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PROFITABILITY OF CROP PRODUCTION UNDER THE KANO RIVER IRRIGATION PROJECT, NORTHERN, NIGERIA

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Abstract

Four major crops rice, maize, wheat and tomato were examined in the Kano River Irrigation Project. The project was divided into 3 sections; the head, middle and tail ends. One hundred farmers were randomly selected from each sections making a total of 300 hundred farmers. Net farm income, and profitability index were used to assess the profitability of the enterprises. It was concluded Rice, maize, and wheat were profitable while tomato was unprofitable that year attributable to market glut and perishability of the crop. It was recommended that storage facilities be provided by both private and government agencies to curtail the losses incurred by the farmers.

Keywords: Crops, profitability analysis, irrigation, Nigeria

Introduction

In the wake of the Sahelian drought of the early 1970s and the untold hardship it brought to Nigeria, particularly the northern parts, it seemed to have dawned on government that total reliance on rainfed agriculture to provide the food and raw materials requirements of the country, is at best a very risky strategy. This realization prompted government at the federal level to begin paying serious attention to irrigation development. Thus in 1973 the first two river basin development authorities were established. These were the Chad-Basin and the Sokoto-Rima Basin Development Authorities. And in 1976, nine additional River Basin Development Authorities (RBDAs) were created and the existing two reconstituted (Baba, 1989, 2010). Today, there are 12 RBDAs in existence in Nigeria and they include, the Chad, Hadejia-Jama'are, Sokoto-Rima, Upper Niger, Lower Niger, Upper Benue, Lower Benue, Ogun-Oshun, Anambra-Imo, Benin-Owena, Cross River, and Niger Delta Basin Development Authorities.

The RBDAs are charged with a range of responsibilities including the harnessing, management, and exploitation of the country's water resources for agricultural production and other purposes. The authorities then proceeded to establish large-scale capital intensive irrigation projects. One of such projects is the Kano River Irrigation Project (KRIP) which was established under the Hadejia-Jama'are River Basin Development Authority. The objective of the KRIP, and the other large-scale irrigation schemes established in Nigeria, is apparently to increase aggregate food and raw materials production for the country while at same time raising the incomes of the farmers. The increased income is, in turn, expected to raise the living standards of the farmers and others involved in the value chain of the various commodities produced under irrigation.

The establishment of large-scale irrigation schemes in Nigeria is highly capital intensive and requires the expenditure of huge sums of money in an already scarce foreign exchange. Scientific advances have led to the development of productivity-increasing inputs such as inorganic fertilizers, improved seeds and agro-chemicals. Irrigation is known to increase the scope of employment of these inputs and crop productivity. However, the inputs come at a cost to the farmers. An important question to ask is whether the inputs generate enough returns to cover their costs and leave farmers with reasonable profit. Therefore, this study is aimed at evaluating the extent of profitability of crop production under large scale irrigation schemes using Kano River Irrigation Project (KRIP) as the analytical case in point.

Methodology

The Study Area

The KRIP with Headquarters at Kura, covers Bebeji, Tudun-wada, Bunkure, Kura, and Rano Local Government Areas of Kano State. It lies within latitudes 11° 45' N - 12° 05 ' N and longitudes 8° 30' E - 9° 05' E. It is located about 35 km southwest of Kano City, on both sides of Kano – Zaria road. Currently, 15,000 hectares are under irrigation (JICA, 1994, Anon, 2001).

Sampling and Data Collection

A total sampling frame of eight thousand eight hundred (8800) irrigators across the local government areas was established. Stratified random sampling method was used to select 300 irrigators. This sample was drawn from three major hydrological locations (strata) within the irrigation command area. The farmers were stratified into three, namely irrigators at head, middle and tail ends of the main canal. These locations determine extent of water availability at farmers' plots. One hundred farmers were selected from each stratum (hydrological location) using systematic sampling. The main aim of this selection is to ensure that irrigators in all the locations in the project area are adequately represented. Input-output data were collected from the farmers for two irrigation seasons (i.e 2012/2013 and 2013/2014 seasons) using an interview schedule.

