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Impact of National Fadama Development Project on Crop Production and Farm Incomes in Kebbi State, Nigeria.

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Abstract: *The study was conducted to evaluate the impact of the National Fadama Development Project on resources use, crop yield and farm incomes in Kebbi State. A hundred farmers (50 participants and 50 non-participants) were randomly selected from five local government areas of the State. Data collected were analyzed using descriptive statistics, Production functions and farm budgeting. The study revealed that participants used more improved inputs especially, fertilizer, improved seeds, water pumps and pesticides than non-participants. The results obtained showed that tomato, onion and pepper production was profitable. Profit was however higher for participants. The regression analysis showed that land, labour, seed, fertilizer and irrigation hours were important in explaining the variation in output of tomato, onion and pepper under irrigation by the two categories of farmers. From the resource use efficiency stand point, substantial resource use disequilibria were found. Opportunity therefore, exist for raising profitability through resource re-allocation under existing irrigation systems.*
Keywords*: National Fadama Development Project, Resource use, Crop yield, Farm income*.

I. Introduction

One of the key constraints to agricultural production in Nigeria has been inadequate supply and uneven distribution of water. Since rain fed agriculture is limited to six months or less in much of the arid and semi-arid areas of Northern Nigeria, households whose primary occupation is crop farming have often contended with idleness of their resources (especially land and labour) during the dry season (Phillip, 1990). Crop production even in the Fadama lands has traditionally depended on rainfall in the wet season and on residual soil moisture after flood recession in the dry season. In areas with easily accessible shallow ground water or surface water, traditional water lifting devices such as shadoof and calabash are also used to lift water for irrigation (KARDA, 1997).

While the traditional devices are low cost and depend mostly on farmers labour for construction and operation, their irrigation potential is limited to small plots, usually less than 0.5ha per shadoof (KARDA,1997). Furthermore, water lifting by such devices is laborious and time consuming. Because of these constraints, the traditional irrigation techniques could not be relied upon to achieve the full potentials of irrigated farming. In apparent recognition of the continuing limitation posed to expansion of agricultural production by poor development of irrigation facilities and the need for the sector to grow substantially, government initiated the modern small-scale, low-cost, farmer-managed irrigation system. Fadama land development in recent times has been undertaken under the World Bank- assisted National Fadama Development Project (NFDP) through the Agricultural Development Projects (ADPs) in various Sates in collaboration with the Federal Agricultural Coordinating Unit (FACU) (Baba and Singh, 1998). The project was implemented from 1993 to 1999 in five States of Kebbi, Kano, Gombe, Sokoto and Bauchi in the country.

The approach adopted by the National Fadama Development Project (NFDP) is to impound floodwaters, build small-earthen dams, and develop ground water by sinking washbores and tubewells. It is also involved in the distribution to farmers, of small petrol water pumps for lifting water from the source. To facilitate the distribution of pumps and other improved inputs, farmers were encouraged to form Fadama Users Associations (FUAs) (Baba and singh, 1998). Following the introduction of the Fadama Development Project in Kebbi State, it is expected that agricultural production will be enhanced leading to improved farm incomes of the participating farmers. It is also expected that resources will be better managed and utilized. The extent to which these objectives have been achieved requires some investigation. The study is therefore, designed to evaluate the impact of participation in the NFDP on crop yield, resource use and farm incomes in the area.
Considerable resources have been expended on NFDP in the State and it is necessary to see how this has translated into benefits to farmers in terms of increased resource use, crop yields and farm incomes. To evaluate the impact of the project, answers must be provided to a number of research questions, including;

i) To what extent has the project influenced the level of resource use in irrigation farming in Kebbi State
ii) How has the project affected crop yield?
iii) What is the impact of the project on the income of farmers?
iv) How efficiently have resources been utilized under the project?
v) What are the constraints associated with crop production under the project?

Answers to these and related questions will be useful in determining the extent to which the objectives of the Project have been achieved in Kebbi State.

The specific objectives of this study therefore, are to:

i) compare the level of resource use between farmers participating in the NFDP and non-participants
ii) compare crop yields between the participants and non-participants.
iii) compare the costs and returns between participants and non-participants.
iv) determine the efficiency of resource use by the two categories of farmers, and
v) identify the constraints to irrigated farming in the area.

II. Methodology

The Study Area

The study was conducted in Kebbi State, which was carved out of the old Sokoto State in 1991, and is located within latitudes 10^{o} – 13^{o} 15' N and longitudes 3^{o} 30' - 6^{o} E. Kebbi State covers an area of 36, 129 sq km. It is bounded to the east and north by Sokoto State, to the south by Niger State, to the southeast by Zamfara State, to the west by Benin Republic and to the northwest by Niger Republic (www.kebbistate.org.ng.2012).

