

Interview sessions further revealed that the apparent popularity of rice growing in the sub-county was due to the following reasons:

1. Rice is the only major crop that can at least bring income to households;
2. It brings in more income than cotton;
3. Rice is both a food and cash crop;
4. The area has no perennial cash crops;
5. The chances of total loss of the rice crop occurring are minimal;
6. There is no way of predicting yield, so the farmers continue to hope that the next season's crop will be better.

The major factors accounting for the current rice production trends in Doho and the surrounding wetlands

A study of the factors influencing rice production revealed variations according to the category of farmer. Ranking of factors by farmers within the Doho Rice Scheme was different from the ranking given by those in the outlying wetlands of Nambaale. Within the Scheme, the major cause of low rice productivity was attributed to the poor management of the Scheme and the diversion of water upstream by other rice farmers (OGS). In the Nambaale Wetland (NWF), the major constraint was over dependence on unreliable rain fed agriculture and the high costs of production. Within the Doho Wetland, the out growers ranked the high costs of production ahead of markets and lack of technical advice. Although not ranked amongst the first five, loss of soil fertility, pest and disease prevalence, use of poor yielding varieties and poor marketing practices were reported by all categories of farmers as factors that influence rice production in the area.

Upland rice growing as an alternative income-generating strategy

The paddy yields are significantly lower than those reportedly obtained by growing Upland rice varieties (1,250 to 1,500 kg/acre) (African Rice Centre, WARDA, 2008; MOAAIF, 2008). Apart from the high yield, other advantages of growing Upland varieties include the following:

1. Most varieties are resistant to pests and diseases,
2. The shorter growth period (90-110 days) compared to the current paddy varieties such as K23 which take 120 days or longer,
3. The nice aroma of the rice,
4. It could save the Doho Wetlands from further degradation,
5. Easier to cultivate and is not associated with many health problems such as Bilharzias, which is reported to be on the increase (Wandulu, 1999; Ego, 2001),
6. It requires comparatively less water.

Few farmers in Nambaale Wetland who have shifted to the growing of Upland rice have reported yields of as much as 1,200 kg/acre. Consequently, there is rising interest in the growing of Upland rice varieties. Upland rice growing could potentially offer a solution to the degradation of DWE. An investigation into what the local farmers consider to be viable income-generating options to paddy rice growing, as ranked by the farmers showed a deep understanding of the market demands in Uganda.

Appreciable proportion of farmers (35.3%), were of the view that a perennial cash crop such as vanilla or coffee should be introduced to the area. This was followed by the suggestion of growing Upland rice (29.4%). Other suggestions included accessing loans to support income-generating activities, with low interest rates (23.5%). The respondents complained about the high interest rates charged by the various micro-finance institutions. However, the rice yields remain low and payment is difficult. Some farmers consider fish farming as having a

big potential in the area.

DISCUSSION

Rice production has witnessed a steady rise from 27,000 tons in 1980 to the current estimate of over 180, 000 tons, placing it amongst the most widely grown food crops in the country (MAAIF, 2008; MoFPED, 2008; Bureau of Statistics Report, 2008). Most of this rice is produced in the eastern districts of the country. Several factors have been responsible for the rising trends in rice production. Firstly, in the 1970s, the Government encouraged paddy production through the establishment of commercial farms in the country. These farms served as important demonstration gardens, which were not only responsible for providing technical advice, but also generated interest among farmers in the surrounding areas. Secondly, shortage of land in the densely populated districts of Eastern Uganda forced people to cultivate rice and other crops in wetlands. Thirdly, rapid urbanization and the current decline in the production of food crops such as millet, cassava and bananas, have caused an increase in the demand for rice. Lastly, rice is now an important source of income for rural households.

The importance of rice as a source of income is highlighted by its continued popularity in Doho Wetlands. Farmers reported that rice fetches more income than any other crop in the area, including cotton. As a result, farmers in the area consider rice growing as the most viable option for raising household incomes. Rice growing will therefore continue to be an important strategy for fighting household poverty in the area, until viable alternatives have been found. The major contribution of income from rice was reported to be the improvement of family welfare.

In spite of its growing importance as both a food and cash crop, rice production in Doho Wetlands has continued to lag behind demand. Yields from farmers' fields have remained low, rarely exceeding 800 kg/acre as compared to yields in excess of 2000 kg/acre obtained in experimental trials (Anon, 1975; MAAIF, 1980; MAAIF, 2008). The sharpest decline was recorded amongst rice growers in Nambaale Wetlands, who rely on rain fed agriculture. Under rain-fed conditions, the yield is greatly influenced by the amount of available water during the vegetative phase of rice growth. At this stage of crop development, the longer the field remains saturated, submerged or flooded, the greater the chances of obtaining higher crop yields. Within the DRS, output has declined due to neglect of the infrastructure such as maintenance and repair of water channels, de-silting, timely planting and the provision of critical inputs. Other factors that have adversely affected rice yields include use of low yielding varieties or farmer's inability to purchase fresh seeds for planting during the new season, poor agronomic practices, the declining soil fertility levels, and the lack of quality technical advice. It was noted that the four Agricultural Officers deployed at DRS, were too few for the effective education and training of over 3,000 farmers in the area.

The contribution of rice growing to household incomes has therefore sharply declined due primarily to the declining soil fertility levels, farmers' inability to control water use, use of low yielding varieties, and poor farming practices, thereby creating a possibility of adversely impact on the Doho Wetlands. Declining yields imply that rice growing in the area, is becoming less profitable than in the past. In fact, the costs of production in many instances are equal to or more than the rice earnings, particularly for farmers outside the Scheme. However, most rice farmers do not cost family labor, resulting in the false impression that it is profitable. As a strategy for generating income therefore, rice growing in the wetlands will become less and less important unless rice yields increase in the near future.

Declining yields may either force farmers to continuously cultivate the crop, leaving little room for the soil to recover lost nutrients or to expand acreage in an attempt to increase yields. However continuous cultivation in wetlands has been reported as a major factor that predisposes wetlands to destruction and even loss (Oonyu, 2001). There are also reports of the rising infestation of such rice pests as leaf rollers, rice bugs, leafhoppers and caterpillars, and the incidence of Rice blast caused by the fungus *Pyricularia grisea* (Cooke) (Ochollah et al., 1997; Adipala et al., 1997; Wandulu et al., 1997). Unless patterns of pest infestation in the area are understood, it will not be easy to design appropriate remedial action in order to ensure higher rice yields.

Although the Wetlands Inspection Division (WID) has produced guidelines for small- holder paddy rice cultivation in seasonal wetlands (WID, 2002), these are unfamiliar to the majority of farmers in the area. For instance, it is recommended that 2 to 5 years of rice production should be alternated with 2 to 3 years of fallow. A major impediment to fallowing is the growing pressure on land by the rapidly rising population. It is important that farmers implement recommended agronomic practices for rice cultivation in wetlands. This in turn depends on the capacity of extension staff and local leaders to interpret and enforce these guidelines. Unless this is done, the sustainability of paddy cultivation in Doho Wetlands is in doubt.

Upland rice yields can be as high as 2,000 kg/acre and the few farmers who have taken it up in the area have experienced very good results. However, it is important to note that even the yields of Upland rice could decline if the farmers do not pay attention to good agronomic practices including the application of fertilizers. Secondly, it is necessary for farmers to synchronize planting dates with the periods of water availability because even Upland rice requires plenty of water during the pre-anthesis stage. Lastly, it is vital for the farmers to

obtain new planting varieties each season if they are to maintain the yields of Upland varieties. Nevertheless, the growing of Upland rice offers many potential benefits as a strategy for the income generation and for ensuring that the Doho and other wetlands are not abused.

