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AN ASSESSMENT OF THE EFFECT OF THE NATIONAL FADAMA DEVELOPMENT PROGRAMME ON RESOURCE USE IN PEPPER PRODUCTION IN ZAMFARA STATE, NIGERIA

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ABSTRACT

The role played by small-scale irrigation scheme was examined through an evaluation of the National Fadama Development Programmme in Zamfara State. One hundred and sixty respondents comprising eighty participants and eighty non-participants in the programme that grow Pepper were selected through Multi-stage random sampling. Data generated from the study were analyzed using Descriptive statistics, Farm budgeting, and Production Function. The results showed that participants had larger farm sizes ($P<0.01$) and used more fertilizers ($P<0.01$) than the non-participants. The non-participants employed more labour ($P<0.01$) and used more seeds ($P<0.01$) than the participants. Total cost of production of the participants was less than that of the non-participants but yield obtained by the former was higher ($P<0.01$) than that of the latter. Marginal analysis showed that all the inputs used by the participants were under-utilized while all the inputs used by the non-participants, except land, were over-utilized. It was concluded that small-scale irrigation scheme under the National Fadama Irrigation Scheme has brought about expansion of farmlands and increased use of fertilizers but reduced farm labour and seeds used in pepper production. It was recommended that participants should increase the levels of resources in pepper production so that their profit margin could increase.

Keywords: Small-Scale Irrigation; Resource-use; Pepper

INTRODUCTION

The urge for survival and the need for additional food supply are necessitating a rapid expansion of irrigation practice throughout the world. Even though irrigation is more in arid and semi-arid regions of the world, it is now becoming increasingly important in the semi-arid regions because of the need for the dry season production of many crops especially vegetables (Israelsen *et al*., 1962).

For some years, Nigeria has been faced with acute shortage of some food items including wheat, rice and vegetables. This was caused by lack of proper use of the available resources, natural hazards such as drought experienced in some parts of the country and other factors. In an attempt to make the country self-sufficient in food production, irrigated agriculture was introduced in large scale under the supervision of River Basins Development Authorities throughout the country with the aim of producing crops all year round (Bello and Abdullahi, 1996, Baba and Alassane, 1997). However, the large scale projects have failed to achieve the desired objectives (Baba and Singh, 1998).

The problems identified with large-scale irrigation schemes according to Baba and Singh (1998) include the highly capital-intensive nature which constitutes a heavy drain on our scarce foreign exchange. In addition, they require the use of complex foreign technologies and are usually identified, planned and implemented without the involvement of the potential beneficiaries referred to as ‘top-down’ approach to planning. Furthermore, large scale irrigation schemes characteristically require the construction of dams and impounding large reservoir of water which have been discredited for the environmental degradation and conflicts which they cause. It is an apparent reaction to these serious short comings of large-scale irrigation that emphasis is now shifting towards the development of small-scale irrigation especially in the Fadama lands. The seasonally flooded low land areas (fadama) are known to hold great potentials for the production of important grain crops and vegetables in quantities large enough to at least meet domestic demand if they are adequately exploited. Consequently, small scale irrigation in the fadama has been identified as a key source of agricultural growth especially in the northern states of Nigeria. Fadama farming has a long history in northern Nigeria. Farmers in northern Nigeria have traditionally undertaken irrigation through the use of such technologies and methods as shadoof, buckets and calabash. These systems though have advantages of being low cost and farmer managed, they have limited potentials because farmers are restricted to small plots and low crop output (Bello and Abdullahi, 1996).

To this end, in 1991, the federal government of Nigeria took a loan of US$76.5m equivalent to finance a project geared at developing Fadama lands (flood plains) by introducing small-scale irrigation. The core States implementing the projects were Sokoto, Kebbi, Kano, Jigawa and Bauchi states and later Zamfara state, which was created out of former Sokoto state in 1996. The project was designed to help transfer appropriate simple technology for small scale irrigation which is much cheaper than large scale irrigation and which has so far failed to meet its potential. The programme was also necessitated by the seasonal and erratic rainfall that is being received and the availability of unexploited fadama land scattered all over in the participating states. The main aim of the programme was to boost the productive potentials of the widely scattered fadama lands in the state.

