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A Study on Relative Profitability of Sole and Mixed Cropping Enterprises among Smallholder Irrigation Farmers in the Hadejia-Nguru Wetlands of Northeastern Nigeria

BY

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Farmers have often practiced different cropping systems for various reasons, ranging from increased incomes, insurances against crop failures to other simple reasons like skill. This study compared the relative profitability of sole and mixed cropping enterprises among small holder irrigation farmers in the Hadejia-Nguru wetlands of Northeastern Nigeria. Data on the inputs and outputs of the various enterprises studied were collected by the use of structured questionnaires administered to 200 smallholder irrigation farmers practicing two main irrigation systems. The data were analysed using the farm budgetary techniques to determine the profitability of the various cropping enterprises practiced. Though, the findings revealed that all the irrigated cropping enterprises analysed were profitable, a further comparison of the two dominant cropping systems revealed that mixed cropping enterprises were more profitable. However, sole pepper enterprise recording the highest net farm income of ₦404,35., a revenue cost ratio of 3.24 and rate of return of 224%. The study further showed that mixed enterprises which were all vegetable based, were generally more profitable compared to the sole enterprises. The most profitable among the mixed enterprises is the mixture that comprised of four vegetable crops and it recorded a return to investment of ₦1.87 for every Naira invested in the enterprise. With their abundant natural resources, the wetlands no doubt offer opportunities for sustainable smallholder irrigation development, hence the study suggest that farmers in the area should form cooperative groups so as to fully benefit from the various incentives and projects provided by both government and nongovernmental organizations.

Key words: Wetlands, Profitability, smallholder, farmers, enterprises, irrigation

INTRODUCTION

Several definitions of wetlands exist, mostly depending on perceptions or needs. However, a general and common definition is that given by the Ramsar Convention which states that wetlands are areas with water that is static or flowing, fresh or salty including rivers, lakes, ponds, marshes, coastal areas, estuaries, bogs and marine areas with depth of not more than 6m (Ramsar Convention, 1971). Wetlands occupy only about 6% of the earth's surface but are among the most productive ecosystem in the earth (Turner *et al.*, 1990). From an agricultural point of view, most wetlands have good potential for expanding and intensification of agriculture, their major advantages being water availability and relative fertility of their soils. These wetlands' properties have provided numerous

opportunities for both wet season and dry season cultivations, thus providing significant development potentials. Nigeria is a country richly endowed with these productive ecosystems, which are estimated to cover 24,009 km² (Kio and Adams, 1986), and comprise of inland swamps, mangrove and fresh water swamps and shallow to deep water *Fadama* (low-lying flood plains with fertile alluvial soils and easily accessible shallow ground Water) (Ayotade and Fagade, 1980).

Today, Nigeria is faced with the challenge of providing adequate food supply for its surging population. With a current population of about 140 million (NPC, 2006), FAO (2000) has consistently, listed Nigeria among countries that are technically unable to meet their food needs from rain fed agriculture because of low level input. The report further emphasized that the situation is likely to remain so

even at intermediate level of inputs at sometimes between 2000 and 2025 (Fakayode *et al.*, 2009). This jolting observation, in addition to the rapid growing demand for food, coupled with the erratic nature of rainfalls in the dry sub-humid and semiarid agro-ecological zones of Nigeria have necessitated the supplementation of rain fed agriculture with irrigation. Hence, the inevitable need for the Nigerian government to explore its copious water resources and embark on investments in small-holder irrigation. This is because, evidence on the improved levels of productivity, employment and income resulting from irrigation is widespread, well documented and relatively uncontroversial (Hasnip *et al.*, 2001.). For example, both empirical studies of the Green Revolution and of irrigation development alone, confirm that higher value crops, higher yields and the more intensive cultivation techniques lead to higher, less risky and more continuous levels of rural employment and income, for both farm families and landless labour (Hasnip *et al.*, 2001.) In recognition of these immense benefits of irrigation, the Nigerian Government had made attempts, in past years, to exploit the country's large irrigation potential through investing in large public irrigation schemes. Unfortunately, these large schemes were short lived and unsuccessful; the reasons for their failure are numerous but the most common among them was mismanagement. Efforts to stimulate small-scale irrigation were more successful as demonstrated by the Nigeria *Fadama* Development Projects (Federal Republic of Nigeria, 2006). Around half of Africa's total wetland areas consist of floodplains, including the Hadejia-Nguru wetlands (Barbier, 2002). A floodplain is usually a relatively flat area of recent alluvial deposits (Kiepe, 2006). Large floodplains are very suitable for irrigation because they are more or less leveled, often fertile and close to water sources (Kiepe, 2006). According to Hollis *et al.* (1993) total cultivated area in the Hadejia-Nguru floodplain is estimated at about 230,000 hectares, of which approximately 77,500 hectares occurs in the dry season which offers considerable development potentials.