Data Analysis

Analysis of data was done using cost and returns (farm budgeting) technique. Net farm income (NFI) or profit is defined as:

$$\pi_i = P_i Y_i - \sum \left(X_j R_j + K_i \right) \quad \text{.....1}$$

Where,

π_i = profit from the i^{th} enterprise

Y_i = level of output of the i^{th} enterprise

P_i = price per unit of i^{th} enterprise

X_j = level of the j^{th} input

R_j = price per unit of the j^{th} input:

K_i = fixed cost per period associated with i^{th} enterprise

Gross Margin (GM) is the difference between the gross income (GI) and the total variable cost:

$GM = P_i Y_i - \sum X_j R_j$ 2

Where:

GM = gross margin; the other symbols are as earlier defined

The following measures of financial efficiency of the enterprises were computed:

Operating ratio $= \dfrac{\text{Operating Expenses (Variable Cost)}}{\text{Gross Income (Revenue)}}$ 3

Gross Ratio $= \dfrac{\text{Total Cost (Total Farm Expenses)}}{\text{Gross Income (Revenue)}}$ 4

Fixed Ratio $= \dfrac{\text{Total Fixed Cost}}{\text{Gross Income (Revenue)}}$ 5

Return on investment = Gross income/Total cost 6

The analysis was done separately for each of the major irrigated crops (rice, wheat, maize and tomato) produced under the project.

Results and Discussion

The results of profitability analysis of the four major crops produced under the Kano River Irrigation Project are presented in Tables 1 – 4 as averages of the 2012/2013 and 2013/2014 seasons. In each table, the results of cost and returns structure are presented according to the location of the farmers at the project (i.e whether they are located at the head, middle or tail). The results in Table 1 show that for the average farmer, close to 60% of the total rice production cost was accounted for by variable costs. The variable costs tended to decrease from the head to the middle and then the tail. Furthermore, inorganic fertilizer (accounting for more than 20% of total costs at the three locations) was the most costly single item of variable cost. Governments in the area always claim that fertilizer is provided to farmers at subsidized prices. However, fertilizer sales from

Table 1: Average costs and returns structure in rice production under the project for the 2012/2013 and 2013/2014 combined seasons (₦/ha)

	Location of farmers			
Items	Head	Middle	Tail	Overall
Variable cost				
Land preparation	5774.65(6.78)*	5352.56(7.24)	5131.94(7.24)	5419.71 (7.00)
Sowing	1527.82(1.80)	1065.38(1.38)	976.39(1.9)	1189.86 (1.53)
Weeding	5035.92(5.92)	1778.85(2.39)	1550.69(2.18)	2788.49 (3.60)
Harvesting	13746.48(16.15)	10558.97(14.18)	1644.44(2.32)	11043.88 (14.28)
Seed	3811.62(4.48)	3755.77(5.05)	4000.00(5.64)	3855.79 (4.98)
Fertilizer	20371.13(20.39)	17955.13(24.12)	23954.17(33.82)	18826.62 (24.34)
Pesticide	2035.92(2.39)	1373.72(1.84)	1284.72(1.81)	1564.79 (2.02)
Total variable cost	52303.54(61.46)	41840.38(56.20)	38542.36(54.91)	44228.76 (57.75)
Fixed cost				
Water charge	2844.72(3.34)	2647.12(2.55)	2321.53(3.28)	2604.46 (3.36)
Land rent	27500(32.31)	27500(36.94)	27500(38.83)	27500 (35.55)
Depreciation	2455(2.88)	2455(3.30)	2455(3.46)	2455 (3.17)
Total fixed cost	32799.72(38.54)	32602.12(43.80)	32276.53(45.57)	32559.46(42.10)
Total cost	85103.26	74442.50	70818.89	77335.72
Total revenue	224197.65	216739.56	196384.72	(212440.64)
Gross Margin(GM)	(171894.11)	174899.18	157842.36	(168011.88)
Net Farm income(NFI)	139094.39	142297.06	125565.83	135104.92
Operating ratio	0.23	0.19	0.19	0.20
Gross Ratio	0.38	0.34	0.36	0.36
Fixed ratio	0.02	0.15	0.16	0.10
Return on investment	2.63	2.91	2.77	2.74

*Figures in brackets are percentages of total cost.

Source: Field survey, 2013/2014

government sources are highly politicised and only those who are locally powerful or are "well-connected", even if they are not farmers, have direct access to the commodity at the subsidized prices. Majority of the farmers purchase the commodity at very high prices (sometimes up to ₦5,000.00 per 50 kg bag in the survey year) in the open market. On the other hand, the fixed costs were dominated by the rent on land which must be paid to the Management of the project annually. In all cases, rent accounted for more than 30% of the total production cost. At all the locations, net farm income was positive for the average farmer. However, farmers at the head earned the highest profit followed by those at the middle and then those at the tail. Rice requires abundant supply of water to perform optimally. Water availability at the farmers' plots decreases from the head, through the middle to the tail. The decreasing profits observed could be attributed to lower yields obtained the farther away from the primary water source due to insufficient water at the plots. This indicates that profit efficiency of the rice farmers was high. Similarly, the returns per naira invested in rice production under the project were quite high even though they varied according to location. The average rice producing farmer at the head earned N139,094.94/ha.

Cost structure for irrigated wheat production presented in Table 2 shows that variable costs dominated the production costs accounting for close to 60% of total costs in the three locations.

Table 2: Average costs and returns structure in wheat production under the project for the 2012/2013 and 2013/2014 combined seasons (₦/ha)

	Location of farmers			
Items	Head	Middle	Tail	Overall
Variable cost				
Land preparation	7600.00(9.79)*	5250.00(6.62)	6093.75(7.35)	6214.58 (7.83)
Sowing	936.00(1.20).	1010.00(1.27)	1189.58(1.43)	1045.19 (1.31)
Weeding	1536.00(2.00)	1731.00(2.18)	1677.08(2.02)	1648.02 (2.08)
Harvesting	14100.00(18.15)	14783.33(18.65)	18020.83(21.74)	15634.72 (19.71)
Seed	6080.00(7.83)	5950.00(7.51)	7616.67(9.19).	6548.89 (8.25)
Fertilizer	12912.00(16.62)	16440.00(20.74)	13327.08(16.08)	14226.36 (17.93)
Pesticide	1440.00(1.85)	1663.33(2.09)	1471.87(1.77)	1026.06 (1.29)
Total variable cost	44604.00(57.43)	46827.67(59.10)	49396.86(59.60)	46343.82(58.42)
Fixed cost				
Water charge	3099.12(4.00)	2455.00(3.10)	3522.40(4.25)	3025.51(3.81)
Land rent	27500(35.41)	27500(34.70)	27500(33.18)	27500(34.66)
Depreciation	2455(3.16)	2455(3.10)	2455(2.96)	2455(3.09)
Total fixed cost	33054.12(42.56)	32410.00(40.90)	33477.40(40.39)	32980.51(41.57)
Total cost	77658.12	79237.67	82874.26	79324.33
Total revenue	85046.88	114004.0	131583.33	110211.40
Gross Margin	40442.88	67176.33	82186.47	63867.58
Net Farm Income(NFI)	7388.76	34766.33	48709.17	30887.07
Operating ratio	0.52	0.41	0.37	0.43
Gross Ratio	0.91	0.69	0.63	0.74
Fixed ratio	0.39	0.28	0.25	0.31
Return on investment	1.1	1.44	1.59	1.39

*Figures in brackets are percentages of total cost

Source: Field survey 2013/2014

Labour cost for harvesting and fertilizer were the most important variable cost items. Compared to rice and maize, wheat net income was low. It was lowest for the farmers located at the head section of the project and highest for those at the tail. Similarly, in terms of financial efficiency, as revealed by the various ratios (i.e. fixed, operating and gross), farmers at the tail performed best because the ratios were lowest. They also obtained the highest return per naira invested. The return to investment of 1.10, 1.44 and 1.59 shows that the average farmer located at the head, middle and tail of the project obtained a profit or net income of ten kobo, 44 kobo and 59 kobo, respectively.

The average costs and returns structure in irrigated maize production under the KRIP presented in Table 3 shows that fixed cost accounted for slightly more than half of the total production cost at all the locations.

Table 3: Average costs and returns structure in maize production under the project for the 2012/2013 and 2013/2014 combined seasons (₦/ha)

	Location of farmers			
Items	Head	Middle	Tail	Overall
Variable cost				
Land preparation	5696.97(9.11)*	4891.89(7.74)	5509.15(9.15)	5366.0 (8.66)
Sowing	1250.76(2.00)	943.24(1.49)	962.73(1.59)	1052.24 (1.70)
Weeding	1926.52(3.08)	1607.84(2.54)	1497.27(2.48)	1677.21 (2.70)
Harvesting	3352.76(5.36)	3186.22(5.04)	4282.91(7.12)	3607.30 (5.82)
Seed	1819.24 (2.91)	1286.46 (2.03)	1374.55 (2.03)	1493.42 (2.41)
Fertilizer	14222.73 (22.75)	17495.95 (2768)	12658.19 (21.03)	14792.29 (23.87)
Pesticide	1550.76(2.48)	1272.30(2.01)	1266.36(2.10)	1363.14 (2.20)
Total variable cost	29819.74(47.70)	(30683.90(48.55)	27551.16(45.78)	29351.60 (47.38)
Fixed cost				
Water charge	2732.20(4.37)	2559.46(4.04)	2674.55(4.44)	2655.40(4.28)
Land rent	27500(43.99)	27500(43.51)	27500(45.69)	27500(44.38)
Depreciation	2455(3.93)	2455(3.88)	2455(4.07)	2455(4.00)
Total cost fixed	32687.20(52.29)	32514.46(51.44)	32629.55(54.22)	32610.40(52.63)
Total cost	62506.94	63198.36	60180.71	61962.01
Total revenue	130814.47	103487.70	118330.67	117544.28
Gross Margin GM	100994.73	72803.38	90779.52	88192.68
Net Farm Income	68307.53	40289.34	58149.96	55582.28
Operating ratio	0.22	0.29	0.23	0.25
Gross Ratio	0.48	0.61	0.51	0.53
Fixed ratio	0.25	0.31	0.27	0.288
Return on investment	2.09	1.64	1.97	1.90

*Figures in brackets are percentages of total cost

Source: Field survey 2013/2014

The fixed cost was dominated by rent which farmers must pay to the management of the project for using one hectare of land for one irrigation season. In fact, rent accounted for more than 40% of the total cost. Fertilizer, accounting for more than 20% of total cost at all locations, was the most costly item of variable costs.

Furthermore, net farm income (profit) from maize varied according to location of farms in the project. It was highest for farms located at the head and lowest for those at the middle section. Similarly, all the financial ratios computed (including operating, fixed and gross ratios) varied according to location of the farms. However, they all were lower than one as expected. This shows that the farmers were quite financially efficient at generating profits from sales. Again, farmers located at the head were most financially efficient, followed by those located at the tail. Return on a naira invested in maize production was quite high for all categories of farmers. The value of 2.09 for the average farmer at the head implies

that a profit of one naira and nine kobo was realized for every naira invested. Similarly, a profit of 64 kobo and 97 kobo was obtained for every naira invested in maize production by the average farmer located at the middle and tail of the project, respectively.

Table 4 indicates the cost and return of tomato enterprise in the project in which farmers from head to tail encountered losses that year particularly in the middle and tail ends. Lower financial ratios were noticed as well . Also variable dominated the cost structure. The loss was attributed to glut of tomato market as a result of over supply of the commodity that season.

Table 4: Average costs and returns structure in tomato production under the project for the 2012/2013 and 2013/2014 combined seasons (₦/ha)

	Location of farmers			
Items	Head	Middle	Tail	Overall
Variable cost				
Land preparation	4126.88(17.58)*	3835.88(18.06)	3567.0(16.90)	3843.25 (17.51)
Sowing	887.10(3.78)	770.23(3.61)	708.25(3.35)	788.52 (3.58)
Weeding	1261.83(5.38)	1016.03(4.76)	944.33(4.47)	1074.06 (4.87)
Harvesting	9175.27(39.10)	8680.28(40.67)	8113.12(38.44)	8656.22 (39.4)
Seed	1170.43(4.10)	985.88(4.62)	996.40(4.72)	1050.90 (4.48)
Fertilizer	5723.66(24.40)	5159.54(24.17)	5900.00(27.95)	5594.4 (25.5)
Pesticide	1122.58(4.78)	896.79(4.18)	878.49(4.16)	965.75 (4.37)
Total variable cost	23467.74(42.31)	21344.63(40.07)	21107.59(40.00)	21973.32 (40.79)
Fixed cost				
Water charge	2037.90 (6.37)	1959.16(6.14)	2013.45(6.30)	2003.5(6.27)
Land rent	27500(85.96)	27500(86.17)	27500(86.02)	27500(86.05)
Depreciation	2455(7.67)	2455(7.69)	2455(7.68)	2455(7.68)
Total fixed cost	31992.90	31914.16	31968.45	31958.50
Total cost	55460.64	53258.79	53076.04	53931.82
Total revenue	55945.43	50133.32	51115.98	52398.24
Gross margin (GM)	32477.69	28788.74	30008.39	30424.94
Net Farm Income	484.97	-3125.47	-1960.46	1533.71
Operating ratio	0.41	0.42	0.41	0.41
Gross ratio	0.99	1.02	1.03	1.02
Fixed ratio	0.57	0.64	0.63	0.61
Return on investment	1.01	0.94	0.96	(0.97)

*Figures in brackets are percentages of total cost

Source: Field survey, 2013/2014

Seasonal Variation in Profits

Fig 1 shows the 4 major crops cultivated in the project in the 2012/2013 and 2013/2014 seasons. It could be observed that in the 2012/2013 season the average rice and maize farmers had generated positive income, while wheat and maize farmers had negative incomes in 2012/2013 seasons signifying losses. The better performance of wheat during

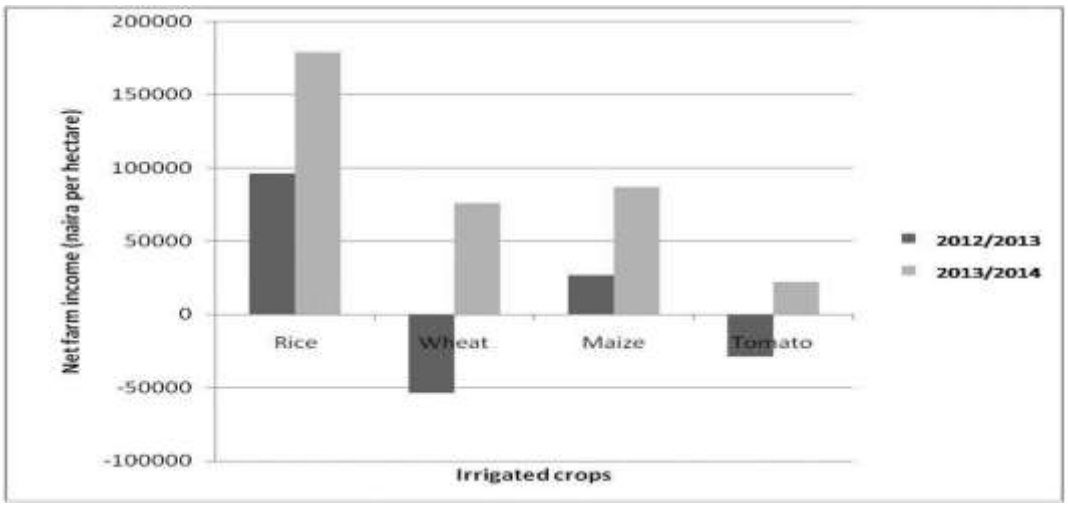

Figure 1: Irrigation farmers' net farm income according to season and crop type

the 2013/2014 season was attributable to the ban on its importation that year. On the other hand, the poor performance of tomato was a result of glut of the commodity during the 2012/2013 season. The area experiences occasional glut in perishable vegetable crops during which prices are usually highly depressed.

Figure II shows the seasonal variation in the incomes of rice farmers according to location at the irrigation project. Incomes were higher in all locations during the 2013/2014. In both seasons, incomes tended to decrease from the Head, through the Middle to the Tail sections. As mentioned earlier, this variation could be attributed to the variation in water availability among the sections. Water which is a critical factor in irrigation reaches the Head, Middle and Tail in that order, so farmers in the head obtain

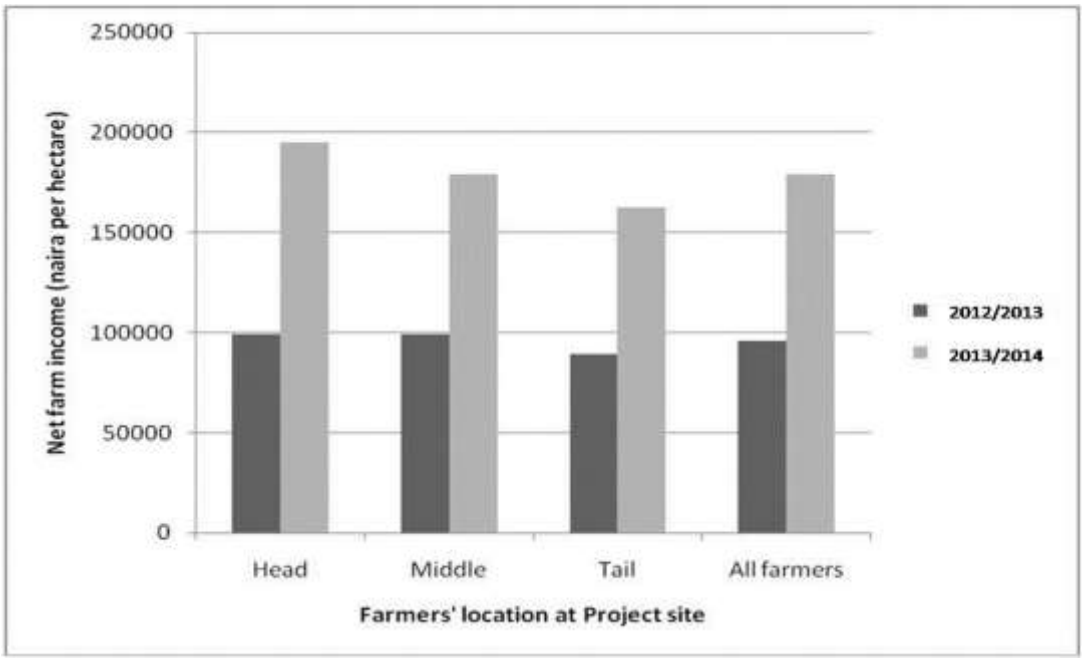

Figure II: Net farm income from rice according to season and location

water first in abundance before the middle and finally the tail. If there is water shortage, it is felt most severely at the tail. No wonder farmers at the Tail complained of obtaining low rice yields.

The results in Figure III indicate that wheat production in 2013/2014 season was profitable in all the locations. However, farmers in the Middle and Tail locations obtained higher income than those at the Head. Income of farmers in the Head region was low.

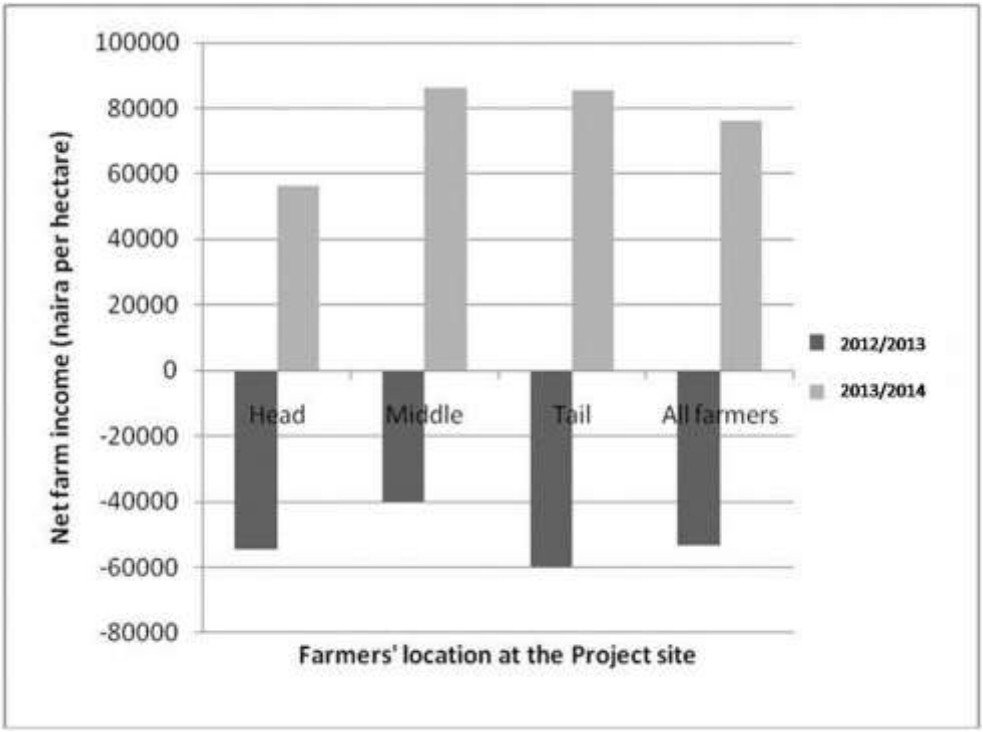

Figure III: Net farm income from wheat according to season and location

Further analysis revealed that farmers at the Head obtained the lowest wheat yield probably due to excessive water application. It can also be seen from the figure that wheat farmers in all sectors of the Project incurred losses in 2012/2013 season. This was due to low wheat prices that season owing to poor competition of local wheat with imported wheat.

Figure IV shows that maize was profitable 2013/2014 season in all the sectors. However, the middle sector incurred losses in 2012/2013 season.

