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DETERMINING OPTIMAL MAIZE-BASED ENTERPRISE IN SOBA LOCAL GOVERNMENT AREA OF KADUNA STATE, NIGERIA.

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ABSTRACT

This study was designed to determine the optimal maize-based enterprise in soba local government area of Kaduna state, Nigeria. Data were collected from a survey conducted with 200 farmers in eight districts in the local government area. Results of the dominance analysis showed that maize/cowpea enterprise dominated the other enterprises because it had the highest gross margin and lowest total variable cost. The linear programming analysis indicated that a gross margin of ₦56,920.30 was obtained in the planned farm as against ₦26,282.00, per hectare of maize/cowpea in the unplanned farm. The study also indicates that Maize/cowpea enterprise was the most competitive enterprise in the study area. Labour and land were the most limiting resources.

key words: Maize based enterprise, Linear Programming Analysis, Planned farm, farm Management.

INTRODUCTION

The study of farm management involves three successive stages: (i) analysis of the present position of the farm business, (ii) interpretation of the present position for indication of possible improvements and (iii) preparation of an acceptable course of action for improvement of the farm business (Tajuddin et al, 1994). Most farm management studies in Nigeria have been concerned with analysis of existing performance in the arithmetic fashion, usually of groups of sample farms selected under certain criteria. Some studies e.g. Okezie and Okoye (2006), Fasasi (2006), Sanusi and Salimonu (2006), Rahman *et al* (2005), attempted production function analysis showing the marginal conditions of resource use with respect to production of individual or selected enterprises. Few others such as Ayoola and Adedzwa (2006), Okezie and Ude (2006) used budgeting techniques to evaluate economic benefits of alternative crop production systems. Such types of analysis do not specify what would be the optimum combination of enterprises under given restraining conditions as expansion of such enterprises may also be constrained by physical, economic, social and environmental constraints (Alam, 1994; Alam *et al,* 1995; Schipper et al, 1995; Stonehouse, 1996; Sama, 1997; Adejobi *et al*, 2003; Ibrahim, *et al* 2004; Alford, 2004). It is therefore imperative to use the techniques of mathematical programming and the methods of budgeting in the planning process of the farm. Furthermore, maize is grown in the same ecological zone where other crops like sorghum, groundnut and cowpea do well, and the farmer in making his budget is willing to grow the crops that gives him the highest returns per unit of limiting resource(s). Farmers also diversify by growing crops other than maize in order to reduce risks resulting from climatic and other factors. This study is thus a modest attempt to determine the optimal maize-based enterprise in the study area.

METHODOLOGY

This study was conducted in Soba Local Government area of kaduna State, Nigeria. The study area has a typical climate characterized by two distinct seasons, dry and rainy seasons. Like in most part of the savanna, the rainy season begins in May and ends in September; while the dry season starts in October and ends in March. The mean annual rainfall is about 1099.3mm. Soba area consists of a mixed formation of trees, shrubs and grasses. Mixed cropping is popular among farmers in the area, but sole cropping is also being practiced. Maize, Sorghum, millet, cowpea, groundnut, soyabean and vegetables are the main crops grown in the area. A reconnaissance survey was conducted to identify the popular maize based enterprises among the farmers (Table 1). One village was purposively selected from each of the eight districts in soba local government area based on its number of maize farmers and 25 farmers were randomly selected per village. Therefore, a total of 200 farmers were used for the study. Data were collected during the year 2005 cropping season through the use of an interview schedule. Data collected was on inputs and outputs for the different maize based enterprises. Analysis was done using the Gross margin analysis and the Linear programming model.

The Gross margin analysis.

The gross margin is defined as difference between the gross farm income and total variable cost.

The model is given as GM = GI - TVC

Where;

GM = Gross Margin (Naira/ha)

GI = Gross Income (Naira/ha)

TVC = Total variable costs (Naira/ha)

The Linear Programming Model.

The objective function was to maximize returns (product term of average yield of an enterprise and its unit price) over variable cost (costs associated with the use of the variable inputs). The linear programming model was specified as follows.

Max. Gross returns $Z = \sum_{j=i} C_j X_j \; [j = 1, 2, 3, n]$

Subject to:

$\sum_{j=i}^{n} a_{ij} X_j \leq a_i$ ..... land restriction

$\sum_{j=i}^{n} b_{ij} X_j \leq b_i$ =.....labour restriction

$\sum_{j=i}^{n} c_{ij} X_j \leq c_i$.....Fertilizer restriction

$\sum_{j=i}^{n} d_{ij} X_j \leq d_i$ ..... Seed restriction

$\sum_{j=i}^{n} e_{ij} X_j \leq e_i$ .....Insecticide restriction

$X_j \geq O$ i.e The non negativity condition.

Where;

Z = Objective Function

X_j = area under jth crop production activity

C_j = Gross margin per unit of the jth crop activity

a_{ij}=land coefficient for jth crop

b_{ij} =labour requirement for jth crop activity

c_{ij} = fertilizer requirement for jth crop activity

d_{ij} = seed requirement for jth crop activity

e_{ij}=insecticide requirement for jth crop activity

a_i =available land in hectares

b_i=human labour available in manhrs

c_i =available fertilizer in Kg

d_i =quantity of seed available in Kg

e_i =quantity of insecticides available in litres

n =Number of crop production activities

Restrictions in the Model

(i) Land restriction: The average farm size observed in the study area (2.5 Ha) was taken as the limit of land available for cultivation as suggested by Beneke and Winterboer (1973).

(ii) Labour Restriction: Labour restrictions were measured in man- hours and the restraint level was determined from the size and composition of the households, while Norman's conversion factor (1972) was used to arrive at man-hour equivalents as shown below;

Male adult (15 years and above)	1.00
Female adult (15 years and above)	0.75
Large Children (7 to 14 years)	0.50
Small Children (less than 7)	0.00

The restriction for family labour was therefore 350 man-hours.

(iii) Seed Restrictions: Seed restrictions were introduced so as not to allow the farmers to miss use seeds. All crop productions activities have as their coefficient in the seed rows the recommended seed rates per hectare .

(iv) Fertilizer Restriction: The types of fertilizer considered in the study were NPK, Urea and SSP fertilizers. The coefficients of the crop production activities in the fertilizer row were

the recommended rates per hectare of NPK, Urea and SSP fertilizers for each of the crop enterprises considered in the model.

(v) Insecticide Restriction: The two insecticides included in the model were Cymbush and Karate. The row values were also the recommended rates for each of the insecticides.

The activities included in the model were crop production (Table 1), labour hiring, seed buying, fertilizer buying, insecticide buying, crop selling and use of own seed activities.

Table 1: Distribution of Farmers to Crop Enterprises in Soba area of Kaduna State

CROP ENTERPRISES	FREQUENCY	PERCENTAGE (%)
Sole Maize	27	13.5
Maize -Sorghum	23	11.5
Maize-Cowpea	41	20.5
Maize -Soybean	30	15.0
Maize -Rice	32	16.0
Maize –Millet	28	14.0
Maize- Groundnut	19	9.5
Total	200	100.0

RESULTS AND DISCUSSION

The Gross margin per hectare for the enterprises were as follows: sole maize (N14,687.69), maize- sorghum (N14,240.00), maize-cowpea (N26,282.00), maize-rice (N16,422.22), maize soybean (N22,240.00), maize-groundnut N20,460.00), maize-millet (N11,200.00). This implies that all maize-based enterprises are economically attractive in the study area because they gave positive gross margins. Furthermore, the benefit: cost ratios were greater than one (Table 2). Results of the dominance analysis showed that maize/cowpea enterprise dominated the others (Sole maize, maize/sorghum, maize/millet, maize/groundnut, and maize/rice enterprises) as it had the highest gross margin and lowest total variable cost. The above analysis can demonstrate only comparative inputs costs and benefits of alternative maize based enterprises.

Table 2: Economic results for Maize based enterprises in Soba area of Kaduna State.