The State has an estimated population of about 3,238,628 (National Population Census, 2006). Majority of the inhabitants of Kebbi State are peasant farmers who reside in rural settlements particularly along the banks of the Rivers Niger and Rima.

It is located in the semi-arid sudano-sahelian ecological zone and experiences serious moisture deficiency in greater part of the year (Singh, 1995). However, the southern portion of the State falls within a Northern Guinea Savannah ecological zone. The annual rainfall in the State that begins mostly in April and ends in October with highest being recorded in July and August ranges from 400 to 850mm increasing both in amount and intensity within the State from the north to the south. The State is characterized by high temperatures especially in the months of March, April and May. The annual temperature varies from 21^{o} C to 38^{o} C. The soil type found in the State ranges from heavy clay in the fadama areas to loamy, sandy loam and sandy soils in the upland area which supports upland crops like millet, sorghum, rice, cowpea and maize. The fadama crops include tomato, onion, maize, okra, lettuce, carrot, etc. Other occupations in the area include fishing and livestock rearing (KARDA, 1997).

III. Sampling and Data Collection

The categories of respondents interviewed in the study include fadama farmers who participated in the National Fadama Development Project (NFDP) and those who did not. The latter served as control. In order to achieve the objectives of the study, five local government areas were purposively selected and in each local government area, two villages were also purposively selected making ten villages in all. Purposive selection was employed in the selection of local government areas and villages, because dry season farming is not practiced in all the local government areas of the State. Five participants who grew tomato, onion and pepper were randomly selected in each village drawn from the list of registered Fadama Users Association (FUA) members in the villages selected. In addition, five non participants who grew tomato, onion and pepper were randomly selected from a list obtained from the village heads of the selected villages. This brings the size to 50 participants and 50 non- participants and a total of 100 farmers in all.

The selected villages include Kardi and Gulumbe in Birnin Kebbi Local Government Area (LGA), Gwandu and Dalijan in Gwandu LGA, Sabiyel and Kashin Zama in Aleiro LGA, Jega and Gehuru in Jega LGA, as well as Tiggi and Bayawa in Augie LGA. Data collected for the study include demographic, input-output, sales and price data. Trained enumerators assisted in data collection using questionnaires during the 1999/2000 dry season period in single visit interviews. Secondary data were obtained from the official documents of the Kebbi Agricultural and Rural Development Authority (KARDA).

Data Analysis

The first objective, which is to compare the level of resource use between the participating and non-participating farmers, was achieved by descriptive statistics. In addition, t- test and X^2 test were used to test for significant differences between participants and non-participants.

The second objective of comparing the crop yield of participating and non- participating farmers was also achieved through descriptive statistics and t- test. The third objective of comparing the costs and returns of participating and non- participating farmers on the other hand was achieved through farm budgeting, while the forth objective of determining the efficiency of resource use for the two categories of farmers was achieved through production function analysis the ordinary least squares technique. The fifth objective of identifying the constraints of irrigated farming was achieved using descriptive statistics (including percentage and frequency distribution).

Specification of the Farm Budgeting Model

The farm budgeting model used in achieving the third objective of the study is of the form:

NFI = GI - FC - VC .... (1)

Where:

NFI = Net farm income or profit
GI = Gross farm income
FC = Fixed costs
VC = Variable costs.

The Farm Production Function Model

Production function displays the technical relationship between resource inputs and product output (Upton, 1979). It provides comprehensive information on productivities of resources, efficiency of resource use, elasticity of production and return to scale. The data obtained from the study were subjected to several algebraic forms of the production function, such as the linear model, the quadratic, and Cobb Douglas models as represented in equations 3, 4 and 5, respectively. The functions were estimated through multiple regression analysis separately for tomato, onion and pepper enterprises.

The production function employed in achieving the third objective is of the general from:

$Y = f(X_1, X_2, X_3, X_4, X_5)$………………………………………………………… (2)

where

$Y =$ Yield (Kg)
$X_1 =$ Farm size (ha)
$X_2 =$ Human labour input apart from irrigation hours (man-hours)
$X_3 =$ Seed input (Kg)
$X_4 =$ fertilizer input (Kg)
$X_5 =$ Irrigation hours (man-hours)

Specific functional forms employed are specified as follows;

a) The linear function estimated was of the form:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + u$…………………………………..…(3)

Where:

$Y, X_1 \ldots X5$, are as earlier defined and
U = Error or random disturbance term
a = Constant
$b_1 \ldots b_5$ = Regression coefficients

b) The quadratic function estimated was of the form:

$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_1^2 + b_7X_2^2 + b_8X_3^2 + b_9X_4^2 + b_{10}X_5^2 + b_{11}X_1X_2X_3X_4X_5 + u$ ……..….….…….(4)

c) The Cobb-Douglas function estimated was of the form:

$\ln Y = \ln a + b_1 \ln X_1 + b_2 \ln X_2 + b_3 \ln X_3 + b_4 \ln X_4 + b_5 \ln X_5 + u$ ....………......(5)

IV. Results and Discussion

Resource Use

Irrigation water

The distribution of respondents in accordance with the sources of irrigation water is presented in Table 1, which shows that the major source of irrigation water for members was tubewell (68%), followed by open well (26%). On the other hand, majority (60%) of non- members obtained irrigation waters from open wells and only 18% used tubewells.

Source of irrigation water	Participants		Non- Participants		Total	
	Freq.	%	Freq	%	Freq	%
River	3	6	6	12	9	9
Stream	0	0	5	10	5	5
Tube well	34	68	9	18	43	43
Open well	13	26	30	60	43	43
Total	50	100	50	100	100	100

X^2 = 27.26: significant at P < 0.05

Source: Field Survey. 2004.

It could be observed that only few non-participants obtained irrigation water from tubewell compared to participants. This indicates that participants were guaranteed more adequate and reliable irrigation water than non participants. This is because tubewells are more reliable than open wells in terms of adequate water supply. The finding of this study agrees with that of KARDA (1997) which reported that participant of Fadama Users Associations mostly used tubewell as the major source of water supply in the fadama areas. Information on the system of water delivery used by the respondents is presented in presented in Table 2, which shows that all participants used pumps compared to only 38% of non-participants.The fact that more participants that used tubewells and pumps is not surprising considering the fact that drilling of tubewells and distribution of motorised pumps to participants was the focal point of fadama development by the Fadama project.

Table 2: Distribution of respondents according to water delivery system

Delivery system	Participants		Non-participants		Total	
	Freq	%	Freq	%	Freq	%
Shado of	0	0	19	38	19	19
Motorized pump	50	100	12	24	62	62
Pump Hiring	0	0	19	38	19	19
Total	50	100	50	100	100	100

Source: Field survey, 2004.

Land

Table 3 reveals that land tenure by inheritance pre- dominated. About 76% of the members and 88% non-members acquired their land through inheritance, with only few farmers acquiring land through rent. The fact that few farmers rented or purchased land is an indication that commercial transactions in land are minimal in the area. This may have a negative implication for ease of transfer of land title.

On the other hand, land tenure by inheritance, as pointed out by Baba and Wando (1998) usually results in land fragmentation thereby preventing the farmers from benefiting from economies of scale. The finding agrees with that of Nwagbo and Onwucheka (1988) who noted that land in Abakaliki area of south eastern Nigeria is generally acquired through inheritance.

Information on average farm sizes cultivated by participants and non-participants is presented in Table 4, which shows that farm sizes were generally small, with members cultivating an average of 1.30 ha and non-members cultivating 0.80ha. This difference between participants and non-participants is statistically significant (P<0.01). Larger plots cultivated by participants could be attributed to the fact that they owned irrigation water pumps which required less irrigation labour than the traditional method (shadoof) used by some non-members. The use of tubewells by participants guarantees more water adequate availability of water than the open wells used by many non-participants. This could also explain cultivation of larger plots of land by the former.

Table 3: Distribution of respondents according to Land tenure system.

Tenure system	Members		Non-members		Total	
	Freq	%	Freq	%	Freq	%
Inheritance	38	76	44	88	82	82
Purchase	8	17	3	6	11	11
Rented	4	8	3	6	7	7
Total	50	100	50	100	100	100

$X^2 = 3.989$: Not Significant

Source: Field Survey, 2004.

Labour

Table.7 shows that non-participants used more labour on the average than participants. While participants used an average of 317 man-hours/ha non- participants used an averages of 436 man-hours/ha. This difference is statistically significant (P<0.01). This finding is not surprising, because it is expected that non-members should employ more labour than members, since many of them used shadoof, which is manually operated and hence requires more labour. Such a difference was also pointed out by Baba (1993) in Bauchi State, Nigeria.

Table.4: Average levels of resource use and crop yield

Input	Participant		Non-Participant		T-Value
	Mean	S/D	Mean	S/D	
Land (ha)	1.30	0.30	0.80	0.17	10.526***
Labour (Man hrs/ha)	317	181.5	436	167.45	3.407***
Expenditure on seed(N/Ha)	2343	4159	2252	1790	0.65$^{n.s}$
Expenditure on pesticide (N/ha)	3034	758	1780	1159	6.403***
Fertilizer use (kg/ha)	227	102.57	157	96	3.514***
Onion yield (kg/ha)	9126	4209	8304	2896	1.378$^{n.s}$
Tomato yield (kg/ha)	5718	2258	4072	2383	3.888***
Pepper yield (kg/ha)	3370	1975	3050	1403	0.934$^{n.s}$

*** = Significant at P<0.01; n.s = not significant

Sources: Field survey, 2004

Seed

The sources of planting materials (seeds) by the two groups of farmers are presented in Table 5,revealing that a reasonable proportion (40%) of participants obtained their planting materials (seeds) from Kebbi Agricultural Supply Company (KASCOM) as against 8% for non- participants. Thirty percent (30%) of the participants obtained planting material (seeds) from the open market while 44% of non- participants were in this category. Participants obtained improved varieties of planting materials from a government source (KASCOM). Such materials are higher yielding than the ones obtained from the open market or from fellow farmers. Participants were able to obtain the seeds from government sources, because they were organized into associations. Table 4 also shows the average expenditure on seed input by the two categories of respondents. The two categories of farmers were almost at par in terms of average expenditure on seed input, with participants spending an average of N 2,343/ha and non participants about N2,252/ha, a difference which is not statistically significant.

Table 5: Distribution of respondents according to sources of planting material.

Source	Participants		Non-Participants		Total	
	Freq	%	Freq	%	Freq	%
Open market	15	30	12	44	27	27
Government (KASCO)	20	40	4	8	24	24
Previous harvest	12	24	20	40	32	32
Fellow farmers	3	6	4	8	7	7
Total	50	100	50	100	100	100

Source: field survey, 2004.

Pesticides

The average levels of pesticides used is also presented in Table 4, which shows that participants (N 3,034/ha) spent more on pesticides than non-participants (41.33%). which represents a significant difference for participants over non- participants.

Fertilizer

Table 4 shows that participants used an average of 227kg/ha compared to 157kg/ha by non participants. The difference is statistically significant ($p<0.01$). Participants used more fertilizer than non participants because they obtained the fertilizer at a subsidized rate from the government, through their associations. However, the rates used by both categories of respondents were lower than the recommended rate of 500kg/ha for vegetables grown in the fadama of northern Nigeria (AERLS, 1985).

Crop Yield

Information on tomato, onion and pepper yields is presented in Table 4, showing that participants recorded higher yield in all the three enterprises than non- participants. The average yield of tomato was 5,218kg/ha for participants and 4,072kg/ha for non- participants. This represents a difference of 28.80% for participants over non- participants, which is statistically significant ($P<0.01$). However, the average onion yield for participants (9,126kg/ha) was not significantly different from that of non-participants (8,304kg/ha) for non participants. The average yields of pepper for participants and non- participants were 3,370kg/ha and 3,050kg/ha, respectively. This represents a yield difference of 9.50% for participants over non- participants but the increase is not statistically significant. The higher yields obtained by participants over non-participants could be attributed to the fact that the former used more improved inputs such as seeds, fertilizer and chemicals.

Costs and Returns

Tables 6, 7 and 8 show the costs and returns structure for the two categories of respondents in onion, pepper and tomato production, respectively. From Table 6, it can be observed that variable costs dominated the onion production costs accounting for more than 92% of the total costs for participants and 97.16% for non-participants. Among the participants, labour accounted for 47.31% of the total cost while for non-participants it accounted for 53.84%. The variable cost for non-participants exceeded that of participants because non-participants employed more labour than participants did. However, the fixed cost for participants was higher because they invested more in fixed capital items such as tube wells and motorised pumps.

The average net farm income for participants and non- participants were N 198,690.74 and N 167,525.97 respectively. This shows that participants earned more profit than non-participants in the production of Onion did. This is not surprising considering the fact that participants produced at lower cost and obtained higher yields than non-participants obtain. The result compares well with the findings of Baba and Wando (1998) who reported that participants earned more profit than non-participants did.

In pepper production, the results show that participants produced at an average total cost of N 33,934.66/Ha as against N 38,667.24/Ha for non-participants. This is not surprising considering the fact that participants obtained their inputs at relatively lower prices from their associations, than non-participants who obtain their inputs at relatively higher prices from the open market. Again, variable costs dominated the production costs, accounting for 92.02% of the total costs for participants, and 97.60% for non-participants. The variable cost for non participants exceeded that of participants while the fixed cost for participants was higher than that of the non participants, for the reason explained earlier. The average net income for participants and non participants were N 53,685.34 and N 40,632.76 respectively, confirming that participants growing peppers also earned more profit than non- participants.

