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Full Length Research Article

Economic Analysis of Crop Production under Jibiya Irrigation Project, Katsina State, Nigeria

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ABSTRACT: The study examined costs and returns of crop production under Jibiya Irrigation Project as well as problems that were militating against the achievement of the Project objectives. 120 farmers were randomly sampled and interviewed. The data were analysed using descriptive statistics and farm budgeting model. The average age and land holding of the farmers were 42 years and 0.8ha, respectively. Majority of the farmers were married and can read and write. Most of them had between 0 - 5 and 0 - 3 children and dependants, respectively. Their average costs of crop production were ₦ 94,513.61, ₦ 90,969.20 and ₦ 3,544.41 per hectare of total, variable and fixed cost, respectively. Whereas the total revenue, gross margin and net farm income they obtained were ₦ 190,329.36, ₦ 99,360.16 and ₦ 95,815.75 per hectare, respectively. They enjoyed a net return on investment of ₦ 1.01. There were many problems facing the farmers, which if not addressed adequately, will not only significantly reduce the productivity of crop production but will also discourage farmers from farming under the Project. The performance of the farmers, though good, could be improved if there is adequate funding of the Project; inputs are made readily available to farmers at subsidized rate and in good time and the farmers offer hands in ensuring the safety and security of the Project's facilities.
Keywords: Economic analysis, Crop production, Jibiya irrigation project.

INRODUCTION

Irrigation is an important factor that can boost agricultural productivity of a country. It gives room for utilization of resources, which would otherwise remain idle. The threat of drought especially in the semi-arid areas can also be reduced through irrigation. In fact, it is an avenue through which agricultural resources can be utilized more efficiently.

Akinola and Ogunwale (1998) noted that in the past, irrigated agriculture in the semi-arid northern Nigeria was restricted to the seasonally flooded plains along the major savannah channels and/or depressions, locally called *fadama*. They explained that it was small-holder irrigation dependent on the shadoof system of lifting water as well as on residual moisture utilization techniques.

Subsequently, large-scale irrigation projects (LSIPs) were introduced in Nigeria to make best use of the available resources in order to boost agricultural production. These projects are managed by the River Basin Development Authorities (RBDAs). One of the earliest RBDAs is the Sokoto Rima River Basin Development Authority (SRRBDA) established in 1973 (SRRBDA, 1992). The SRRBDA covers Sokoto, Katsina, Kebbi and Zamfara States of Nigeria. Many large-scale irrigation projects were created under the SRRBDA, including the Jibiya, Bakalori, Zauro Polder and Goronyo Irrigation Projects. It is basically assigned with the development of both the surface and underground water resources for multipurpose uses and also the control of floods and soil erosion in its area of jurisdiction (SRRBDA, 2013).

Jibiya Irrigation Project (JIP), like others in Nigeria, is aimed at boosting agricultural productivity of the country. The objective is to improve the standard of living of the people, through the creation of job opportunities, food production and increased income (SRRBDA, 1991). Before the establishment of the Project, crop production in the area was mostly limited to the rainy season relying on rainfall for moisture supply. A lot of damage to crop production had been caused by recurring droughts. This became a serious threat, sometimes significantly reducing the farm production. Although small-scale irrigation practices had been undertaken during the period, mostly along streams and river-banks as well as other *fadama* areas, the output obtained from these practices was relatively small. This implies that, before the establishment of JIP, agricultural resources in the area were not efficiently utilized.

The establishment of JIP was apparently aimed at creating an opportunity for better utilization of the

available resources in the area. The Project envisages the development of about 3,450 hectares of land for irrigation, and impoundment of water in the reservoir started in May, 1989 (SRRBDA, 1991). Tremendous amount of money (₦ 106,700,000.00) was spent in the establishment of the Project. The aim is to improve food production, raise farm incomes and improve the standard of living of the people in the area (SRRBDA, 1982). Upton (1996) noted that the establishment of irrigation facilities presents a capital investment, which enhances the productivity of natural resources of land and water. Yet he conceded that no matter the good intention behind the establishment of the facilities, the realization of the goals of such projects will be difficult to achieve without proper handling. SRRBDA (2013) stated that it is important to note many beautifully scattered projects in Nigeria especially those championed by the nation's founding fathers and those being put in place now all over the country. It however lamented that the question is how to build the best facilities and have support in place to ensure they are well maintained and sustained.

JIP was established many years ago, economic analysis of crop production under it, would reveal the extent to which some of its objectives are being achieved. This will also contribute to the debate on the viability of Nigeria's large-scale irrigation projects. For instance, Rowland (1993) stated that the performance of Nigeria's large-scale irrigation schemes has been disappointing, giving in most cases a very poor return on investment. In contrast, Okoh (1999) reported that Kano River Irrigation Project Phase 1 (KRIP1) has made a profound impression on the project's participants and inhabitants of its environs. This study is expected to show the extent to which these views are true for Jibiya Irrigation Project.

METHODOLOGY

The study covered Jibiya Irrigation Project, which is located in Jibiya Local Government Area of Katsina State. The project site is endowed with abundant fertile land, on which various farming activities are undertaken (SRRBDA, 1979). The average population density of the area is estimated to be 160 inhabitants per 30.25km^2, and the average population increase for the past fifteen years drawn from the records of local authorities is approximately 1.7% per annum (SRRBDA, 1982). The Local Government Area (LGA) is located at the north-western part of the State, bordering Batsari and Batagarawa Local Government Areas to the south, Katsina and Kaita Local Government Areas to the east, Zurmi Local Government Area of Zamfara State to the west, and to the north it shares an International Border with Niger Republic. Katsina State Surveyors (1993) revealed that Katsina State is approximately located between latitude 11^{0}7'49" and 13^{0}20'N and longitude 6^{0}52'3" and 9^{0}2'40"E, while the Local Government Area is between latitude 12^{0}5' and 13^{0}16'N and longitude 7^{0}2' and 7^{0}49'E, whereas the Project is between latitude 12^{0}5' and 13^{0}9'N and longitude 7^{0}1' and 7^{0}4E. Mu'azu *et al.* (2013) also found that the State is approximately located between latitude 11^{0}07'49" and 13^{0}20'00"N and longitude 6^{0}25'03" and 9^{0}02'40"E.

The climate of the region is semi-arid, and the area is far enough from the Equator to experience a single rainy season and a long intense dry season. The most critical climatic element is rainfall and its distribution varies from year to year and from month to month. The average annual rainfall in the region was 716mm and the mean annual temperature was 26^{0}C. The recorded minimum and maximum were 5^{0}C and 42^{0}C, respectively (SRRBDA, 1982).

According to SRRBDA (1991) Jibiya Dam is constructed across Gada River, to boost agricultural production and supply portable drinking water for the people living within and around the area. It has a maximum height of about 20m and a length of approximately 3,680m, which created an impounding reservoir with full storage capacity of 142 x 10^{6}m^3, dead storage capacity of 21 x 10^{6}m^3 and an active storage capacity of 121 x 10^{6}m^3.

The dam consists of a pumping station and two compensation reservoirs. Water from the pumping station is taken directly from the valve chamber to the reservoirs, from where the water is supplied to the main canals, then to the lateral canals and finally to the fields for irrigation (SRRBDA, 1991). The irrigation method is of two types namely, gravity irrigation covering 206ha and irrigation by pumping covering 3,266 ha. This gives a total area of 3,472ha, and the irrigation area is divided into six parts (hydrological boundaries), based on six main canals (F_1 to F_6) that supply water to sub-canals and then to the irrigation plots (SRRBDA, 1982).

Both primary and secondary data were collected. The primary data were obtained mainly through

questionnaire administration. In order to give every farmer in the study area equal chance of being selected, so as to obtain a representative result, simple random sampling method was adopted. Twenty farmers were randomly sampled and interviewed from each of the six hydrological boundaries (which supply water to almost equal number of farmers), giving a total of one hundred and twenty farmers. The list of farmers (sampling frame) in each hydrological boundary from which twenty were randomly sampled was obtained from the staff of the Project.

A well-structured questionnaire was administered to the farmers with the help of trained enumerators. Secondary data were obtained from relevant literatures, such as books, bulletins and progress reports of the Project. The data were analyzed using farm budgeting technique and descriptive statistics. The farm budget model used is specified as:

NFI = GFI - VC - FC

Where: NFI = net farm income (profit)

GFI = gross farm income, which is the value of farm product

VC = variable cost incurred by the farmer in the course of production e.g. cost of labour, seed, fertilizer, etc.

FC= Fixed cost e.g. depreciation on implements, such as siphon tubes, hoes, cutlasses etc.

RESULTS AND DISCUSSION

Socio-economic Characteristics of the Respondents

All the respondents interviewed were male. This implies that in Jibiya Irrigation Project, women were not actively involved in crop production. However, they play a significant role during the harvest and post-harvest operations. Similarly, Muhammad *et al.* (2011) found that women participation in Fadama II Project, in Niger State was low. In contrast, Ezeh *et al.* (2012) and Mazza *et al.* (2012) reported that 73.33% and 20%, respectively, of the Fadama II Project farmers they sampled in Imo State were females. This implies that in a southern part of Nigeria women were more actively involved in crop production than in the northern part of the country. This could be due to religious and/or cultural reasons.

Age is a basic population characteristic. The age of a person influences his needs, his occupation and the pattern of public expenditure on him (Okafor *et al*., 1994). Table 1 reveals that a major proportion (64.17%) of the respondents fall within the age range of 30-49 years and the average age was 42 years. Similarly, Mazza *et al.* (2012) reported that 82.59% of the Fadama users they interviewed were within the age range of 20 – 49 years. Ezeh *et al.* (2012) found that 36.63 years was the mean age of the farmers they sampled. These findings imply that, in Nigeria young adults were actively involved in farming activities. Thus, they do not agree with the notion that Nigerian youth are not interested in agricultural activities.

Table1: Distribution of the farmers based on their socio-economic characteristics

Characteristics	Frequency	Percentage
Age Range		
20-29	13	10.83
30-39	47	39.17
40-49	30	25.00
50-59	15	12.50
60-69	11	9.17
Over 69	4	3.33
Total	120	100.00
Educational Attainment		
Primary School	24	20.00
Secondary School	12	10.00
Tertiary School	10	8.33
Adult literacy	11	9.17
Qur'anic Only	33	27.50
Informal Education	30	25.00
Total	120	100.00
Marital Status		
Married	109	90.83
Single	10	8.33
Widowed	1	0.83
Divorced	0	0.00
Total	120	100.00
Family Size		
1 – 5	46	38.33
6 – 10	38	31.67
11 – 15	25	20.84
16 – 20	7	5.83
Over 20	4	3.33
Total	120	100.00

Mean age = *42 years*

Source: Field survey, 2005.

It is generally agreed that education is an important factor that could enable a person to think properly and make reasonable decisions. Mazza *et al.* (2012) were of the view that level of education enhances

communication among farmers and facilitate participation in Fadama II Project, as educated farmers accept challenges and are known to be less conservative. Table 1 depicts that major proportion (38.33%) of the farmers were formally educated.

It also shows that 36.67% and 25% of the farmers had non-formal and informal education (education acquired through experience), respectively. From the Table, it can be deduced that 75% of the farmers in Jibiya Irrigation Project could read and write. The results are in contrast with the findings of Muhammad *et al*. (2011) who found that 46.7%, 22.7% and 9.3% of the farmers involved in Fadama II Project in Niger State attended primary, secondary and tertiary schools, respectively. The discrepancy suggests that the level of education of Nigerian farmers is increasing. This could be due to the awareness of the farmers about the significance of education in carrying out business activities.

According to Okafor *et al*. (1994), marital status of a population may be defined as the proportion of single, married, widowed and divorced people within it. Table 1 reveals that majority (90.83%) of the farmers were married, whereas only 0.83% were windowed. The table implies that there may be abundance of labour supply in Jibiya area since most of the people of the area were married and they are likely to have children. This is similar to the finding of Mazza *et al.* (2012) which revealed that 96.52% of the farmers they sampled in Imo State were married. The findings imply that in Nigeria, there is abundant labour supply that could be used to carry out farm operations. Okafor *et al*. (1994) stated that marital status influences the size of the family and rate of population growth. This in turn, determines the number of hands to help in farm work.

The size of the families in a society usually influences the rate of population growth of that society, which in turn can determine the labour force. It is assumed that the larger the size of the family of a farming community, the greater the availability of hands to offer help in farm work (Okafor *et al*., 1994). Table 1 shows that majority (38.33%) of the respondents had between 1 – 5 family members whereas 31.67% and 3.33% had between 6 – 10 and over 20 members, respectively. The table implies that majority (38.33%) of the farmers had less burden upon them. However, it implies that they may have few hands to offer assistance in farm work. Thus, hired labour is likely to be used by this proportion of the farmers in order to meet their labour requirements. This could be a source of employment to other people in the area, who have excess labour capacity. The finding is similar to that of Muhammad *et al.* (2011) which revealed that 72% of the farmers they sampled in Niger State had over 10 family members. It differs from that of Korie *et al.* (2012) and Lemchi *et al.* (2013) who reported that only 12.50% and 13.75% of the farmers they sampled in Abia and Rivers States, respectively, had family size that exceeds 10 members. This implies that in southern part of Nigeria there were less family members to offer hands in farm operations compared to northern part of the country. Thus, in the south hired labour is likely to prevail. This could be one of the reasons why youth move from the north to the south (especially during dry season) to offer labour in different types of economic activities.

The size of land (farm size) of an individual usually determines his production capacity. Under normal circumstances, it is expected that the larger the land size, the greater the output that can be produced. In addition, the adoption of some agricultural technologies (such as those related to mechanization) which improve efficiency, is related to land size. The distribution of Jibiya irrigation farmers according to land size is displayed in Table 2 which shows that a major proportion (45.83%) of the farmers irrigated between 0.05 and 0.55 hectares of land, whereas only 1.67% irrigated over 2.59 hectares. The average land holding was 0.8ha and the individual plot sizes ranged from 0.05 to 3.0ha implying that farm sizes were small under the Project. The average farm size is however, larger than the 0.58ha reported by Baba *et al*. (1998) for small-scale irrigators in Sokoto State, Nigeria. Similarly, Korie *et al.* (2012) reported that none of their respondents had over three hectares of land. This implies that in Nigeria, there is high level of land fragmentation, which is an obstacle to farm mechanization (a means of boosting agricultural productivity).

Crops produced by the respondents were wheat, cowpea, groundnut, onion, tomato, maize, Irish potato, sweet potato, pepper, garden egg, lettuce, cassava, sorrel, among others. However, wheat, cowpea, groundnut, onion, maize and tomato were the major crops (SRRBDA, 2013). Table 2 indicates that wheat was the major crop grown by majority (77.50%) of the respondents followed by cowpea and groundnut which were grown by 72.50% and 48.33%, respectively. This could be due to the importance of the crops in the diets

of the people in the area and/or appreciable price the farmers used to get immediately after harvesting the crops.

Table 2: Distribution of farmers according to land sizes and types of crops produced

Items	Frequency	Percentage
Land Sizes		
0.05-0.55	55	45.83
0.56-1.06	31	25.83
1.07-1.57	19	15.83
1.58-2.08	5	4.17
2.09-2.59	8	6.67
Over 2.59	2	1.67
Total	120	100.00
Types of Crops		
Wheat	93	77.50
Cowpea	87	72.50
Groundnuts	58	48.33
Onion	24	20.00
Maize	23	19.17
Tomato	15	12.50
Total	300*	

Mean farm size = 0.8ha *Multiple responses
Source: Field survey, 2005.

Costs and Returns of Crop Production in the Project

Returns to production can be defined as the value of output obtained or revenue generated as a result of the production. The returns to crop production (average for all crops) obtained by Jibiya irrigation farmers can be seen in Table 3, which shows that the variable, fixed and total costs of production were ₦ 90,969.20, ₦ 3,544.41 and ₦ 94,513.61 per hectare, respectively. The finding indicates that expenditure on variable inputs dominated the production costs, accounting for 96.25% of the total cost. Among the variable costs, watering (37.97%) was the most costly item. This was followed by weeding (11.98%) and harvesting (7.81%). The finding differs from that of Ezeh *et al.* (2012) which shows that the farmers they sampled under National Fadama II Development Project incurred ₦ 48,759.50, ₦ 18,270.32 and N67,029.82 as variable, fixed and total costs, respectively. This could be due to experts' advice the Fadama Project farmers got and utilised, which help them to minimize costs of production and/or differences in the climates/soils of the regions.

The analysis of the costs and returns reveals that the farmers had a revenue cost ratio of 2.01:1. This means that the farmers at Jibiya Irrigation Project realised ₦ 2.01 as revenue for every naira invested in crop production during the 2004/2005 irrigation season. The average net farm income realised by the farmers as shown in the table was ₦ 95,815.75/ha. The profitability index was 101%. This implies that during the 2004/2005 irrigation season, the farmers obtained a profit of ₦ 1.01 for every naira invested in crop production. Similarly, Ezeh *et al.* (2012) reported that fadama farmers in Imo State realized a net return of ₦ 84,006.18 per hectare from vegetable enterprises.

Table 4 indicates a crop-by-crop analysis of the cost and returns structure in crop production under the Project. From the table, it can be seen that maize had the highest average total cost per hectare, amounting to ₦ 113,757.28, followed by tomato and groundnut with ₦ 103,781.13 and ₦ 103,584.45, respectively. On the other hand, onion had the lowest average total cost per hectare. The high cost of maize production is perhaps due to the fact that maize requires much work in processing, transportation and storage, whereas the low cost of onion may be due to the fact that some farmers sold their onion right from the farm, thus, avoiding cost of processing, transportation and storage. The Table also reveals that cowpea, with an average net farm income of ₦ 102,551.77/ha was the most profitable enterprise. This is probably due to the appreciable price of the crop received by the farmers, which ranged from ₦ 80 to ₦ 100/kg. Further inquiry revealed that there was a poor harvest of the crop during the preceding wet season. This could be one of the reasons for the high prices of the crop enjoyed by the farmers. On the other hand, tomato had the lowest net farm income (₦ 34,204.07/ha). This may be due to the high perishability of the crop coupled with absence of a tomato processing industry in the area. This resulted in glut and the concomitant low prices of the crop during the harvest season. The analysis of the revenue-cost ratio revealed that wheat, cowpea, groundnut, onion, maize and tomato had ratios of 2.05:1, 2.06:1, 1.56:1, 1.92:1, 1.72:1 and 1:33:1,respectively. This means that ₦ 2.05, ₦ 2.06, ₦ 1.56, ₦ 1.92, ₦ 1.72 and ₦ 1.33 were realised as revenue for every naira invested in the production of the crops, respectively. Further analysis revealed that there were net returns of ₦ 1.05, ₦ 1.06, N0.56, ₦ 0.92 ₦ 0.72 and ₦ 0.33 for every naira invested in the production of the respective crops.

Table 3: Average costs and returns of crop production (2004/2005 season)

Items	Average cost(₦/ha)	Percentage of total cost
VARIABLE COST		
Land preparation	5,183.94	5.48
Seed and nursery	5,108.89	5.41
Planting/transplanting	6,086.94	6.44
Watering	35,886.27	37.97
Water charge	2,000.00	2.12
Weeding	11,318.31	11.98
Fertilizers	5,767.65	6.10
Organic manure	3,553.81	3.76
Insecticides	2,486.92	2.63
Harvesting	7,381.69	7.81
Processing	5,284.73	5.59
Transportation	910.05	0.96
Total variable cost	**90,969.20**	**96.25**
FIXED COST		
Land rent	3,043.77	3.22
Total depreciation	298.85	0.32
Storage	201.79	0.21
Total fixed cost	**3,544.41**	**3.75**
Total cost	**94,513.61**	**100.00**
Total revenue	190,329.36	
Gross margin	99,360.16	
Net farm income	**95,815.75**	
Revenue-cost ratio	2.01:1	
Profitability index	101%	

Source: Field survey, 2005.

