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RESOURCE ALLOCATION IN FOOD CROP PRODUCTION AND FARMING HOUSEHOLD FOOD SECURITY IN KWARA STATE

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ABSTRACT

This study was designed to identify the optimal combination of enterprises in food crop production in order to improve the food security status of farming household in Kwara State. Data was collected from 74 farming households by means of a three – stage random sampling technique. Analytical tools used include food security indices and a linear programming model. The study found that more than 60% of the sampled farming households are food insecure. Given the average household land size, labour and capital of 2.236hectares, 271.57 man-day and ₦15,677.30 respectively, optimal resources allocation will yield the highest annual farm income of ₦110,473.50. To improve the food security status of farming households in the study area, farmers should allocate their resources in such a way that they would realize highest return from their productive activities

Key Words: Resources, Food Security, Activities

INTRODUCTION

Nigeria is the most populous country in Africa with estimated population of about 133 million. Approximately, 75% of this population consist of women and children with over 70% residing and securing their livelihood in the rural areas (Maziya-Dixton et al; 2004). Nigerian agriculture is one of the important sectors of notable relevance in economic development and growth. It contributes more than 30% of the total annual GDP, employs about 68% of the labour force, accounts for over 70% of the non-oil exports and provides over 80% of the food needs of the country (Adegboye, 2004).

Food is a basic necessity for the existence of man. Its production constitutes a substantial proportion of the economic activities in most societies, generating substantial employment, industrial activities and export earnings (Ajibola, 2000).

A determination to relegate hunger to the world's history books was observed to be a promising foundation for promoting sustainable development and ending the desperate need that impoverishes us all (Hall, 2002). Hence food security, which is defined as access to adequate and sustainable foods supplies, has become a topic of widespread international interest (Schaffer, 2002).

Households are food secure when they have year round access to the quantity and variety of foods their members need to lead active and healthy lives. At the household level, food security refers to the ability of the household to secure, either from its own production or through purchases, adequate food for meeting the dietary needs of all its members (Maziya-Dixton et. al., 2004).

Households face a set of prices that determine the level of consumption that can be supported by their levels of income (Hoddinott, 2001). Attempts and measures to discourage importation particularly of food items coupled with the devaluation of currency by the deregulated exchange rate have led to astronomical rise in the prices of consumer items, thereby implying low purchasing power of the people, especially wage earners and adversely affecting the food security situation in Nigeria (Okunmadewa et. al., 1999).

Food security is a poverty problem. This view was observed by Schuh (2002) who claimed that the lack of food is due to the lack of the means to acquire it and not in general, due to a short fall in food production. The nutritional problems of the rural poor can be overcome either by strengthening the household resource base or by enhancing their control and management of these resources (Moris, 2001).

Effective management of the available resources will enable a farming household get as much income as possible from its production and consequently improve its economic access to food required by its members.

Linear programming has been found by Agricultural Economists as a useful research tool for determining the least cost technique of production or the most profitable combination of enterprises. Its unique suitability for solving practical farm production problems arises from the peculiar characteristics of the agricultural industry (Adesimi, 1988). As a planning method, linear programming is often helpful in decisions requiring a choice among a number of alternatives (Beneke and Winterboer, 1973).

This study determined the optimal combination of enterprises in food crop production in order to improve the food security status of farming household.

METHODOLOGY

This study was conducted in Kwara State of Nigeria.. Kwara State with a total of sixteen Local Government Areas(LGA's) has a population of 1,566,469 and a total land size of 3682500 hectares (NPC 1991, FOS 1995). The State is located between latitudes $7^0 45$'N and $9^0 30$'N and longitude $2^0 30$'E & $6^0 25$'E. The topography is mainly plain to slightly gentle rolling lands. The annual rainfall ranges between 1000mm and 1500mm. Average temperature ranges between 30^0C and 35^0C. It also has an estimated figure of 203,833 farm families with the majority living in rural areas Kwara State is divided into four zones by the Kwara State Agricultural Development Project (KWADP) in consonance with ecological characteristics, cultural practices and project's administrative convenience (KWADP 1996). The zones are : Zone A: Baruteen and Kaima LGA's, Zone B: Edu and Patigi LGA's ,Zone C: Asa, Ilorin East, Ilorin South, Ilorin West and Moro LGA's and Zone D: Ekiti, Ifelodun, Irepodun, Offa, Oyun, Isin and Oke-Ero LGA's.

The population for this study comprise of all farming households in Kwara State. A three – stage random sampling technique was used in selecting the sample for this study. The first stage involved a random selection of zone C out of the four agricultural zones in Kwara State. Stage two involved a random selection of nine villages in each of the five local government areas that make up the zone. The third stage involved a random selection of three households in each of the selected villages. