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Optimum Enterprise Combination in Maize Farm in Orire Local Government Area of Oyo State Nigeria

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Abstract: Small holder farmers in Orire Local Government Area of Oyo State have multiple goal, in most cases the goals of providing food for family throughout the year, accumulating monetary income and ensuring minimum use of paid labour are paramount. Eighty farm households were selected purposively and their hectare allocation were maize/sorghum/cassava (3 ha) maize/millet/pepper (1.6 ha), maize/yam/cassava (1 ha) and maize/cassava (2 ha). The minimum cost of this plan is ₦45,000, the result revealed that some household resources such as land is not yet the constraining factor among the farmers. However the efficient allocation of farm resources are important and should be built into programme promoting increased agricultural productivity among farmers.

Key words: Optimum enterprise, combination, maize farm, monetary income, agricultural productivity

INTRODUCTION

The principle of combining enterprise in farming management is often confronted with the problem of what enterprise should take up, how far or should we go in combining the enterprises with another or replacing an enterprise, depend partly on the interrelationship between different enterprises and the price of products and inputs (Adejobi and Komawa 2003).

It is well known fact that the bulk of food production in the country takes place on small-scale farms. But with this tremendous potential output effect in such farms, production organization and techniques remain poor. There is problem of inadequate preparation of an operational programme for a farm which will ensure efficient utilization of production resource such as land, labour and capital thereby increasing the net farm income satisfaction of the farmer this is termed to be farm planning. There are four major tools, used in farm planning namely.

Budgeting, programme planning, marginal analysis and linear programming. Budgeting this make use of organized arithmetic to draw a specific plan for operation of the farm during some future period of time, the purpose of the budget is to estimate the return which can be expected during the plan period, while programme planning involves the desk calculator to obtain farm plan. Marginal analysis is the use of production function for the purpose of planning and linear programming involves the use of computer to obtain optimal farm plan which is capable for maximizing the net farm income of the farmer.It is therefore imperative for farmer to select and combine enterprises which will be fitted together so as to maximize the net income of the farm, as well as the combinations that will balance the farm business.

Maize is chosen as the major crop with the fact that is one of the important cereals consumed by the people and it has diverse of the ways it could be put in use, namely for poultry feed, as one of the raw materials in breweries industry. Also it could be served as the main meal of the day.

This underlines the need for more research into raising productivity by providing to individual farmers on how to utilized the available resource most efficiently so as to reduce loss in order to bring more cash to producers and to the economy as a whole, this will minimize the rural-urban drift.

Ogunfowora (1970) used a poly period linear programming analysis for planning a farm organization, which could achieve the dual objective of maximizing farm income for the farmer and his family, and be self financing within a short time. This could be achieved by used pattern of cost net revenue return flow of activities and subjective restraints to solve three-year crop and livestock enterprises combinations.

In similar studies Olayide and Olowude (1972) used linear programming to determine the most profitable combination of farm enterprises in the derived savanna

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belt of western state. They synthesized basic input data as were made available from experimental results and farm survey. They used these to develop their programming models for optional farm enterprise combination.

Objectives of the study: The broad objective of the study is to determine optimum enterprise combination of farmers in Orire Local Government Area, specifically to;

- Develop optional crop enterprises combination level that maximize net farm income
- Assess the resource productivity on the farm by using the linear programming techniques

MATERIALS AND METHODS

The study area is Orire local government in Ogbomoso area of Oyo state, which consist of about 630 villages and Ikoyi as the headquarters it has a land size of 2040 sqkm, with low population density, it's vegetation type is derived savannah.

Purposive sampling was used in the selection of farmers, since there is pre-knowledge of the farmer as to the types of crops they are planting. Five cells were selected per block, and four villages per cell of which four respondents were randomly chosen per village; making a total of eighty respondents 60 males and 20 females; data were collected through the use of questionnaire.

The statistical tool used is the linear programming techniques of which certain assumptions have to be satisfied, Additivity and linearity divisibility, finiteness and certainty.

The problem is to maximize an objective function subject to the limitation of certain restraints.

Maximize gross return (I)

$$Z = \Sigma cj \times j \quad (1)$$

where;

Cj =Net price/unit of activity
Xj =Level at which activity is to be produced

The constraint can be expressed as follows:

$$bi > \varepsilon^{n} xj \ (I = 1\text{-}m) \quad (2)$$

Where bi is j = 1 the level of the resources (there are m different resources) acj indicates per unit requirement of the jth activity for the jth resource and xj specified the level of which the jth activity is to be carried on. With slake activities added equation becomes

$$bi = e_j^{n} aij + p_n + 1 = j = 1 \quad (3)$$

Where $P_n + 1$ is the activity which allow non-use of part or al of the jth resources. Net farm income in this model is the difference between the gross return and the fixed cost of production.

Where ii is the net profit and x are defined as the net price and level of which activity is to be produced.

Activities in the model: The crops combination enterprises are:

X_1 = Maize/cassava/melon
X_2 = Maize/sorghum/cassava
X_3 = Maize/millet/pepper
X_4 = Maize/yam/cassava
X_5 = Maize/cassava

The constraints are:

- Land constraint
- Labour constraint
- Capital constraint

The objective function for this programme is as follows:

$$\text{Maximize } Z = 5130x_1 + 4330x_2 + 3300x_3 + 100x_4 + 3000x_5$$
$$Z = 5.13x_1 + 4.33x_2 + 1k_4 + 3x_5 \leq 298$$

Subject to the constraints

$$2X_1 + 3X_2 + 1.6X_3 + 1X_4 + 3X_5 < 10 \text{ land}$$
$$3000X_1 + 4000X_2 + 1500X_3 + 200X_4 + 2500X_5 \leq 4500 \text{ capital}$$

$$37X_1 + 150X_2 + 163X_3 + 170X_4 + 129X_5 \geq 242\text{- labour.}$$
$$X_1 > 0 \ (I = 1,2,3,4,5,)$$

For the dual problem Z is maximized as maximize $Z = 10_1 + 45v_2 + 242v_2$ Subject to the constraints

$$2v_1 + 3000v_2 + 37v_3 \geq 5130$$
$$3v_1 + 4000v_2 + 150v_3 \geq 4330$$
$$1.6v_2 + 1500v_2 + 162v_3 \geq 3300$$
$$V_1 + 2000v_2 + 170v_3 \geq 1000$$
$$1.5v_1 + 2500v_2 + 129v_3 \geq 3000$$

Matrix formulation: Column X_1-X_5 indicates how the total value of the solution will be altered by the addition of one units of activity in the initial phase of the iterative process leading to the simplex solution-columns S_1, S_2 S_3 shows the slack real activities. The real activities column indicates the amount of each of the resources required pre hectare of each of the resources.

Table 1a: Analysis of programme 1 (minimum resources)

Price per unit	Activity	Level of activities	Real activities X_1	X_2	X_3	X_4	X_5	Slack activity	S_2	X_3	R
C			5.13	4.33	3.30	1	3	0	0		
5.13	X_1	5.00	1.00	1.5	0.80	0.50	12.5	0.50	0	0	4
0	S_1	30.00	0	0	-0.50	-0.90	-1.25	-1.50	1.00	0	24
	Z	0	0	0	0	0	0	0	0	0	0
	Z-C	25650	0	-3.37	-0.08	-1.57	3.41	2.57	0	0	

Source: field survey 2003

Table 1b: Summary of optimum plan programme 1

Activities	Level	Shadow price	
X_1	5	0	Source: Field
X_2		3.37	
X_3		804	survey 2003
X_4		1.57	Optimum
X_5		3.41	Income = ₦25, 650
S_1	30	2.57	Farm Income
S_2	57	2	= 10 ha.
S_3		0	

Table 2a: Analysis of programme II (averages resources)

Price per unit	Activities	Level of activities	X_1	X_2	X_3	X_4	X_5	S_1	S_2	S_3	R
C			5.13	4.33	3.30	1	3	0	0.	0	
3.14	X_5	0.69	0	1.14	1.6	1.83	1	0	0.012	0.6	0.00833
5.14	X_1	4.14	-0	0.075	-1.2	-1.78	0	0.5	0.015	0.8625	4
0	S_1	30.86	0	0.926	1.1	2.78	0	1.5	1.015	0.8625	24
	Z	23.59	-5.13	5.20	-0.7	-2.89	3.41	2.57	4.46	6.78	
	Z-C	23.59	10.26	0.057	-4.0	-3.89	0.41	2.57	4.46	6.78	

Source: Field survey 2003

Table 2b: Summary of optimum plan Programme II

Activities	Activities level	Shadow prices
X_1	4.14	
X_2		
X_3		
X_4		
X_5	0.69	
S_1	30.86	2.57
S_2		4.46
S_3		6.78

Source: Farm size = 10 hectares, Optimum Income = ₦23, 590

RESULTS AND DISCUSSION

From Table 1, the model depicts the optimal plan for a small size farm and optimum solution occurred at the result of iteration. The farm income for model is ₦25, 650 and that is the maximum that any average farmer in the area of the study can be given at the existing level or resources only one activity that is, maize/cassava/melon planted for 10 hectares of land (X_1) entered the programme and this activity was planted for 10 hectares of land.

