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Optimum Farm Plans for Fadama Farms in Niger State, Nigeria

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ABSTRACT
The study sought to determine the optimal farm plan for Fadama farms in Niger State, Nigeria. A Random sampling of 105 Fadama farm families were interviewed using structured Questionnaires, though only ninety eight were found usable from the site of the study at the end of the survey. Most of the respondents (95%) were males and were within the ages groups of 21 to 50 years (75%). Half of the respondents in the study area had no formal education. 70% of the respondents were, however, married couples with family sizes of eight (8). They result of the linear programming analysis shows that only Rice Enterprise should be carried out on a 0.66ha of land, as this will yield an optimal return of =N=43,743.47/ha. Capital was the most limiting resource in the study area. Therefore farm families engaged in other enterprises (Sugarcane, Tomato/Pepper mixture and Cassava/Sweet Potato mixture) could equally divert their resources to the Production of Rice. It was recommended that more Land resources be allocated to Rice Production in the study area.

INTRODUCTION

Fadama is a Hausa word which refer to low-lying relatively flat areas either in stream less depressions or adjacent to seasonally or perennially-flowing streams or rivers (Kolawale and Scoones, 1994). Fadama in Northern Nigeria and elsewhere in Western Africa is synonymous to bas found in Sahel. Wadi or Khor in Sudan, Dambo in Southern Africa (Scoones, 1992) and inland valley in other parts of the world. It has characteristic moisture retention capacity within a very close to rhizosphare and fertility for greater part of the year than the adjacent upland (Kolawale and Scoones, 1994). 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 and managed. They help in stabilizing production in Northern parts of the country with marginal rainfall (Ismail, 2004). Similarly, small-scale irrigation in Fadama has been identified as a key source of agricultural growth and development. Fadama irrigation farming has a long history in Northern Nigeria where farmers have traditionally undertaken irrigation through the use of such technologies and methods as Shadouf, buckets and calabash to produce high value agronomic and horticultural crops which are widely grown, such as rice, sugar cane, cocoyams, leafy vegetable among others in diverse cropping system. Several hundreds of fruits trees like Citrus, Mango and Cashew, etc are planted within and around Fadama lands, this provides cash income as well as food crops to the farmers. This identifies Fadama as a critical resource within the semi-arid Northern Nigeria.

A critical assessment of the performance of Fadama farming in Niger State however reveals that the sub-sector is bedeviled with a number of technical, financial, institutional and human resource problems which submerged farmers persistently in the vicious cycle of poverty due to low income from low productivity. It is useful to develop an optimum farm plan for Fadama farmers that will be profitable and sustained for a very long period of time by the user in specific situations. For example, Ogunfowora (1970) studied the potential

role of farming in the food production sector of Nigerian Agricultural Industry. Two models were designed and tested. The first model was designed to characterize the peasant farming farm operating entirely on a semi-subsistence basis while the second model characterized a family farm with commercial orientation in the sense of incorporating labour hiring and capital borrowing. The solutions of the Linear Programming (LP) problems posed in these two model revealed that there is a wide range of income opportunities in peasant farming through efficient combination of enterprises, increases in resources base and improvement in managerial ability that is required for the operation of larger farm units. The results also show that an efficient combination of enterprises will provide an inbuilt stability against income variations arising from yield and price changes.

Tsoho (2005) used LP approach to examine the possibilities of combining Tomato/Onion/Pepper and Tomato/Onion to determine which yield optimum returns. His findings was that Tomato/Onion/Pepper and Tomato/Onion be carried out on 0.39 and 0.62 hectares of land respectively and that this will yield an optimum returns to labour and management of =N=31,806 15k

Materials and methods

The area of study was the Gbarabo Fadama in Wuya Kede, Kede-Tifin District of Mokwa Local Government Area, Niger State. The Fadama is along the flood plains of River Kaduna. The Fadama is cultivated by small-scale farmers who are migrants from the neighboring states of Kebbi, Sokoto, Kaduna and Zamfara. They irrigate their farmlands using Pump and Calabash or bucket. Shadouf is however uncommon in the area. The Fadama is cultivated all year round for the production of Rice, Sugar cane, Tomato, Okra, Potato, Cassava and some times Onion

Sampling procedure and sample size

The sampling size of the study was 105. The choice of this number was on the basis of the preliminary survey of the study area. Random sampling was however used to draw the sampling size. The choice of random sampling technique was to give equal opportunity or chances for each farm family of being selected.

Data collection

Data for the study was collected using interview guide with aid of a well structured questionnaire. The data was collected between December, 2004 and January, 2005. Data collected were mostly demographic and those related to inputs and outputs. However, at the end of the interview, only 96 of the questionnaires were found usable.

Measurement of variables

The resource constraints in the study area include land, labour capital and irrigation water. The various levels of constraints were determined by what the "representative" farmer in the study area had. The representative farmer in the study area was taken to be the farmer who used the arithmetic means of each of the resources. This view was supported by Okuneye (1985) who reported "A representative farm can be used to depict a typical farm in the sample". He further noted that although representative farms are often synthesized in the sense that none of them depict an actual farm, their components can be found on majority of the farms they represent.

The land constraint:- used represents the arithmetic mean of land cultivated by the farmers in the study area, and was measured in hectares (ha).

Labour constraint:- Aggregated family, communal and hired labour measured in man-days was obtained and the total labour used per hectare must be less than or equal to this value. A man-day referred to an average man working for eight (8) hours.

Capital constraint:- The maximum own capital available was obtained by determining the arithmetic mean of farmers expenses (costing capital items) on purchased inputs like fertilizers, seeds/seedlings, agrochemicals, fuel etc. The mean capital devoted to each crop or crop mixture determined and summed up to obtain the total capital used in the study area.

Water input constraint:- Irrigation was carried out by respondents in the area to supplement the natural rain fall, especially towards the end of the cropping season. The average water input expressed in ha-cm was similarly obtained.

Furthermore, the basic activities in the study area refers to the crops grown, and only enterprises, which were carried out by up to six (6) percent of the total respondents, were considered appropriate for the analysis (Mohammed - Lawal, 2003).

These enterprises include X_1 (Sole rice), X_2 (Sole Sugarcane), X_3 (Cassava/Sweet potato), X_4 (Vegetable Tomato/Pepper).

These activities are defined in units of one hectare (1ha), for each of the enterprises.

Data analysis.

The data were analyzed using Descriptive statistics and Linear Programming Model. Descriptive statistics were used to describe the socio-economic characteristics while the LP model was used to develop the optimal farm plan in the study area.

The Linear Programming Model fitted was estimated as:

$$\text{Max. } Z = \sum (Pjqj - Cj)$$

$$= \sum_{j=1}^{m} aij\ \chi ij \leq Bi$$

$$= Xj \geq O\ (j = 1 - m)$$

where :

Z	=	Returns to owners labour and Management (=N=/ha)
Pj	=	Price of jth crop per unit in =N=
qj	=	Quantity of jth crop in calorie/kg
Cj	=	Total variable cost of labour and purchased inputs
aij	=	Per unit requirement of the jth activity carried out
m	=	The number of activities and it ranges from 1 – 4
jth	=	Resources, ranges from 1 – 4
bi	=	The level of jth resources

Where :

b_1	=	Average farm size (ha)
b_2	=	Average labour available per farmer in man-day/ha.
b_3	=	Average capital employed per farmer in =N=/ha
b_4	=	Average water input employed in cm-ha

Results and Discussion

Gender distribution of respondents

Over 95 percent of the respondents were males with females accounting for only 4.17%. (Table 1.) This confirms the popular belief in the area that farming is an occupation for the male folks while the female folks are only to prepare food for the males while working on their farms.

TABLE 1. Gender distribution of respondents

Gender	Frequency	Percentage
Male	92	95.83
Female	4	4.17
Total	96	100.00

Age distribution of respondents

More than half of the respondents (75%) were within the age groups of 21 50 years. Because of the tedious nature of manual farming which characterized the farming system in the area, only the adults of working age could take into Fadama farming. The age group also represents the most economically active age group.

Furthermore, the reason for this low percentage of young farmers (7.29%) could be due to rural urban migration and the quest for modern education in urban centers.

TABLE 2: Age distribution of respondents

Age group	Frequency	Percentage
10 20 years	7	7.29
21 30 years	15	15.63
31 40 years	20	20.83
41 50 years	37	38.54
51 60 years	15	15.63
61 70 years	2	2.08
Total	**96**	**100**

Modal age group = 41 - 50 years
Mean age group = 40 years

Educational distribution of respondents

Roger and Shoemaker (1971) and Obibuaku (1983) stated that education is not only an important determinant of adoption of innovations but also a tool for successful implementation of innovation. Table 3 shows the educational status of respondents. The table reveals that half of the respondents in the study area had no formal education. This corroborates with the findings of Tsoho (2005).

TABLE 3: Educational status of respondents

Highest Edu. Level attained	Frequency	Percentage
Qur'anic education	44	45.83
Adult education	21	21.88
Primary education	19	19.79
Secondary education	8	8.33
Tertiary education	4	4.17
Total	**96**	**100**

Marital status of respondents

The marital status of respondents may become an important factor in agricultural production especially when farm labour is in short supply. Marital status also determines the status of respondents towards their household responsibilities. Married couples with large family size may have ready supply of family labour to work on the farm and this may increase the size of farmland cultivated. Table 4 reveals that about 70 percent of respondents (69.80%) in the study area were married couples having average family size of 8 (table 5). This is an indication of their chances of getting family labour for use on their farms.

TABLE 4: Marital status of respondents

Marital Status	Frequency	Percentage
Single	21	21.88
Married	67	69.80
Divorced	4	4.16
Widower	4	4.16
Total	**96**	**100**

TABLE 5: Family size of respondents

Family size	Frequency	Percentage
1 – 5	30	31.25
6 – 10	43	44.70
11 – 15	17	17.71
16 – 20	4	4.17
21 – 25	3	2.08
Total	**96**	**100**

Average family size = 8

Standard deviation = 4.6

Optimal Enterprise Combination

Model : The Enterprise include;

X_1 = Sole Rice Enterprise

X_2 = Sole Sugarcane Enterprise

X_3 = Cassava/Sweet Potato Enterprise

X_4 = Vegetable (Tomato/Pepper) Enterprise

These activities are defined in units of one hectare (lha) for each of the Enterprises.

The Linear Programme Model Estimated is:

Max $Z = 66517.02 X_1 + 9714.60 X_2 + 15455.75 X_3 + 33601.60 X_4$

Subject to:

Land = $= 1 X_1 + 1X_2 + 1 X_3 + 1X_4 \leq 0.73$ha

Labour = $= 142.34 X_1 + 96.15 X_2 + 108.55 X_3 + 98.04 X_4 \leq 154.12$ man-days.

Capital (Purchases in puts) = $19212.94 X_1 + 12712.55 X_2 + 14662.27 X_3 + 15666.71 X_4 \leq$ =N=12634.97.

Irrigation water = $148.62 X_1 + 151.15 X_2 + 123.45 X_3 + 169.03 X_4 \leq 109.71$ ha-cm.

Where Z = Return to Labour and other Managements

TABLE 6: Summary of linear programme

No	Variable	Solution Cost	Opportunity Coefficient	Objective Coefficient	Min. Obj. Coefficient	Max. Obj.
1.	X_1	+0.65762812	0	+66517.03	+4127.023	+ Infinity
2.	X_2	0	+34297.457	+9714.5996	- Infinity	+ 4401
3.	X_3	0	+35306.422	+15455.750	- Infinity	+ 5076
4.	X_4	0	+20638.039	+33601.602	- Infinity	+ 5423

Max. Objective = ^43,743.47

TABLE 7: Resource Constraints

No	Constraints	Status	RHS	Shadow Price	Slack or Surplus	Min. RHS	Max
1.	Land	Loose	≤+0.7300	0	+0.072	+0.658	+ Infinity
2.	Labour	Loose	≤+154.12	0	+60.51	+93.607	+ Infinity
3.	Capital	Tight	<+123634.97	+3.4623	0	0	+ 1402
4.	Irrigation Water	Loose	<+108.71	0	10.97	+97.74	+ Infinity

Max. Objective = N43,743.47

Table 6 and 7 are Summary of the Linear programme results. As shown in Table 6, only Rice activity should be carried out on a 0.66ha of Fadama land. This is capable of yielding an optimal income of =N=43,743.47. Similarly, Table 7 shows that capital is the most limiting resource. It has a shadow price of =N=3.46. Other resources are in surplus.

CONCLUSION AND IMPLICATION FOR POLICY

The study shows that respondents in the study are generally small holders Land, Labour, Capital and purchased inputs were the main factors influencing Fadama production of crops in the area.

Based on the findings of this study, it could be concluded that the optimal enterprise combination with the highest returns to owner's labour and management is rice production on a 0.66 ha of fadama.

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