

ECONOMICS OF RAINFED AND IRRIGATED RICE PRODUCTION UNDER UPPER BENUE RIVER BASIN DEVELOPMENT AUTHORITY SCHEME, DADINKOWA, GOMBE STATE, NIGERIA

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ABSTRACT

The study compared the costs and returns of rice production under rainfed and irrigation methods in the Upper Benue River Basin in Dadinkowa, Gombe State, Nigeria. Questionnaires were used to collect data from 40 randomly selected rice farmers who engaged in both rainfed and irrigated production in the area. Descriptive statistics and gross margin analysis were employed in data analysis. Results showed that mean age, farming experience and farm size of the respondents were 59.84 years, 26.63 years and 0.35 ha respectively. In both cases, labor constituted the major component of total costs of production while sales of unthreshed rice was the major income component in rainfed (40.00%) and irrigated (45.00%) production methods. Moreover, the per hectare gross margin and net return per naira invested in rainfed production were ₦ 61,606.12 and 0.51 respectively; while in the irrigation method the respective values were ₦100,889.00 and 0.78. Furthermore, results revealed that water supply (83.33%), extension activities (78.90%) and canal maintenance (70.27%) were the most satisfied services while fertilizer supply was the least as indicated by the respondents. The study testifies that both the production methods were profitable, though the irrigation was more profitable and recommends both methods but prefers irrigated in alternative situations.

KEYWORDS: Economics, Rice, Rainfed, Irrigated, Production

INTRODUCTION

Demand, particularly, for rice has been on increase in Nigeria at a much faster rate than in other West African countries since the mid seventies (FAO 2000). Akanji (1998) opined that the rising demand for rice in Nigeria was partly due to increasing population growth, increased income levels following the discovery of crude oil, rapid urbanization and the commodity's convenience in terms of its ease of preparation. Though the country is the largest producer of rice in West Africa, yet it accounted for up to 20 per cent of sub-Saharan Africa's rice imports for domestic consumptions (Omotola and Ikechukwu 2006). Hence, to bridge the gap between domestic rice production and consumption, increased production can be a good alternative because rice is one of the staple crops on Nigeria's import list (Shehu *et al.* 2007). In addition, increase in rice production is necessary because it has a great potential to play a crucial role in contributing to food and nutritional security, income generation, poverty alleviation and socioeconomic growth of Nigerians (Ibrahim *et al.*, 2008). Increased production can easily be achieved in the country since one of the most original features of rice is the fact that it can be grown under different environmental conditions, particularly from the point of view of its water supply. Hence, Bamire *et al.* (2007) observed that rice is cultivated in virtually all the agro-ecological zones of Nigeria, from the mangrove and swamps environment of the Niger-Delta in the coastal area to the dry zones of Sahel in the North. It can also be grown as an upland crop supplied solely by rainwater or at the other end of the scale, as a floating crop in a sheet of water that may be several meters deep. These, have, invariably made rice one of the most important cereals in Nigeria both in production and in consumption.

Thus, the study assessed the economics of rice production under the scheme of Upper Benue River Basin Development Authority (UBRBDA) in Dadinkowa, Gombe State Nigeria with a view to compare between rainfed and irrigation methods. Specifically, it attempts to give answers to questions such as: What were the major cost and return components in rainfed and irrigated rice production methods in the study area and which method was more profitable? What were farmers' assessments of the UBRBDA'S supports towards boosting rice production in the area?

METHODOLOGY

The Study Area

Dadinkowa is a town located in Yamaltu-Deba Local Government Area of Gombe State in northeastern Nigeria. It is situated within Latitudes $9^{\circ} 30'$ - $12^{\circ} 30'$ North of the Equator and Longitudes $8^{\circ} 45'$ - $11^{\circ} 45'$ East of Greenwich meridian (Gombe State Government 2009). It is situated on an altitude of about 600 meters above sea level (Mohammed 1998). The average rainfall of the area is 800 – 900 mm per annum, mean temperature ranges from 30 – 32 °C and it experiences a relative humidity of 17 – 90 per cent. The main occupation of the people in the area is small-scale farming and the major crops grown include rice, maize, cowpea and vegetables.