Table 4: Distribution of major crops according to their costs and return (₦/ha)

Crops	Yield(kg/ha)	AFC/ha	AVC/ha	ATC/ha	AGFI/ha	AGM/ha	ANFI/ha
Wheat	3006.00	3865.94	87.573.38	91,439.32	187,714.10	100,140.11	96,274.77
Cowpea	2408.59	3,276.12	92,750.59	96,026.76	198,578.53	105,827.95	102,551.77
Groundnut	2370.68	3,031.29	100,553.17	103,584.45	161,856.39	61,303.22	58,271.94
Onion	4032.34	3,177.36	70,997.32	74,174.68	142,739.97	71,742.65	68,565.29
Maize	2835.35	3,377.00	110,380.28	113,757.28	196,553.26	86,172.99	82,795.99
Tomato	4014.80	4,918.42	98,862.71	103,781.13	137,985.20	39,122.49	34,204.07

Sources: Field survey, 2005.

Problems Facing Jibiya Irrigation Farmers

Farmers in JIP faced many problems in their irrigation activities. These include shortage of irrigation water, high cost and unavailability of fertilizers and insecticides, inadequate capital, difficulties of obtaining loans, pests and diseases, among others. Table 5 depicts that majority (73.33%) of the farmers stated that they had experienced shortage of irrigation water, whereas 68.33%, 55.67% and 45.83% reported the problems of inadequate fertilizers, capital and difficulty in obtaining loans, respectively.

It can be seen from Table 5 that the farmers under JIP not only faced the problem of inadequate capital but also found it difficult to obtain loans to finance their irrigation activities. This is a serious threat to irrigation

in the area. Mbam *et al.* (2012) stated that most of their respondents accessed informal sources of credit. They said this may be due the less rigorous procedure involved in obtaining them relative to formal sources. Ugbajah *et al.* (2012) realized that the major problems encountered by rural farmers in obtaining credits were collateral assets required by formal financial institutions. The table also shows that the farmers suffered from the problems of irrigation water shortage as well as unavailability and high cost of fertilizers. Solving these problems would help to improve irrigation activities in the area.

Table 5: Distribution of farmers according to major problems they faced

Problem	Frequency	Percentage*
Inadequate capital	68	56.67
Irrigation water shortage	88	73.33
Inadequate fertilizers	82	68.33
Pests and diseases	16	13.33
Inadequate insecticides	38	31.67
Lack of loans	55	45.83

*Multiple responses.
Sources: Field survey, 2005.

CONCLUSION AND RECOMMENDATIONS

The study revealed that the farmers (average age of 42 years) were young adults who irrigated small plots (average of 0.8ha, with freehold as major system of tenancy). Majority of them were married and can read and write. They produce wheat, cowpea, maize, tomato, onion, groundnut, potatoes among other crops. It was found that crop production in the area was profitable with average returns on investment greater than 100%. Cowpea was the most profitable enterprise.

Problems encountered by the farmers include inadequate capital, difficulty in obtaining loans, shortage of irrigation water and high cost and non-availability of inputs. The performance of the farmers, though good could be further improved if:

- efforts are made by all tiers of government to improve funding of the project
- adequate inputs, at subsidized rates are made readily available to the farmers and in good time. Here the federal, state and the local governments need to join hands
- efforts are made by the management of the Project to ensure adequate and equitable water supply to all plots.
- interruption of irrigation activities is avoided, as it discourages farmers from participating in the Project. It also causes the damage and theft of irrigation facilities.
- farmers regularly pay their water charges through appropriate channels and report any irregularity they come across.
- farmers continue to assist the management of the Project in ensuring the safety and security of the irrigation facilities.
- strong water user associations are formed so that farmers can easily raise their complains to the management and policy makers through their leaders.

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