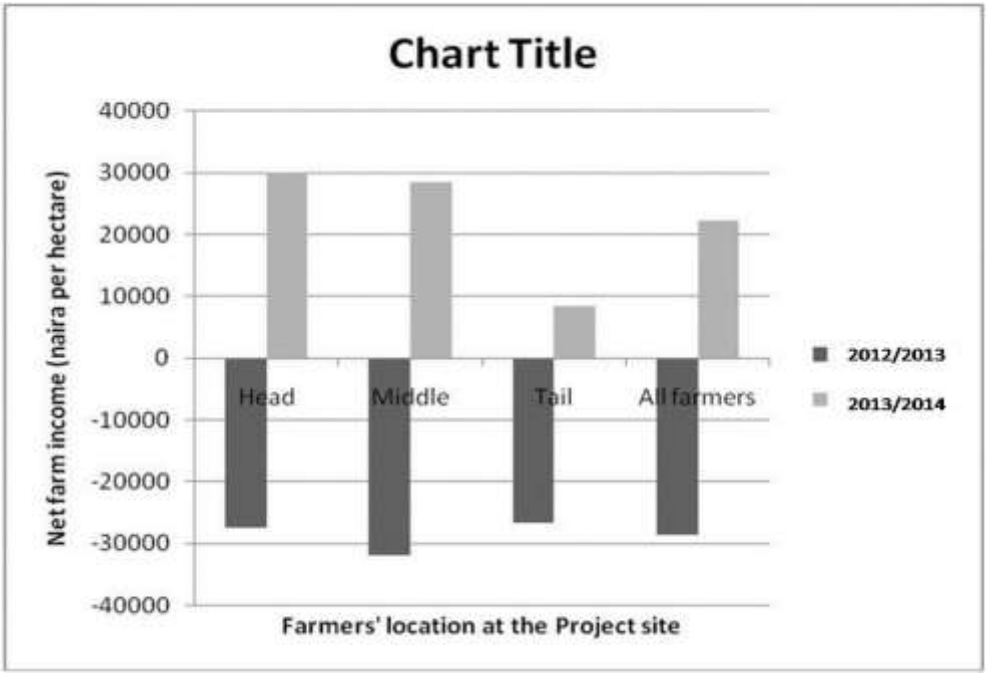

Figure IV: Net farm income from maize according to season and location

Profits tended to be highest in the Head than other sectors of the Project. The relatively good performance of maize in terms of profit could be attributed to the ban on importation of maize in to the country during the period of the survey. The reduced competition with imported maize enabled farmers to sell at fairly remunerative prices, thereby increasing their incomes.

Figure V presents farmers that cultivate tomato as a vegetable fruit which is widely used in the preparation of dishes.

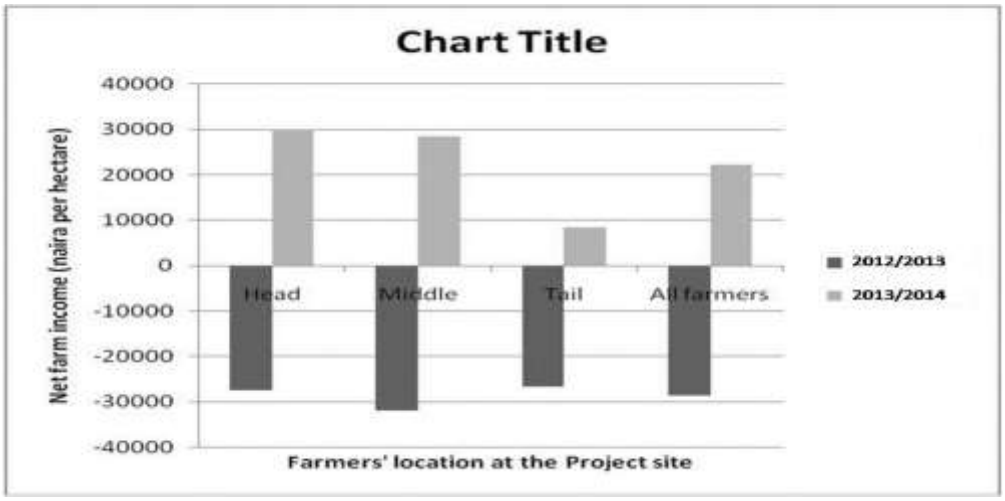

Figure V: Net farm income from tomato according to season and location

It is produced by the farmers as a cash crop. Farmers in all sectors earned profits in 2013/2014, with the profits declining from Head to the Tail sector. They however, incurred substantial losses in the 2012/2013 season. The main reason for the losses in the latter season was low prices arising from glut in tomato supply.

Conclusion and Recommendations

The findings of the study, it could be concluded that crop production under the KRIP was largely profitable. Hence the project could be said to have increased the income of farmers. Improvement in the exiting project capacity will be of great advantage to the farmers. In addition establishment of tomato processing plants in the project area would aid farmers in reducing losses in tomato production since majority of the farmers cultivate the crop.

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