The UBRBDA is a Nigeria federal government's organization in charge of Dadinkowa Dam in the area and it supplies irrigation water to registered rice farmers. The Dam, constructed along the Upper Benue River Basin, was identified for hydroelectric power generation by the former National Electric Power Authority in 1959. Construction commenced in January 1981 and was commissioned on June 15, 1988. The Dam was constructed to serve the following purposes:

- Irrigation agriculture of about 44, 000 ha
- Hydroelectric power generation of up to 34 mw.
- Fishing and fishery development (over 20, 000 metric tones of fish annually).
- Flood control and flow regulation
- Domestic water supply to the State capital and environs.
- Recreational and other socioeconomic benefits.

However, the generation of hydroelectric power is the only activity that is yet to commence but the historic irrigation of agricultural lands has been massively going on in the area and rice farmers have been the major beneficiaries.

Data Collection

Data were collected through administration of pre-tested questionnaires to forty respondents selected using Simple random sampling technique from a sampling frame of 210 farmers who practice both rainfed and irrigated farming under the UBRBDA's Scheme in the area. Data were collected on the respondents' socioeconomic and production variables for both rainfed and irrigation methods. These included information on age, farming experience, farm and family sizes as well as on farmers assessment of supports received from UBRBDA. Other information elicited was on issues pertaining to sales of output, purchases of inputs and payments to labor operations.

Data Analysis

Descriptive statistics such as minimum, maximum mean and percentages in addition to Gross margin analysis were employed in the analysis of the data. Gross margin analysis, according to Olukosi and Erhabor (1988), is a very useful tool in situations where fixed capital is a negligible portion of the farming enterprise, as the situation is in this case. The Gross margin model is of the form:

$$GM_r = GI_r - TVC_r \dots\dots\dots (1)$$

$$GM_i = GI_i - TVC_i \dots\dots\dots (2)$$

Where:

GM_r = Gross margin under rainfed production (N/ha)

GI_r = Gross farm income under rainfed production (N/ha)

TVC_r = Total variable cost under rainfed production (N/ha)

GM_i = Gross margin under irrigated production (N/ha)

GI_i = Gross farm income under irrigated production (N/ha)

TVC_i = Total variable cost under irrigated production (N/ha)

The decision rule is that the higher the value of GM the better the enterprise. Thus, if GM_r is greater than GM_i , then rainfed production is preferred over irrigated, otherwise reverse is the case.

Similarly, measures of Gross Farm Income, Net Farm Income and Return per Capital Invested were also used to compare between the two methods of production. Thus:

$$i) \text{ Gross Farm Income} = \sum Y_i \times pY_i$$

Where,

Y_i = Units of various output components

pY_i = Unit price of the various output components

Explicitly, it is expressed as:

$$GI_r = Y_{1r} \times pY_{1r} + Y_{2r} \times pY_{2r} + Y_{3r} \times pY_{3r} + Y_{4r} \times pY_{4r} + Y_{5r} \times pY_{5r} + vR_r \dots \dots \dots (3)$$

$$GI_i = Y_{1i} \times pY_{1i} + Y_{2i} \times pY_{2i} + Y_{3i} \times pY_{3i} + Y_{4i} \times pY_{4i} + Y_{5i} \times pY_{5i} + vR_i \dots \dots \dots (4)$$

Where:

Y_{1r} = Number of 100Kg bags of unthreshed rainfed rice sold

pY_{1r} = Average price of a 100Kg bag of unthreshed rainfed rice sold

Y_{2r} = Number of 100Kg bags of threshed rainfed rice sold

pY_{2r} = Average price of a 100Kg bag of threshed rainfed rice sold

Y_{3r} = Number of 100Kg bags of parboiled rainfed rice sold

pY_{3r} = Average price of a 100Kg bag of parboiled rainfed rice sold

Y_{4r} = Number of 100Kg bags of home consumed rainfed rice

pY_{4r} = Average price of a 100Kg bag of home consumed rainfed rice

Y_{5r} = Number of 100Kg bags of rainfed rice given as gift or alms

pY_{5r} = Average price of a 100Kg bag of rainfed rice given as gift or alms

vR_r = Lump-sum value of residues under rainfed rice production

GI_r = as earlier defined

Y_{1i} = Number of 100Kg bags of unthreshed irrigated rice sold

pY_{1i} = Average price of a 100Kg bag of unthreshed irrigated rice sold

Y_{2i} = Number of 100Kg bags of threshed irrigated rice sold

pY_{2i} = Average price of a 100Kg bag of threshed irrigated rice sold

Y_{3i} = Number of 100Kg bags of parboiled irrigated rice sold

pY_{3i} = Average price of a 100Kg bag of parboiled irrigated rice sold

Y_{4i} = Number of 100Kg bags of home consumed irrigated rice

pY_{4i} = Average price of a 100Kg bag of home consumed irrigated rice

Y_{5i} = Number of 100Kg bags of irrigated rice given as gift or alms

pY_{5i} = Average price of a 100Kg bag of irrigated rice given as gift or alms

vR_i = Lump-sum value of residues under irrigated rice production

GI_i = as earlier defined

ii) Net Farm Income is expressed as:

$$NFI_r = GM_r - FC_r \dots\dots\dots (5)$$

$$NFI_i = GM_i - FC_i \dots\dots\dots (6)$$

Where,

NFI_r = Net farm income under rainfed rice production (~~N~~/ha)

GM_r = Gross Margin under rainfed rice production (~~N~~/ha)

FC_r = Fixed Cost under rainfed rice production (~~N~~/ha)

NFI_i = Net farm income under irrigated rice production (~~N~~/ha)

GM_i = Gross Margin under irrigated rice production (~~N~~/ha)

FC_i = Fixed Cost under irrigated rice production (~~N~~/ha)

iii) Return per Naira Invested is shown as:

$$RNI_r = NFI_r \setminus TC_r \dots\dots\dots (7)$$

$$RNI_i = NFI_i \setminus TC_i \dots\dots\dots (8)$$

Where:

RNI_r = Net return per Naira invested in rainfed rice production

TC_r = Total Cost of Production under rainfed rice (~~N~~/ha)

NFI_r = as earlier defined

RNI_i = Net return per Naira invested in irrigated rice production

TC_i = Total Cost of Production under irrigated rice production (~~N~~/ha)

NFI_i = as earlier defined

For purpose of enterprise selection, in all these measures, the higher the value the better the enterprise.

RESULTS AND DISCUSSION

Socioeconomic Characteristics of Respondents

Alkali (2003), Murtala *et al.* (2004), Murtala *et al.* (2006) as well as Danwanka and Ggala (2007) all observed that socioeconomic characteristics of respondents are particularly important in decision-making process. Socioeconomic characteristic investigated in this study are age, years of experience in rice production, family size, and farm size. Accordingly, Table 1 shows that the minimum, maximum and mean ages of the respondents were 40.00, 69.00 and 59.84 years respectively. This indicates that majority of the farmers were aged and this could mean high labour cost as most of them would have resort to hired labour in the absence of availability of family labour. However, the results does not corroborate with earlier findings by Umoh (2006) and Idiong *et al.* (2006) where swamp and upland rice farmers were found to be relatively of younger age. The Table also shows

that with a minimum 10.00 years and a maximum of 50.00 years, the average years of experience of the respondents was 26.63. This implies that majority of the farmers were well experienced in rice production, a situation which could result to increased yield. The 10 years experience as minimum might also imply that recruitment of new members into the UBRBDA rice production scheme was not frequent. The mean of 26.63 years of experience in rice production was also much higher than 10.8 years was found by Idiong *et al.* (2006) among rice farmers in Cross Rivers State of Nigeria. Experience in farming activities plays important role in decision-making relating to output increase and risk avoidance (Mohammed *et al.* 2009). Again, Table 1 shows that the average, minimum and maximum members of respondents' families were 17, 4 and 35 persons respectively. It can, therefore, be deduced that majority of rice farmers in the study area had large family sizes. Larger family sizes might play a significant role in provision of family farm-labour which helps to reduce expenditure on production (Murtala *et al.* 2004), but increases costs of expenses on the family. The larger sizes of families discovered in this study could go along way in assisting the high-aged respondents to continue operating. Finally, the Table reveals that the mean farm size of the respondents was 0.35 ha while 0.05 ha and 1.00 ha were recorded as minimum and maximum respectively. This implies that rice farmers under the scheme were small-scale operators and it could mean that there was room for improvement when farmlands are increased in order to tap the benefits of economies of scale.