Similarly, the results on tomato production show that participants produced at an average total cost of N21,085.83/ha as against N40,302.04/ha for non- participants. Variable costs dominated the production costs, accounting for 92.13% of the total costs in the case of participants and 97.5% for non- participants. A larger proportion of the variable cost is attributable to labour input that accounted for 46.64% of the total cost for non-participants and 54.85% for participants. The variable cost for non- participants in most cases exceeded that of participants because non- participants employed more labour than participants did. However, the fixed cost for participants was higher than that of non-participants because participants require more fixed capital investment than non- participants. Again, participants earn higher net income than non-participants on tomato production do.

From the profitability standpoint, it could be observed that onion was the most profitable enterprise for participants and non-participants alike. This was followed by tomato for participants and pepper for non-participants. The returns per naira invested followed a similar pattern.

Table 6: Cost and returns structure in onion production (N/ha)

Item	Members		Non-members	
	Cost/Return	% of Total	Cost /Return	% of Total
Variable Costs				
Seed	2,514.21	8.53	2.531.51	6.31
Fertilizer	3,245.81	11.01	6810.8	16.99
Labour	13,939.43	47.31	21,577.95	53.84
Pesticide	1,607.37	5.46	2,183.04	5.44
Fuel/Repairs	5,389.26	18.32	1,597.66	3.98
Tractor hiring	414.21	1.40	2,160.00	5.39
Pump hiring	-	-	2,262.23	5.64
Total variable costs	27,110.29	92.02	39,122.57	97.62
Fixed Costs				
Depreciation on pump/tubewell	1,746.97	5.93	626.61	1.56
Depreciation on implements	602.00	2.04	291.79	0.73
Depreciation on shadoof structure	-	-	33.06	0.10
Total fixed cost	2,348.93	7.97	951.46	2.37
Total cost	29,459.26	100	40,074.03	100
Yield (Kg)	9126		8304	
Price per kg of output(N)	25		25	
Total revenue	228,150		207,600	
NFI per hectare	198,609.74		167,525.97	
Return on investment	7.74		4.18	

Source: field survey, 2004.

Table 7: Costs and returns structure in pepper production (N/ha)

Item	Members		Non- member	
	Cost/ Return	% of total	Cost/Return	% of total
Variable Costs				
Seed	2.896.13	8.53	2.462.82	6.36
Fertilizer	3,738.86	11.01	6.625.38	17.13
Labour	16,056.90	47.32	20,992.44	54.28
Pesticide	1,851.53	5.45	2,123.80	5.49
Fuel/Repairs	6,207.91	18.29	1,554.30	4.02
Tractor hiring	477.13	1.40	1.782.00	4.60
Pump hiring	-	-	2,200.85	5.69
Total variable cost	31,228.46	92.03	37,741.59	97.60
Fixed Costs				
Depreciation on pump/tubewell	2,012.34	5.93	609.61	1.57
Depreciation on implements	693.83	2.04	283.88	0.73
Depreciation on shadoof structure	-	-	32.16	0.10
Total fixed cost	2,706.20	7.97	925.65	2.39
Total cost	33,934.66	100	38.667.24	100
Gross yield (Kg)	3,370.00		3,050.00	
Price per kg of output	26		26	
Total revenue	87,620		79,300	
NFI per hectare	53,685.34		40,632.76	
Retun on investment	2.58		2.05	

Source: field survey, 2004

Table 8: Cost and returns structure in tomato production (N/ha)

Item	Members		Non- member	
	Cost/ Return	% of total	Cost/Return	% of total
Variable Costs				
Seed	1,773.95	8.41	2,563.60	6.43
Fertilizer	2,290.15	10.86	6,977.23	17.31
Labour	9,835.25	46.64	22,107.25	54.85
Pesticide	1,134.11	5.37	2,236.59	5.54
Fuel/Repairs	3,802.50	18.03	1,636.84	4.06
Tractor hiring	592.25	2.80	1,458.00	3.61
Pump hiring	-	-	2,317.72	5.75
Total variable cost	19,428.21	92.13	39,327.23	97.58
Fixed Costs				
Depreciation on pump/tubewell	1,232.61	5.84	641.99	1.59
Depreciation on implements	425.01	1.16	298.95	0.74
Depreciation on shadoof structure	-	-	33.87	0.08
Total fixed cost	1,658.62	7.87	974.81	2.42
Total cost	21,085.83	100	40.302.04	100
Gross yield (Kg)	5,718.00		4,072.00	
Price per kg of output	15		15	
Total revenue	85,770.00		61,080.00	
NFI per hectare	64,684.17		20,777.96	
Return on investment	4.07		1.52	

Source: field survey, 2004

4.5 Resource Use Efficiency
Regression Results

The production function analysis was used as a tool for examining resource productivity and resource use efficiency. The linear, Quadratic and Cobb-Douglas production functions were estimated. The functions that gave the best fit in terms of magnitude of R^2 and appropriate "signing" of regression coefficients was thereafter selected as the lead equations and were used in determining productivities and resource use efficiency in the study area. Using the estimated coefficients, the marginal value productivity (MVP) of each resource was computed. The resource use efficiency of each input was obtained using the ratio of its MVP to marginal factor cost (MFC).