Although some studies have been conducted on the impact of the project on participants, like the internal implementation and completion report, such studies have not compare the resource-use and crops yields realized from agricultural production through the use of small scale irrigation technology by the participants and those not participating in the scheme. This study was designed to bridge such a gap.

MATERIALS AND METHODS

Site Description

The study was conducted in Zamfara state of Nigeria. Zamfara state was created from old Sokoto state on 1st October, 1996 and is located in the north western part of Nigeria on latitudes $10^0 40'$N – $13^0 40'$N and longitudes $4^0 30'$E – $7^0 06'$E. It covers a land area of about 35,171 km^2. It has an estimated 254,411 farming families and a population of 3,259,846 people (N.P.C., 2006).

The climate is characterized by wet and dry seasons. The state falls within the sudan savannah ecological zones. Annual rainfall in Zamfara state ranges from 700mm to 900mm (ZADP, 1998). The rainfall duration is about 5 months, beginning mostly in May and ending around October. This leaves a period of dry season of about 7 months during which irrigation farming under the various systems of irrigation is undertaken.

In the fadama, the soil generally consists of finer sands, silts and clays. The fadama are low lying, flood plain, poorly drained and finer textured, less acid soils. The state is blessed with 40,750ha of fadama land with a lot of underground water, which could be economically tapped for dry season irrigation (ZADP, 1998).

The source of drainage pattern and river system flows of the state develops from the central highland in Nigeria (Zaria to Funtua) and Jos plateau. This radial pattern of drainage develops with rivers draining to Zamfara and Sokoto rivers. The major rivers in the state are the Sokoto Rima Rivers. Both rivers have numerous tributaries such as river Bunsuru, Gagare, Ka and zamfara. The fadama along the flood plains of these rivers are intensively cultivated under irrigation.

The categories of respondents interviewed in the study included fadama farmers participating in the National Fadama Development Project (NFDP) and non-participating fadama farmers. The latter served as control. There are two zonal offices under the Zamfara Agricultural and Rural Developmet Project. Zone I comprises of Gusau , Bungudu, Tsafe, Maru, K/Namoda, Zurmi, B/Magaji and Shinkafi local government areas while zone II comprises of Anka, T/Mafara, Maradun, Bakura, Bukkuyum and Gummi local government areas.

Sampling Procedure and Data Collection

Multi-stage random sampling technique was used. In stage one, two local government areas each, were randomly selected from each of the two zones, making four local government areas. In stage two, from each of the selected local government areas, two villages where there were extensive fadama cultivation were purposively selected, giving a total of eight villages in all. The villages from which the farmers were samples included Wanzamai and Yankuzo villages in Tsafe local government area. Shinkafi A and Shinkafi B in Shinkafi local government area, Jabaka and Kededi in Gummi local government area and Bukkuyum and Farnawa in Bukkuyum local government areas. In stage three, after a preliminary survey to determine farmers that grow Pepper, a sample of ten participants and ten non-participants pepper farmers were selected in each village giving a total sample size of 160 farmers in all. The crop was considered because it is one of the major fadama crops grown in the study area.

Two sets of data were collected and used for the study. The first set contained socio-demographic information such as sex, educational status, and occupation of the respondents. The second set contained information on inputs and output such as farm labour, seeds, fertilizers, pesticides, water application systems crop yield and prices.

The first set of data was collected by the researcher together with trained enumerators in single visit interviews using structured questionnaire, whereas, the second set of data was collected on weekly basis for 18 weeks from November 2004 to March 2005. That was because the respondents did not keep records of farm activities.

Data Analysis

The analytical procedure used for achieving the objectives of the study included descriptive statistics, production function analysis and farm budgeting. The data generated from the study were subjected to several algebraic forms of the production functions such as the linear, the Cobb-Douglas, and the quadratic functions. The general form of the production function model employed in this study was as follows:

$Y = f(X_1, X_2, X_3, X_4, X_5, X_6, U)$ ………… (1)
Where
Y = output (kg)
X_1 = Human labour input (man-hours)
X_2 = Fertilizer input (kg)
X_3 = Seed input (kg)
X_4 = Fixed capital investment (Naira)
X_5 = Irrigation water input (M^3)
X_6 = Land (ha)
U = Error or random disturbance term.

The linear function gave the best fit in terms of the magnitude of R^2, appropriate signs of regression coefficients and the level of significance of the variables included in the equations and therefore chosen as the lead equation.

The efficiency with which the resources were used was measured by multiplying the marginal physical product (MPP) with their respective prices to get the marginal value product (MVP) and then taking the ratio of the MVP to MFC (marginal factor cost). If the ratio is less than one, it means that an input is over utilized and is under utilized if the ratio is greater than one. A resource is said to be efficiently utilized if its MVP is equal to its unit acquisition cost or if the ratio of MVP to MFC equals to one (unity). The marginal value product (MVP) of each $input_i$ was obtained bymultiplying its marginal magnitude b_i estimated from the regression equation with its price p_y.

The farm budget model that was used in the study was of the general form:
NFI = GI – Fc – Vc ………… (6)
Where,
NFI = Net farm income or profit (₦)
GI = Gross farm income (₦)
Fc = Fixed costs (₦)
Vc = Variable costs (₦)

RESULTS AND DISCUSSION

Levels of Resources Used in Pepper Production

Availability and accessibility of resources are important determinants of farmers' active involvement in pepper production. The average levels of resources used in pepper production by the respondents is presented in Table 1. It is revealing from the Table that the mean areas of land cultivated by the participants and the non-participants were 1.9 ha and 1.4 ha, respectively and the difference between them was significant (P<0.01). This shows that the participants had access to farmlands for pepper production more than the non-participants. The larger farm sizes exhibited by the participants may be because they had water pumping machines, and therefore, they could easily obtain more water to irrigate their crops.

The amounts of labour used were 2104.02 man-hrs/ha and 2693.52 man-hrs/ha for the participants and non-participants, respectively and the difference between the two sets of respondents was significant (P<0.01). This shows that participants used less amount of labour than non-participants probably because the latter used water pump which was easier to supply water and therefore require less labour than the shadoff.

Table 1: Average levels of resource use and crop yield

Input	Participants		Non-participants		
	Mean	SD	Mean	SD	t-value
Land (ha)	1.9	0.17	1.4	0.28	12.06**
Labour (man-hrs/ha)	2104.02	241.7	2093.53	594.0	6.10**
Expenditure on seeds (₦/ha)	1326	113.02	1824	216.41	8.22**
Expenditure on pesticide (₦/ha)	842.92	604.7	838.00	400.7	13.6^{ns}
Fertilizer use (kg/ha)	416.9	93.02	247.88	130.19	12.5**
Pepper yield (kg/ha)	1501.8	498.1	1309.8	320.8	4.61**

Field survey 2004/2005; ** = (P<0.01), ns = not significant

Results have shown that participants had greater access to improved variety of pepper seeds (74%) than the non-participants (26%). This improved variety was high yielding and early maturing than the local variety that was predominantly used by the non-participants. Table 1 shows that the non-participants, who mostly used local variety spent more on seeds ((1824₦/ha) than the participants (1326 ₦/ha) and the difference was significant (P<0.01). Table 1 shows further that while the participants spent ₦842.92/ha on pesticides, the non-participants spent ₦838.00/ha on the same chemical. However, there was no significant difference between the two in amounts. On the contrary, the Table also shows that the amount of fertilizers used by the participants (416.9 kg/ha) was significantly higher (P<0.01) than the amount used by the non-participants (247.88 kg/ha). This shows that participants had more access to fertilizers than the non-participants. This calls for the need to enhance accessibility of the non-participants to fertilizers.