Analysis of Costs and Returns

The cost and return components of rice production under both rainfed and irrigation methods are shown in Tables 2 and 3 respectively. Table 2 reveals that average Total variable costs of rice production per hectare of rainfed and irrigated lands were ₦104, 097.08 and ₦107, 812.30 respectively, which accounted for 88.59 and 84.12 per cents of Total cost of production in the respective enterprises. Similarly in rainfed farming labor and fertilizers, which were the major cost components, constituted 41.13 and 24.72 per cents while in irrigation the respective values were 34.64 and 27.22 per cents of the Total cost. Total fixed costs were found to be ₦13, 411.86 (11.41%) and ₦20, 353. 64 (15.88%) in the rainfed and irrigation methods respectively. However, the respective Total costs of production in the two enterprises were found to be ₦117, 508.94 and ₦128, 165.94 indicating that cost of cultivating a unit of land was higher under irrigation method.

Table 3, on the other hand, discloses that unthreshed and threshed rice were the major return or revenue components in both the enterprises. Their respective contributions were up to 40.00 and 30.00 per cent of Gross income in rainfed but 45.00 and 24.50 per cent in irrigation. Further, for each hectare under rainfed production, the values of gross income, gross margin and net income were ₦177, 775.37; ₦61, 606.12 and ₦60, 266.42 respectively. On the other hand, the respective values for the irrigation method were ₦227, 727.22; ₦100, 889.00 and ₦99, 561.06. The Table also shows that Gross margins were 34.65 per cent (in rainfed) and 44.30 per cent (in irrigation) of Total revenues while the proportions of Net income in the respective methods were 33.90 and 43.72 per cent. These percentage values represented the proportions of consumer retail price that entered into farmers' pockets as net profits. Return per Naira invested (RNI), on the other hand, explains the net monetary return for each one Naira invested into a business. Accordingly, the rainfed and irrigated values of the RNI were 0.51 and 0.78 respectively; implying that 51 Kobo (in rainfed) and 78 Kobo (in irrigated) were recorded. This confirms that both the production methods were profitable, but irrigation being more profitable. This finding concords with that of Onoja and Achike (2008) who discovered that efficiency level of irrigated rice production was significantly higher than that of rainfed in Kogi State, Nigeria. The study further reveals that while farmers do sell, significantly, both threshed and unthreshed rice but they sell insignificant quantity of parboiled rice.

Assessment of Supports Received From UBRBDA

Table 4 depicts that of all the support services rendered by the scheme, water supply enjoyed highest level (83.33%) of farmers' satisfaction. This was followed by extension services (78.90%), maintenance of irrigation canals (70.27%), and seeds supply (63.33%). This shows that majority of the farmers were okay with most of the assistance received from the UBRBDA. Contrastingly, up to 64.29 per cent of the respondents were unsatisfied with the scheme's fertilizer support programme. The second important problem of the farmers was the smallness of farmland allocated to them where up to 36.09 per cent expressed their non satisfaction; and this is in line with the finding of Bamire *et al.* (2007) who found that reduced land holding per respondent was the major problem of rice farmers in Osun State of Nigeria.

SUMMARY AND CONCLUSION

The study compared the economics of rainfed and irrigated rice productions under the Upper Benue River Basin Development Authority, Dadinkowa. Data were collected from forty randomly selected rice farmers under the UBRBDA scheme. The questionnaire collected data were analysed using descriptive statistics and Gross Margin analysis. Results indicated that, though both production methods were profitable, the irrigated one had higher gross margin, net income and return per Naira invested. The study, therefore, recommends for expansion of farmlands in addition to improving fertilizer input delivery. Further, in alternative situations, irrigated production is also recommended over the rainfed type.