Table 9 shows the estimated production function for tomato for the participants and non-participants. This implies that 33% of variation in output of tomato for participants is accounted for by variations in the use of land, labour, seed, fertilizer, and irrigation hours. The remaining proportion may be attributed to variation in other factors not included in the model. The F- ratio of 4.234 is significant ($p<0.01$) and further confirms the strong explanatory power of the inputs included in the model.

The estimated coefficients were all positive with the exception of labour. Hence, increase in each of the inputs with positive coefficient, holding other inputs constant, would increase tomato output by a proportion corresponding to value of the estimated coefficient of that input. The negative coefficient for labour implies that this input has been over utilized resulting in a decline to output for additional units of labour. However, only the coefficients of land, labour and fertilizer were significant.

Similarly, estimated coefficients for tomato in the case of non participants show that R^2 was 0.53 and the F – ratio of 10.04 was significant ($p<0.01$) implying that the variables significantly explained the variation in the output. Only the coefficients of labour and irrigation hours were significant in explaining variation in tomato output of the non-participants.

Table 9: Cobb- Douglas regression results for tomato

Participants			Non- Participants		
Variables	Regression coefficients	t- value	Variables	Regression coefficients	t- value
Constant term (A)	- 6674.14	- 6.055***	Constant term (A)	5.480	-0.694 n.s
Land (x_i)	0.283	1.465*	Land (X_1)	0.317	1.619 n.s
Labour (x_2)	- 0.363	-2.581***	Labour (X_2)	0.368	3.089***
Seed (x_3)	0.098	0.522 n. s	Seed (X_3)	0.203	1.069 n.s
Fertilizer (x_4)	0.500	3.662***	Fertilizer (X_4)	-0.076	-0.563 n.s
Irrigation hours (x_5)	0.144	1.084 n. s	Irrigation hours (X_5)	0.211	1.811**
R^2= 0.33; F- ratio =4.234*** **= signature at P<0.05; *** = significant (p<0.01); n. s = not significant			R^2 = 0.53; F- ratio = 10.04 *** *= significant (p<0.10); *** = signature at P<0.01; n.s = not signature		

Source: field survey (2004).

The regression coefficients and t- values for pepper for participants are shown in Table 10.

Table 10: Cobb Douglas regression results for pepper

Participants			Non- Participants		
Variables	Regression coefficients	t- value	Variables	Regression coefficients	t- value
Constant term (A)	0.841	0.707 n. s	Constant term (A)	-2.050	2.188**
Land (x_1)	-0.99	-0.555 n. s	Land (x_1)	0.160	1.012n.s
Labour (x_2)	0.264	2.377***	Labour (x_2)	-0.277	-2.410**
Seed (x_3)	0.213	1.168 n. s	Seed (x_3)	0.236	1.598*
Fertilizer (x_4)	0.410	3.220***	Fertilizer (x_4)	0.320	2.329**
Irrigation hours (x_5)	0.274	2.293**	Irrigation hours (x_5)	0.347	2.7330***
R^2= 0.52; F- ratio = 9.691*** **= significant (p<0.05); ***= significant (p<0.01); n. s = not significant			R^2 = 0.47; F ratio = 7.936 *** *= significant at P<0.10 ; **' = significant at P<0.05; *** =significant at P<0.01; n.s not significant		

Source: field survey (2004).

The result reveals an R^2 of 0.52, and a significant F-ratio of 9.691. All coefficients except land were positive in pepper enterprise among the participants. However, only the coefficients of labour, fertilizer and irrigation hours were statistically significant.

The result of the estimated coefficients for pepper (non-particpants) in the Table 10 shows that R^2 was 0.47 and that the F-ratio of 7.936 is significant ($p<0.01$). The regression coefficients of all the inputs except labour are positive, implying that increasing any of the variables, holding others constant will increase the output of pepper for non-participants. All the coefficients were statistically significant with the exception of land.

Table 11 shows the participants' regression results and t-values with respect to onion. The quadratic function gave the best fit and was selected as the lead equation. The results reveal an R^2 of 0.40, and highly significant ($p<0.01$) F-ratio of 2.59 thereby confirming the strong explanatory power of the inputs included in the model. The results further reveal that in both the linear and quadratic terms of the model, only labour significantly ($p<0.05$) explained variation in onion output.

Table 11: Quadratic regression results for onion (participants)

Variables	Regression coefficients	t- value
Constant term (A)	-1.69	-1.201 n. s
Land (X_1)	-0.64	-0.201 n. s
Labour (X_2)	2.66	2. 307**
Seed (X_3)	0.05	0.060 n. s
Fertilizer (X_4)	1.22	1.124 n. s
Irrigation hours (X_5)	-0.75	-0.782 n. s
QX1	-0.66	0.960 n. s
QX2	-2.55	-2.216**
QX3	-0.43	0.536 n. s
QX4	-0.08	-1.088 n. s
QX5	-0.08	0.737 n. s

$R^2 = 0.40$; F- ratio = 2.59***
**= significant ($p<0.05$)
Source: field survey (2004).

The regression result and t-value for onion in the case of non-participants presented in Table 12 reveals that $R^2$was 0.25 implying that 25% of the total variation in the output of onion is explained by variation in the independent variable. The F-ratio was 2.916 and significant at $p<0.01$, implying that the variables significantly explained the variation in the output. The signs of the coefficients estimated for all the inputs were positive.

Table 12: Linear regression results for onion (non-participants)

Variable	Regression coefficient	t-value
Constant terms (A)	-861.74	-0.567 n.s
Labour (X_1)	0.032	0.240 n.s
Fertilizer (X_2)	0.041	0.1311 n.s
Seed (X_3)	0.388	2.915 ***
Fixed capital (X_4)	0.152	1.157 n.s
Irrigation hours (X_5)	0.204	1.508*

$R^2= 0.25$: F – ratio = 2.916 ***
*= significant at $p<0.10$: *** = significant at $p<0.01$: n.s = not significant
Source: field survey (2004)

Resource use efficiency

Table 13 gives the marginal analysis of inputs used by onion growing participants and non-participants. The results show over utilization of land, seed and under utilization of labour and fertilizer by participants. In the case of non-participants all the inputs were over utilized. This means that for participants, profit could be raised by reducing the levels of land, seed and irrigation hours and by increasing the levels of labour and fertilizer inputs. Reducing the levels of all the inputs by non-participants would also increase profit.

The marginal analysis of inputs used by tomato growing participants and non-participants is presented in Table 14. The results show that there was over utilization of all the inputs except fertilizer by the participants and for non-participants, all the inputs were over-utilized.

Table 13: Marginal analysis of inputs used by onion growing participants and non participants.

Resources	Participants				Non- participants		
	MVP	MFC	MVP/MFC		MVP	MFC	MVP/MFC
Land (X_1)	-55.38	1000	-0.06		1.92	1000.00	0.002
Labour(x_2)	159.84	25	6.39		2.46	25.00	0.10
Seed(x_3)	3.00	100	0.03		23.28	100.00	0.23
Fertilizer(X_4)	72.96	20,00	3.65		9.12	20.00	0.46
Irrigation hours (x_5)	- 45.06	25	-1.80		12.24	25.00	0.49

Source: field survey 2004.

Table 14: Marginal analysis of inputs by tomato growing participants and non- participants.

Resources	Participants				Non-participants		
	MVP	MFC	MVP/MFC		MVP	MFC	MVP/MFC
Land (X_1)	11.32	1000	0.01		12.68	1000.00	0.03
Labour(x_2)	-14.52	25	- 0.58		14.72	25.00	0.58
Seed(x_3)	3.92	100	0.39		8.12	100.00	0.10
Fertilizer(X_4)	20.00	20.00	1.00		-3.04	20.00	0.15
Irrigation hours (x_5)	5.76	25	0.23		8.44	25.00	0.34

Source: filed survey.2004.

Table 15: Marginal analysis of inputs used by pepper growing participants and non- participants

Resource	Participants				Non-participants		
	MVP	MFC	MVP/MFC		MVP	MFC	MVP/MFC
Land (X_1)	- 6.93	1000	-0.01		11.20	1000	0.01
Labour(x_2)	18.48	25.00	0.74		-	25.00	-0.77
Seed(x_3)	14.91	100.00	0.15		16.52	100.00	-0.16
Fertilizer(X_4)	28.70	20.00	1.44		22.40	20.00	1.12
Irrigation hours (x_5)	19.18	25.00	0.76		24.29	25.00	0.97

Source: filed survey. 2004.

All inputs in this study except fertilizer in tomato production by participants were inefficiently allocated. Inefficient utilization of production inputs have been reported in previous researches on smallholder irrigated crop production in Nigeria. For instance, Baba (1989) and Baba and Etuk (1991) reported overutilization of labour in their studies in Bauchi State, while Mansir (1996) also reported over-utilization of labour in Sokoto State. Abdulsalam *et al.* (1997) also reported over-utilization of labour and irrigation water, and under-utilization of fertilizer. Similarly, Macaver *et. al.(1997)*, in their study in Gombe State, reported over-utilization of labour and seed, but under-utilization of fertilizer. The over-utilization of labour in this farming system could be attributed to widespread use of family labour which is not directly paid for. The over-utilization of seed, on the other hand, could be attributed to sourcing of seeds from the open market or other farmers. The farmers are usually not certain of the viability of such seeds and tend to plant excessive quantities of the seeds as insurance. The under-utilization of fertilizer in the present and previous studies could be due to the scarcity and high cost of the commodity.

V. Production Constraints

Table 16 gives the details of the production constraints as identified by the farmers. Forty eight percent (44%) of participants and 66% of non- participants indicated that inadequate supply of fertilizer was the most important constraint to effective dry season faming, while 46% of the participants indicated pests and diseases attack and 28% each of non- participants reported non-availability of improved seeds and lack of tractor for land preparation as major constraints to irrigated crop production. Furthermore, credit problem and inadequate storage facilities were identified as constraints by about 34% of participants and 24% of non- participants.

Labour was not a problem during the dry season farming. This could be attributed to the fact that family labour was readily available in the study area especially during the dry season when there is slack in labour employment. Similarly, non-availability of land was not identified as constraint by non- participants while only 2% of participants identified this as constraint indicating that there is available land for cultivation. Irrigation water was also not a serious problem for participants and non-participants in the study area since only 8% and 14%, respectively identified it as constraint. Similarly, non-availability of extension services reported by only 4% of members and 8% of non-members as constraint was not a major constraint.

Other constraints identified by members of FadamaUsers Association in the study area include non-availability of improved seeds (24%), inadequate storage facility (22%), non-availability of petrol (16%), and bad roads (12%). In the case of non-members, other constraints were non-availability of credit (18%), non availability of petrol (4%) and bad roads (18%).

The findings of this study agree with the findings of Baba and Etuk (1991) who reported that non-availability of credit, lack of tractor for land preparation, non-availability of fertilizer and non-availability of improved seeds were some of the constraints to production in irrigated agriculture.

Table 16: Constraints to crop production under fadama farming as identified by farmers

Constraints	Participants		Non-participants		Total	
	Freq.	%	Freq.	%	Freq.	%
Non-availability of land	1	2	0	0	1	1
Inadequate storage facility	11	22	12	24	23	23
Non- availability of Labour	0	0	0	0	0	0
Credit problems	17	34	9	18	26	26

Inadequate water supply	4	8	7	14	11	11
Lack of extension service	12	4	4	8	6	6
Inadequate supply of fertilizer	24	48	33	66	57	57
Non-availability of improved seeds	12	24	14	28	26	26
Pests and disease attack	23	46	14	28	37	37
Non-availability petrol	8	16	4	8	14	14
Poor pricing	11	22	12	24	23	23
Lack of tractor for land preparation	14	28	14	28	28	28
Bad roads	6	12	9	18	14	14
Others	0	0	1	2	1	1

X^2= 22.36 not significant; d.f =39; multiple responses.
Source: field survey, (2004)

VI. Conclusion

The study evaluated the impact of small-scale irrigation development under the NFDP on crop production and farm incomes in Kebbi state. From the findings of this study, it may be concluded that the National Fadama Development project (NFDP) has led to increases in resource use, crop yield and farm incomes. However, since most of the resources were utilized inefficiently, it appears opportunity still exists for increasing returns through resource adjustment in all the enterprises.

VII. Policy implications

The formation of Fadama User Associations (FUAs) has assisted greatly in the adoption of improved fadama farming inputs. The formation of more FUAs as institutional strategy all over the state is recommended for the benefit of fadama farmers who may not be able to acquire some of the inputs and equipments on their own. Dry season crops are known to be highly perishable. It is recommended that government should either establish agro-processing plants for these products or create enabling environment for private sector operators to establish them. This will reduce the problem of stourage/processing facilities.

Government should embark on the construction and maintenance of fadama access roads into the villages where dry season farming is carried out. This will provide good road network for movement of agricultural inputs into and conveyance of output out of the producing areas.

The findings of this study showed that most of the variable inputs were used above economic optimum levels. Most likely, farmers do not know the recommended rates of these inputs. More extension services should be extended to the farmers on the proper and effective use of irrigation water, fertilizer and seeds to reduce cost. Furthermore, inputs such as fertilizer and improved seeds should be made readily available to the farmers, to promote more efficient utilization of the inputs.

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