Comparison of the average yield of pepper obtained by the respondents revealed that the participants obtained 1501.8 kg/ha and the non-participants obtained 1309.8 kg/ha; the difference between the two was significant (P<0.01). Three reasons could be advanced for the higher yield obtained by the participants in the programme. (1) The participants used water pumping machine, which was believed to have the capacity to supply more water than the shadoff, they were able to convey more water to the crop than the non-participants. (2) The opportunity of possessing water pumping machine by the participants encouraged them to use improved seed despite its higher demand for water than the non-participants who had to use more of the local variety because of its advantage of withstanding limited water supply. (3) The participants had greater access to fertilizers than the non-participants, hence, the latter were to some extent able to supply the nutrient requirement for growth of the crop more than the former.

Cost and Return Structure in Pepper Production

Table 2 presents cost and return structure in pepper production for the participants and non-participants. It is revealing from the Table that variable cost is the most important cost item representing 95.27% and 97.60% of the total costs for the participants and non-participants, respectively. Among the variable costs, labour was the most important cost item for the two categories of respondents, representing 63.28% and 72,27% of the total costs for participants and non-participants, respectively. This shows that the non-participants spent 8.99% higher on labour than the participants. The non-participants had to spend more on labour since they were using shadoff which was more labour intensive than using water pumping machine.

Table 2: Cost and returns structure in pepper production (₦/ha)

Item	Participants		Non-participants	
	Amount (₦)	% of total	Amount (₦)	% of total
Seed	355.48	2.03	378.02	1.27
Fertilizer	3658.50	20.9	5737.27	19.30
Labour	11076.67	63.28	21485.82	72.27
Pesticide	282.42	1.61	398.48	1.34
Fuel/repair	1302.60	7.44	242.62	0.82
Pump hiring	-	-	770.90	2.60
Total variable cost	16675.67	95.27	29013.11	97.60
Depreciation on pump/tube well	711.99	4.07	367.04	1.23
Depreciation on implement	115.94	0.66	264.99	0.89
Depreciation on shadoff structure	-	-	86.07	0.29
Total fixed cost	827.93	4.73	718.10	2.40
Total cost	17503.60	100	29731.21	100
Gross yield (kg)	1501.73		1309.80	
Price per unit of yield	45.68		45.68	
Total revenue (N)	68599.03		59831.66	
Net farm income/ha	51095.43		30100.45	

Field survey, 2004/2005

The total costs of production were ₦17503.60/ha and ₦ 29731.21/ha for the participants and non-participants, respectively. This shows that non-participants spent more money per hectare in the production of pepper than participants. This was not surprising considering the fact that besides spending more on labour, as the same Table shows, the non-participants were faced with other overheads such as cost of pump hiring and depreciation on shadoff which were not encountered by the participants. Net farm incomes obtained were ₦ 51, 095.43/ha and ₦ 30, ₦ 100.45/ha for the participants and non-participants, respectively and the difference was ₦ 20,994.98/ha. This shows that net farm income obtained by the former was greater than that of the later. This could be as a result of the higher cost of production faced by the non-participants.

Linear Regression the Production Factors

Table 3 shows the linear regression results of the factors that determine pepper production. The R^2 were 0.778 and 0.934 for the participants and non-participants respectively. These imply that 78% and 93% of the variation in outputs of the participants, and non-participants, respectively, were accounted for by the variation in the explanatory variables included in the model. The F-ratios were 40.401 and 161.88 for the participants and non-participants, respectively, and both were significant ($P<0.01$). This shows a strong relationship in the variables included in the model.

Table 3 further shows that, in the case of participants, fertilizers ($P<0.05$), fixed capital ($P<0.1$) and land ($P<0.01$) had significant positive coefficients. On the contrary, irrigation water ($P<-0.05$) had significant negative coefficient. This shows that increasing the levels of land, fertilizers and fixed capital, given the level of water supply by the participants, shall increase output, on the one hand. On the other, decreasing the level of water given the other inputs shall increase output for the participants. This means that the participants had water in excess which gives them the opportunity to expand pepper production by committing more productive resources other than water.