REFERENCES

- Akanji, B. O (1998). Hedonic Price Analysis of the Demand for Grain Crops in Nigeria. The Case of Rice and Cowpea. An unpublished PhD thesis submitted to the University of Ibadan, Nigeria. Pp 97
- Alkali, R. A. (2003). *Issues in International Relations and Nigeria's Foreign Policies*. Second Edition, North Point Publishers, Kaduna. Pp 245.
- Bamire, A. S.; Oluwasola, O. and Adesiyun, A. T. (2007). Land Use and Socioeconomic Determinants of Technical Efficiency of Rice Farms in Osun State, Nigeria. In : Haruna, U. ; Jibril, S. A. ; Mancha, Y. P. and Nasiru, M. (eds). *Consolidation of Growth and Development of Agricultural Sector*. Proceeding of the 9th Annual National Conference of the Nigerian Association of Agricultural Economists (Pp 27 - 35). Abubakar Tafawa Balewa University Bauchi, Nigeria. 5th – 8th November.
- Danwanka, H. A. and Ggala, C. E. (2007). Analysis of Resource-use Efficiency in Irish Potato Production in Jos South L. G. A. of Plateau State. In : Haruna, U. ; Jibril, S. A. ; Mancha, Y. P. and Nasiru, M. (eds). *Consolidation of Growth and Development of Agricultural Sector*. Proceedings of the 9th Annual National Conference of the Nigerian Association of Agricultural Economists (Pp 385 – 389) Abubakar Tafawa Balewa University Bauchi, Nigeria. 5th – 8th November.
- Food and Agriculture Organization (2000). *Agricultural and Food Marketing Management in the Developing Countries*. Rome; pp 366.
- GSG (2009). Gombe State Government, Jewel in the Savannah Diary Book.
- Ibrahim, F. D.; Alhassan, Z. S. ; Ibrahim, M. and Ibrahim P. A. (2008). Private Sector and Boosting Rice Production: A Case Study of R – Box Technology Adoption in Badeggi, Bida Local Government Area of Niger State. In: E. A. Aiyedun, P. O. Idisi and J. N. Nmadu (eds). *Agricultural Technology and Nigeria's Economic Development*. Proceeding of the 10th Annual National Conference of the Nigerian Association of Agricultural Economists (Pp 136 – 144) University of Abuja, Nigeria. 7th – 10th October.
- Idiong, I. C.; Agom, D. I. and Ohen, S. B. (2006). Comparative Analysis of Technical Efficiency in Swamp and Upland Rice Production Systems in Cross Rivers State, Nigeria. In: Adepoju, S. O. and Okuneye, P. B. (eds). *Technology and Agricultural Development in Nigeria*. Proceedings of the 20th Annual National Conference of Farm Management Association of Nigeria (Pp 425 – 432). Federal College of Forestry Jos, Plateau State, Nigeria. 18th – 21st September.
- Mohammed, S. (1998). The Role of Commercial Banks in Financing Agriculture in Gombe State, Nigeria: A Case Study of Selected Banks. An Unpublished B. Tech. Project, Agricultural Economics and Extension Programme, Abubakar Tafawa Balewa University, Bauchi.
- Mohammed, S., Sani, R.M., Idi, S. and Jidda, Y. (2009). Comparative Study of Rainfed and Irrigation Methods of Rice Production in Dadinkowa, Gombe State, Nigeria. In: Mohammed, U. B. Kyiogwom, W. A. Hassan, A. L. Ala, A. Singh and S. D. Dogondaji (eds). *Sustaining Agricultural Growth to Meet National Economic Development Goal*. Proceedings of the 23rd Annual National Conference of Farm Management Association of Nigeria (Pp 304 - 308). Usmanu Danfodiyo University Sokoto, Sokoto State, Nigeria. 14th – 17th December.

Murtala, N.; Haruna, U.; Abdurahman, S. and Gwaram, S. O. (2004) "Costs and Returns Analysis of Poultry Eggs Marketing in Bauchi Metropolis, Bauchi State, Nigeria. Paper presented at the 2004 Annual Conference of the Nigerian Association of Agricultural Economists. Held at Ahmadu Bello University Zaria, Kaduna State, Nigeria.

Murtala, N.; Jibril, S. A.; Sani, R. M. and Sabo, A. M. (2006). Stimulating Growth and Minimizing Risks in Agricultural Lending Under the Agricultural Credit Guaranteed Scheme Fund (ACGSF) in Bauchi State, Nigeria. *FAMAN Journal* 8 (1): Pp 7.

Olukosi, J. O. and Erhabor, P. O. (1988). *Introduction to Farm Management Economics: Principles and Application*, Agitab publishers Limited, Zaria. Pp 109

Omotola, K. A. and Ikechukwu, A. (2006). Rice Milling in Nigeria. Internet. <http://www.ricenigeria.com/> as retrieved on 24 May, 2008

Onoja, A. O. and Achike, A. I. (2008). Technical Efficiency of Rice Production Under Small Scale Farmer-Managed Irrigation Schemes and Rained-Fed Systems in Kogi State, Nigeria. In: E. A. Aiyedun, P. O. Idisi and J. N. Nmadu (eds). *Agricultural Technology and Nigeria's Economic Development*. Proceeding of the 10th Annual National Conference of the Nigerian Association of Agricultural Economists (Pp 242 - 252). University of Abuja, Nigeria. 7th – 10th October.

Shehu, J. F.; Tashikalma, A. K. and Gabdo, B. H. (2007). Efficiency of Resource Use in Small Scale Rainfed Upland Rice Production in North-West Agricultural Zone of Adamawa State. In : Haruna, U. ; Jibril, S. A. ; Mancha, Y. P. and Nasiru, M. (eds). *Consolidation of Growth and Development of Agricultural Sector*. Proceeding of the 9th Annual National Conference of the Nigerian Association of Agricultural Economists (Pp 552 - 560). Abubakar Tafawa Balewa University Bauchi, Nigeria. 5th – 8th November.

Umoh, G. S. (2006). Resource Use Efficiency in Urban Farming: An Application of Stochastic Frontier Production Function. *International Journal of Agriculture and Biology*. Vol. 8 (1) 38- 44

Table 1: Distribution of Respondents Based on Age, years of Experience, family and farm sizes

Variable	Min.	Max.	Mean
Age (years)	40.00	69.00	59.84
Farming experience (years)	10.00	50.00	26.63
Family Size (persons)	4.00	35.00	17.33
Farm size (ha)	0.05	1.00	0.35

Source: Field survey, 2007

Table 2: Costs Analysis of Rice Production under UBRBDA Scheme in Dadinkowa (₦/ha)

Items	Rainfed		Irrigation	
	Value	Percentage	Value	Percentage
Variable costs				
Seeds	15,682.85	13.35	12,683.80	9.90
Fertilizers	29,042.31	24.72	34,880.45	27.22
Chemicals	8,712.69	7.42	7,610.28	5.94
Packaging bags	2,323.38	1.98	1,902.57	1.49
Irrigation water	-	-	6,341.90	4.95
Total labour	48,335.85	41.13	44,393.30	34.64
Total variable cost	104,097.08	88.59	107,812.30	84.12
Fixed costs				
Land (rental value)	1,339.70	1.14	1,327.94	1.04
Equipment depreciation	12,072.16	10.27	19,025.70	14.85
TFC	13,411.86	11.41	20,353.64	15.88
Total Cost	117,508.94	100.00	128,165.94	100.00

Note: One US Dollar exchanges for an average of ₦140 as at the time of data collection

Source: Survey data, 2007

Table 3: Returns Analysis of Rice Production under UBRBDA in Dadinkowa, Gombe State (₦/ha)

Items	Rainfed		Irrigation	
	Value	Percentage	Value	Percentage
Unthreshed rice	71,110.15	40.00	102,477.25	45.00
Threshed rice	53,332.61	30.00	55,793.17	24.50
Parboiled rice	17,777.54	10.00	24,230.18	10.64
Residues	1,777.75	1.00	10,156.63	4.46
Home consumed rice	15,999.78	9.00	15,940.91	7.00
Rice given as gift	17,777.53	10.00	19,129.09	8.40
Gross income	177,775.37	100.00	227,727.22	100.00
Gross margin	61,606.12	34.65	100,889.00	44.30
Net income	60,266.42	33.90	99,561.06	43.72
RNI	0.51		0.78	

Note: Note: One US Dollar exchanges for an average of ₦140 as at the time of data collection

Source: Field Survey, 2007

Table 4: Assessment of supports received from UBRBDA (% of Total Respondents)

Support	Satisfied	Undecided	Unsatisfied
Water supply	83.33	-	16.67
Seeds supply	63.33	6.67	30.00
Fertilizer supply	14.28	21.43	64.29
Extension services	78.90	15.57	5.53
Farmland	58.33	5.56	36.09
Canal maintenance	70.27	13.89	15.89

Source: Field Survey, 2007

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