Conclusions

It was concluded that there were no significant differences ($p>0.05$) in rice yields among small-scale paddy rice growers in Doho and surrounding wetlands during the long rainy season (March to June) and the short rainy season (August to October). The farmers within the Doho Rice Scheme (DRS) had slightly higher yields than their counterparts the out-growers (OGS) and farmers in the seasonal Nambaale Wetland (NWF). Prior to the 1980s paddy rice growing significantly improved the household incomes of rural farmers in the area when yields of up to 1,000 kg/acre were attainable. However as of now, the contribution of rice growing to household incomes has sharply declined due primarily to the declining soil fertility levels, farmers' inability to control water use and use of low yielding varieties, thereby adversely impacting on the integrity of the Doho Wetlands. When the cost of farmers' inputs and labor are considered, paddy growing in the area is becoming uneconomical. Upland rice cultivation offers a more viable alternative to paddy growing as an income generating activity, which could also ensure the conservation of the Doho Wetlands.

It is recommended that emphasis should be put on the cultivation of Upland rice varieties in the area, particularly the high yielding NARIC 3. In order to continue enjoying the benefits of these high yielding varieties, farmers must ensure good agronomic practices including maintaining soil fertility levels, control of pests and diseases, and use of new planting material each season. Since one of the biggest challenges in the use of Doho and other wetlands for rice growing is the sharing of water resources between farmers that are at the various points along River Manafwa, it is vital that water-use agreements are drawn and respected by the different farmers. Upland rice cultivation should attract greater incentives from government than for farmers carrying out paddy rice cultivation. The strategy of alleviating poverty in the area should be shift to Upland rice cultivation first and the improvement of paddy yields within Doho Rice Scheme as a second option.

REFERENCES

Anonymous (1975). Unpublished Rice Production Statistics, Doho Rice Scheme. Doho Rice Scheme, Tororo district, Uganda.

Adipala E, Kamwezi P, Ogenga-Latigo MW (1997). Influence of Time of Planting and Spacing on Development of Leaf Blast on Upland Rice. Afr. J. Plant Protection, 7: 95-101.

Africa Rice Centre (WARDA). 2009. The Growing NERICA Boom in Uganda. WARDA Publications: Cotonou, Benin.

Agribusiness Development Centre (ADC) (2001). Upland Rice Production and Marketing Feasibility Study. ADC Publications: Kampala, Uganda.

Ecaat J (1991). Sustainable Production of Fish, with Particular Reference to the Doho Swamps, Unpublished M. Sc. Thesis, Makerere University.

Ego L (2001). Influence of Time of Planting and Planting Density on Growth and Yield of Upland Rice in Uganda, Unpublished MSc. Thesis, Makerere University.

FAO (1995). FAO Production Year Book, Vol. 48. Rome: FAO Publications

Government of Uganda (1967). Atlas of Uganda. Government Printers; Entebbe, Uganda.

Luzi-Kihupi A (1998). Inter-relationship between Yield and some Selected Agronomic Characteristics in Rice. Afr. Crop Sci. J., 6(3): 323-328.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). 2008. Agricultural Production Statistics, Ministry of Agriculture, Animal Industry and Fisheries: Kampala, Uganda.

Ministry of Finance, Planning and Economic Development (MOFPED) UGANDA (2008). Background to the Budget, Ministry of Finance, Planning and Economic Development, Kampala, Uganda.

Ministry of Finance, Planning and Economic Development (MOFPED) UGANDA. (2009). Background to the Budget, Ministry of Finance, Planning and Economic Development, Kampala, Uganda.

Government of Uganda (2006). Uganda Population and Housing Census. Uganda Bureau of Statistics, Ministry of Finance, Planning and Economic Development: Kampala, Uganda.

Gumonye-Mafabi P (1989). Ecology and Status of the Grey Crowned Crane (Balearica regulorum gibbericeps Reich) in Uganda. Unpublished M. Sc. Thesis, Makerere University.