Enterprises	GR ₦/Ha	TVC (₦/Ha)	GM (₦/Ha)	Benefit/ Cost ratio
SM	31,678.9	16,991.29	14,687.69	1.86
MCP	41,760.00	15,478.00	26,282.00	2.69
MSG	31,240.00	17,200.00	14,040.00	1.81
MMI	27,000.00	15,800.00	11,200.00	1.70
MSB	33,500.00	11,260.00	22,240.00	2.97
MGT	39,000.00	18,540.00	20,460.00	2.10
MRC	37,976.00	21,553.78	16,422.22	1.76

KEY:
GR = Gross Receipts
TVC = Total Variable Cost
GM = Gross Margin
SM = Sole maize
MSG = Maize- Sorghum
MMI = Maize -Millet
MSB = Maize -Sorghum
MGT = Maize -Groundnut
MR = Maize -Rice
MCP = Maize -Cowpea

An alternative and more complete comparison using the linear programming analysis is presented on Table 3. The only activity in the optimal farm plan was maize/cowpea enterprise. The value of the objective function was N56,920.30 The exclusion of other mixtures in Table 1 from the plan implies that although the farmers grow them, they were not competitive enough given the resources available to the farmers. Labour hiring activities also entered the plan in the two labour hiring periods specified in the model (i.e. hiring of extra 150 man- hours for may - july labour and hiring of 200 man - hours for august to October- labour) because labour became very limiting as indicated by the usage of all the quantities available in the household (Table 4). This is probably due to the fact that operations such as weeding harvesting fall under the two labour periods, in other words, the periods are those of intensive farming activities in the study area. Seven (7) seed buying activities were specified in the model, however only 2 (maize and cowpea seeds buying) entered the optimal farm plan. This implies that the model allows farmers in the study area to purchase improved seeds. The above observation is highly encouraging as high yields can only be obtained from high quality seeds available only in the market. Though farmers are known to use their own seeds, the disadvantage is evident in the low yields obtained by them in recent times. Fertilizer is paramount as far as crop production is concerned. The entering of the fertilizer buying activity into the farm plan further supports this. The level was at 450 kg and 75 kg for NPK and SSP respectively. Selling activities were included for all the crop production activities included in the model; however maize selling activity entered the farm plan. The level of sale was 1350.72Kg. This is further indicative of the fact that maize has a dual role of providing food and cash for households in the study area. Cymbush and karate buying entered the farm plan, indicating their importance; the level of activity was 3.5 and 1 litre, respectively.

Table 3: Summary of the Optimal Plan for Maize Based Enterprises in Soba area of Kaduna State.

ACTIVITIES IN THE PLAN	UNIT OF ACTIVITY	LEVEL OF ACTIVITY
Objective Function	₦	56,920.30
Crop production Activities		
Sole Maize	*Ha*	***0.00***
Maize/Sorghum	,,	0.00
Maize/Cowpea	,,	***2.50***
Maize/Soybean	,,	0.00
Maize/Groundnut	,,	0.00
Maize/Rice	,,	0.00
Maize /Millet	,,	0.00
Labour hiring Activities		
May- July Labour hiring	Man hours	150.0
August- October Labour hiring	,,	200.0
Seed buying Activities		
Maize Seed Buying	Kg	120
Cowpea Seed Buying	,,	60
Millet Seed Buying	,,	0.00
Soybean seed buying	,,	0.00
Sorghum seed buying	,,	0.00
Groundnut seed buying	,,	0.00
Rice seed buying	,,	0.00
Fertilizer Buying Activity		
NPK Buying	,,	450.00
SSP buying	,	75.00
Crop selling Activities		
Maize Selling	,,	1350.72
Cowpea "	,,	0.00
Millet "	,,	0.00
Soybean "	,,	0.00
Sorghum "	,,	0.00
Groundnut "	,,	0.00
Rice "		
Insecticide Buying Activities		
Cymbush Buying	L	4.5
Karate Buying	,,	1.0

TABLE 4: Resource Use levels in the Optimum farm Plan

RESOURCE	USED	SLACK
Land (Ha)	2.5	0
Fertilizer (Kg/ha)	525	225
Labour (Man-hours/ha)	350	0
Seed (Kg/ha)	180	30
Insecticide (L)	4.5	1.5

CONCLUSION/RECCOMENDATION

From these study, it can be concluded that maize-cowpea enterprise is the most competitive and profitable maize-based enterprise in the study area. Furthermore, the optimum farm plan may differ slightly from the observed cropping system; however, this is to be expected since a linear programming model aims at selecting the most profitable enterprise(s). The study recommends that the extension services in the state should sensitize farmers on the rational choice of crop enterprise(s) so that they make a judicious allocation of the limited quantities of farm resources at their disposal.

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