Smallholder Irrigation in the study area is a long tradition and forms a significant component in livelihoods strategies of the inhabitants. Rivers and *Fadama* are used for the irrigation of a variety of crops ranging from vegetables to cereals. Two main farming systems viz. sole cropping and mixed cropping, are practiced in the area. Sole cropping is the growing of a particular crop on a piece of land while intercropping (also referred to as mixed cropping) on the other hand, is the growing of two or more crops simultaneously on the same piece of land with distinct row arrangement (Alamu, 2002). Numerous literatures have often argued in favour of one cropping system over the other (Remison and Onelemhemhen, 1999; Tanko and Mbanasor, 2006; Chinaka and

Obiefuna, 2000; Yusuf *et al.*, 2008). For example, sole cropping is argued to be economically a very efficient system, which allows for specialization in equipment and crop production, mixed cropping on the other hand, ensures food security against total crop failure or with intent to maximize yield and profit making by the use of the same labour operations (Usman, 1997). The objective of this study is to compare the two different smallholder irrigation farming systems practiced in the area, in order to know the most profitable enterprise so that extension agents in the area can advise farmers on which to adopt. Also, which enterprise combination and type of crops mixed could ensure reliable harvests against the peculiar problems of flooding and drought in the study area.

MATERIALS AND METHODS

The Study Area

The study was conducted in the Hadejia-Nguru wetlands which are located in the middle part of the Komadugu-Yobe basin in the northeastern Sahel zone of Nigeria. The wetlands occupy an area of approximately 3,500 km² and are located between latitudes 12°15'N to 13°00'N and longitudes 10°00'E to 11°00'E (Ezra *et al.*, 1992). Rainfall in most cases starts from May and extends to September over October, with average rainfall ranging from 500 mm to 700 mm per annum. Estimated population for the wetlands is based on an aerial census by Chiroma and Polet (1996) was 1.2 million. Agriculture is the predominant source of livelihood in the wetlands. The population in the Hadejia-Nguru Wetlands is mainly made up of crop farmers engaged in rain fed, irrigation or "*Fadama*" cropping. Fishing is a secondary activity for most farmers, either as an alternative activity during the dry season, or an additional activity in the wet season (Okali and Bdliya, 1998).

Sampling Framework and Data Collection

A multistage sampling technique was adopted for the selection of respondents. A total of ten villages in the Hadejia-Nguru Wetlands were selected purposively, based on the intensity of irrigation farming system. The sampled villages included Adiyani, Dumsai, Guri, Kabak, Kubayau, Lafiya, Madachi, Malinta, Matafari and Wachakal. Twenty farmers were selected randomly from each village making a total of 200 respondents from 10 villages. A structured questionnaire was then used to collect primary quantitative data. However, only 182 of the completed questionnaires were analysed because some of the questionnaires were discarded due to inconsistencies and incompleteness. Data was collected for the 2008/2009 irrigation farming season. Data collected included socioeconomic, farm size, crop mixtures cultivated, quantities and values of inputs

employed in farm production, quantity of farm labour employed, quantity and value of farm output produced.

Analytical Technique

The net farm income was used to calculate profitability separately for each of the sole and mixed enterprises.

The formula was specified in the form:

$$\text{NFI} = \text{GFI} - \text{TC} \quad (1)$$

$$\text{R-C Ratio} = \text{GFI}/\text{TC} \quad (2)$$

$$\text{RRI} = [\text{NFI}/\text{TC}] * 100 \quad (3)$$

Where;

R-C Ratio = Revenue-Cost Ratio

RRI = Rate of Return on Investment

TC = TFC + TVC

GFI = Gross Farm Income

TC = Total Cost

TVC = Total Variable Cost

TFC = Total Fixed Costs

RESULTS AND DISCUSSION

A total of 8 crop enterprises were selected for analysis based on the total size of farm land allocated to them. Out of this number, 4 were sole crop enterprises while the remaining were mixed crop enterprises. The distribution of the crop enterprises sampled is as presented in Table 1. It can be observed from table 1 that sole rice and Hot pepper/Pepper/Tomato mixture were the most common practiced enterprises in the sole and mixed systems accounting for 47.5% and 47.2% of the total area cropped respectively. This is not surprising owing to the wetlands' reputation for producing large quantities of these crops. Sole tomato recorded the least practiced enterprise during the season, probably due to huge losses usually faced resulting from its perishable nature. It is important to note that total area cropped represented in the table is a combination of different farm plots owned by each sampled farmer. In the area, it is very common for farmers to possess a number of small sized farm plots scattered around different locations.

Table 1 Distribution of area (hectare) cultivated based on enterprises

Enterprise	N0 of Plots (ha)	Area (̄ha)	Mean Area Cropped	Proportion of Area cropped (%)
Sole				
Maize	60	71.30	1.20	31.4
Pepper	31	29.67	0.96	13.1
Rice	63	107.72	1.71	47.5
Tomato	24	18.07	0.75	8.0
Total	178	226.76	4.62	100.0
Mixed				
P/T	15	21.41	1.43	28.4
H/P	6	7.85	1.31	10.4
H/O/P/T	7	10.53	1.50	14.0
H/P/T	24	35.60	1.48	47.2
Total	52	75.39	5.72	100.0

P = Pepper, T = Tomatoes, H = Hot pepper, & O = Onion

Source: Field survey, 2009

Relative Profitability of Cropping Enterprises

The results of the profitability analysis showed that all the crop enterprises surveyed were profitable. In each case, gross revenues from production exceeded total costs of

production, thus yielding positive net farm incomes. The outstanding performance of sole pepper enterprise as revealed in Table 2 could be explained in terms of the market strategy adopted by the farmers. In order to reduce losses due to perishable nature of pepper and

tomato, majority of the farmers sold their produce in a dried form. The estimated return to investment in sole pepper enterprise was 224%, meaning that farmers realized a profit of ₦2.24 for every naira invested in pepper enterprise during the season. Sole maize enterprise performed least during the season with a return to investment of ₦0.20 per naira invested. Its relatively high Gross Farm Income (₦168,368.45) was consumed by factors such as its more tedious and costly operations such as threshing, winnowing and

transportation as well as high cost of improved maize seeds. The high Fixed Cost in sole maize enterprise could be as a result of the use of tube wells and other irrigation inputs. Most maize farmers cultivated their maize in the uplands by lifting water from tube wells and this might have contributed to additional cost compared to other enterprises. The profitability ratios for the sole enterprises implied that the smallholder irrigation farmers realized an average of ₦2.24, ₦1.27, ₦0.34 and ₦0.20 per naira invested in pepper, rice, tomato and maize enterprises respectively.

Table 2: Average Costs-Revenue structure of various enterprises in smallholder irrigated farming system in the Hadejia-Nguru Wetlands

Sole enterprise	Cost revenue					Rank
	AGFI/ha	ATC/ha	ANFI/ha	R-C	RRI	
Rice	284527.00	125315.10	159211.90	2.27	127.00	2 nd
Maize	168368.45	140308.03	28060.42	1.20	20.00	4 th
Pepper	584610.88	180259.81	404351.07	3.24	224.32	1 st
Tomato	233713.78	176808.16	56905.62	1.32	32.18	3 rd
Mixed enterprise						
P/T	395737.33	154536.95	241200.38	2.56	156.08	2 nd
H/P/T	387954.18	148582.52	239368.66	2.61	161.00	3 rd
H/O/P/T	378174.60	131569.73	246604.87	2.87	187.43	1 st
H/P	362434.84	204228.16	158206.68	1.77	77.50	4 th

Source: Field survey, 2009

The result of the mixed enterprises revealed that hot pepper/onion/pepper/tomato was the most profitable generating a net farm income estimated at ₦246,604 per hectare. Factors which may have contributed to its high performance could be the combined effect of the crops, less cost of processing incurred and the market strategy employed (which is the selling of vegetables in their dry forms). These must have reduced cost and increased income, thereby resulting in the high net farm income as revealed in Table 2. The hot pepper/pepper enterprise recorded the least net farm income of ₦158,206. This may be attributed to the lost from spoilage as hot pepper and pepper are sold in fresh forms. Profitability analysis shows that the highest profit realized was ₦1.87 for hot pepper/onion/pepper/tomato enterprise while ₦0.77 was realized in hot pepper/pepper enterprise.

Overall, mixed enterprises performed better than sole enterprises as revealed by their budgetary analyses even though less hectares of land were cultivated. The reason for this could be that in all the mixed enterprises

analysed; only vegetables were cultivated. Vegetables are seasonal crops in Northern Nigeria compared to other irrigated crops such as rice and maize which is grown in both seasons and attracts high market prices, especially if sold in dry forms. This is further supported by Temu and Temu (2006) who noted that vegetables are considered to be high value crops which tend to have higher market values than traditional cereal grains. The findings in this study are also in agreement with Muhammed (2004) who noted that mixed enterprises performed better than sole enterprises in irrigated Oasis farming in Yobe State. The question that arises from this finding is why do small-holder farmers practice sole cropping despite the fact that mixed enterprises generate more income? There are various reasons, but some of the factors guiding farmers' decisions could be input availability, financial capacity, experience or simply convenience. In cereal enterprises for example, stalks and straws are either sold to livestock herders or used by the farmers themselves as livestock feeds.

CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it can be concluded that small holder irrigation cropping enterprises in the Hadejia-Nguru Wetlands is generally profitable. Comparison of the two cropping systems investigated revealed that mixed cropping enterprises performed better than Sole cropping enterprises. However, sole pepper did best in all the enterprises studied with the average farm income of N404,351, revenue cost ratio of 3.24 and rate of return of 224%. The less performing enterprises were sole maize and Hot pepper/Pepper with Hot pepper/Pepper enterprise recording the lowest profit. Based on the findings of this study, it is suggested that small holder irrigation farmers be encouraged to devote their scarce resources in the production of the most profitable crops, vegetables and rice. It is also suggested that smallholder farmers in the area should form farmer groups or water user groups in order to benefit from various initiatives, incentives such as improved farm inputs, extension services, processing and marketing facilities provided by both government and nongovernmental organizations. Furthermore, government on its part should develop the area, by providing infrastructural facilities as well as modern sustainable irrigation facilities, so as to harness the full potentials of the wetlands.

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