Langdale-Brown I (1960). The Vegetation of Uganda (excluding Karamoja). Memoirs of the Research Division, Series 2, No. 6, Department of Agriculture, Entebbe, Uganda.

Langdale-Brown I, Osmaston HA, Wilson JG (1964). The Vegetation of Uganda and Its Bearing on Land Use (Entebbe, Uganda: Government Printer).

Luzi-Kihupi A (1998). Inter-relationship Between Yield and Some Selected Agronomic Characteristics in Rice. Afri. Crop Sci. J., 6(3): 323-328.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF) and Ministry of Finance, Planning and Economic Development, (MOFPED) (2002). Plan for Modernisation of Agriculture, MAAIF/MFPED: Kampala, Uganda).

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). 2001. Agicultural Production Statistics, Ministry of Agriculture, Animal Industry and Fisheries: Kampala, Uganda.

Ministry of Agriculture, Animal Industry and Fisheries (MAAIF). 2009. Agricultural Production Statistics, Ministry of Agriculture, Animal Industry and Fisheries: Kampala, Uganda.

Ministry of Finance, Planning and Economic Development, MOFPED. 1996. Uganda National Household Survey: 3rd Monitoring Survey, Volume I, Crop Survey Module, Ministry of Finance, Planning and Economic Development, Kampala, Uganda.

Ministry of Finance, Planning and Economic Development (MOFPED) (2000). Uganda Poverty Profile: What do We Know About the Poor?

Discussion Paper 3, Ministry of Finance, Planning and Economic Development, Kampala, Uganda.

Ministry of Finance, Planning and Economic Development (MOFPED) (2001). Poverty Indicators in Uganda: Discussion Paper 4, Ministry of Finance, Planning and Economic Development, Kampala, Uganda.

Ministry of Finance, Planning and Economic Development (MOFPED) 2001. Poverty Eradication Action Plan (2001-2003), Volume I & II, Ministry of Natural Resources, Kampala, Uganda.

Ministry of Natural Resources, MoNR (1996). The National Wetlands Conservation and Management Program: Wetland Status Report for Pallisa, Ministry of Natural Resources, Kampala, Uganda.

Ministry of Trade and Industry (MOTI) (2008). Rice Production in Uganda, Ministry of Trade and Industry, Kampala, Uganda.

Ministry of Water, Lands and Environment, MoWLE (1992). Environmental Impact Assessment of Olweny Swamp Rice Irrigation Project, Ministry of Water, Lands and Environment: Kampala,

Uganda.
Ochollah AR, Ogenga-Latigo MW, Nsuguga NB (1997). Impact of Upland Rice Cultivation on Crop Choice and Income of Farmers in Gulu and Bundibugyo Districts. Proc. Afr. Crop Sci. Confer., 3: 1407-1411.
Oonyu JC (2001). Land Use Changes and Local Community Participation in the Conservation and Management of the Khayelitsha Wetlands, Cape Town (Unpublished UNESCO Research Report: University of the Western Cape).
United Nations Development Program (UNDP) (1997). Uganda: Human Development Report. UNDP Publications, Kampala, Uganda
Wandulu JA (1999). Pest Status and Relative Infestation of Some Upland Rice Cultivars by Major Pests in Uganda, Unpublished M.Sc. Thesis, Makerere University.
Wandulu JA, Ogenga-Latigo MW, Kyammanywa S (1997). Effect of Plant Density and Planting Time on Pest Incidence and Damage of Upland Rice. Proc. Afr. Crop Sci. Confer., 3: 1183-1189.
Africa Rice Centre (WARD) (2009). The Growing NERICA Boom in Uganda. WARDA Publications: Cotonou, Benin.
Wetlands Inspection Division (WID) (1999). Report on the Status of Wetlands in Uganda. Ministry of Lands, Water and Environment, Kampala, Uganda.
Wetlands Inspection Division (WID) (2001). Guidelines for Smallholder Paddy Rice Cultivation in Seasonal Wetlands, Ministry of Lands, Water and Environment, Kampala, Uganda.