In the case of non-participants, Table 3 reveals that fertilizers ($P<-0.01$) and irrigation water ($P<0.05$) had significant negative coefficients but land ($P<0.01$) had significant positive coefficient. This implies that the small size nature of farmlands cultivated by the non-participants resulted in intensive use of fertilizers and irrigation water by them. In order to increase output, therefore, the non-participants would have to either reduce the quantity of fertilizer and irrigation water used, or increase farm size, or both.

Table 4 shows marginal analysis of inputs used by the respondents. It is revealing from the Table that all the productive resources employed by the participants were inefficiently utilized associated with gross under-utilization. This shows that the production activities of the participants were in stage 1 of the production process, which is below the optimum level of production. In order for the participants to increase profit generation, therefore, they should commit more resources in the production of pepper. This means that participants in the NFDP had an opportunity to expand pepper production by committing more resources.

On the contrary, Table 4 showed that except land, all other resources were inefficiently utilized associated with over-utilization by the non-participants. That is to say, land, labour, capital, seeds, fertilizers and irrigation water were intensively utilized above the optimum levels. This shows that rather than expand resource use, non-participants need to decrease the amount of aforementioned resources other than land if they were to get more profit from the production of pepper.

Table 3: Linear regression of pepper production factors

Item	Regression coefficient	
	Participants	Non-participants
Constant term (μ)	6.928**	6.341**
	(12.103)	(60.404)
Labour (x_1)	2.531E-06 ^{ns}	-4.484E-04^{ns}
	(0.155)	(-0.849)
Fertilizer (x_2)	1.309E-03*	-5.679 E-03**
	(2.651)	(-4.656)
Seed (x_3)	1.685E-04^{ns}	-2.772 E-04^{ns}
	(1.568)	(-1.182)
Fixed capital investment (x_4)	1.042E-04^{S}	-1.941 E-04^{ns}
	(0.431)	(-0.882)
Irrigation water (x_5)	-4.523E-06*	-1.572 E-05*
	(-2.098)	(3.140)
Land (x_6)	1.413**	6.704**
	(3.735)	(4.073)
R^2 - value	0.778	0.934
F-ratio	40.401**	161.882**

Field survey 2004/2005; ** = Significant (P<0.01), * = significant (P<0.05),
^{S} = Significant (P<0.10); ns = Not significant. The figures in brackets are t-values.

Table 4: Marginal analysis of inputs used in pepper production by the respondents

Resources	Participants			Non-participants		
	MVP	MFC	MVP/ MFC	MVP	MFC	MVP/MFC
Labour (x_1)	0.12	30	0.004	-0.0205	30	-0.00068
Fertilizer (x_2)	0.60	40	0.015	-0.26	40	-0.0065
Seed (x_3)	0.77	100	0.0077	-0.191	100	-0.00191
Fixed capital investment (x_4)	0.48	35	0.014	-0.0088	25	-0.00035
Irrigation water (x_5)	0.21	30	0.007	-0.00072	30	-0.000024
Land (x_6)	64.55	1000	0.065	306.24	1000	0.31

Field survey 2004/2005

CONCLUSION

Based on the outcome of the study it could be concluded that small-scale irrigation scheme under the National Fadama Development Programme has brought about increased water availability and enhanced accessibility to productive resources such as land, improved variety of seed and fertilizers among the participating farmers. This has led to a significant increase in the yield of pepper for the participants. The scheme has also created an opportunity for the participants to expand their pepper production activities by committing more productive resources. Doing so would allow them generate more profit. This was in contrast to the production activities of the non-participants whose productive resources were over utilized relative to their small farm size (approximately 1ha.). They have to reduce resources utilized in pepper production in order to get more profit.

It is therefore, recommended that every farmer in the state should be given equal opportunity to participate in the programme so that everyone would have access to adequate water supply to his/her farmland. There is the need to enhance extension education among farmers to make them realize the benefit of participation in the programme.

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