The shadow prices of real activities not in the programme indicate the amount by which income would be reduced if they were to be added into the plan. However the negative value for activities x_2, x_3, x_4 and x_5 indicate that the farmers income could be improved upon if they are included in the next prorgamme.

Table 2a-b shows that the optimum farm income reduced from ₦25, 650 to ₦23, 570 in programme II in which is the maximum that an average farmer in the area of the study can earn given the existing level of resources.

Table 3a-b, shows that the optimum farm income rose from ₦23, 590 to ₦ 61, 670 in programme III and that is the maximum that an average farmer in the area of the study can earn given the that existing level of resources.

The z-c value corresponding to S_1, S_2, and S_3 are accounting value of land, capital and labour respectively. These accounting values are the shadow prices which would be paid for each unit of the resources in light of their respective marginal contribution to the total output.

The S_1, S_2, S_3 are 2.57,4.46 and 6.78. An accounting value of 2.57 is imputed to land because 20.86 hectares of land are still universe, the withdrawal of hectare 30.865 or land from his stock of land resource would not reduce total output since this could easily be taken from the universe land for which he pays nothing.

The accounting values imputed to capital is 4.46 and the accounting value imputed to labour is 6.78 the explanation is that if each of these resources were to be reduced by one unit, income would decline by the amount of the accounting value. The value of the objective

Table 3a: Analysis of Programme III (Maximum Resource)

			Real activities					Slack activities			
Price per unit	Activities	Level of activities	X_1	X_2	X_3	X_4	X_5	S_1	S_2	S_3	S_4
C			5.13	4.33	3.30	1	3	0	0	0	
1	X_4	11.10	0	0.33	0.4	1	0	0.54	0.41	0	
5.13	X_5	19.623	0	0.54	0.87	0	1	0.99	0.63	0	
	X_1	23.90	-1	0.66	0.47	0	0	1.46	1.09	0	
	Z	66.80	-5.13	5.57	5.88	1	3.41	11.4	3.94	0	
	Z-C	61.67	10.26	1,24	2.58	0	0.41	11.4	11.4	0	

Sources: Field survey 2003

Table 3b: Summary of programme III

Activities	Activities level	Shadow prices
X_1	23.90	
X_2		
X_3		
X_4	11.10	
X_5	19.62	
S_1		11.4
S_2		3.94
S_3		0

Sources: Field Survey 2003. Optimum Income ₦61, 670, Farm size = 107.95 hectares

function of the dual is therefore the amount of land (10) multiplied by the value of imputed to land (2.75) plus the stock of capital available 45,000 multiplied by the value imputed to capital (4.46) plus the amount of labour 242 multiplied the value imputed to labour (6.78) these sum to 23.59, which is also the value of the objective function of the primal problem. This suggests that in linear programming problems, all the profit realized in the production process in accounted for by the imputed marginal valuation of the input used.

CONCLUSION

From the study, farmers in this study area of Orire local government were not operating at optimal level based on the available resources. These resources were not efficiently allocated in terms of inputs as seen in the optimal plan.

Land availability was one of the major resource constraints in the area out of an average of 2 hectares available to each farmer in the area. Only about 10 hectares at minimum was allocated to available crop cultivation. The rest are used for food crop.

The optimum income showed that growing the sole crops yielded more income than combining crops which may be determined to the growing of others thus reducing the total output with existing technology sole crops are in better competition position than crop mixtures: however the linear programming model had helped us to ascertain the price range for which a particular optimum plan will remain stable.

RECOMMENDATION

Most of the farmers used labour for the cultivation of the land in the area, this makes it more expensive, the government can help by introducing tractor hiring units programme in the area, which will help farmer in their farm operations. Also land use legislation should be enforced as to reduce land degrading, which accounted for low yield of their crops.

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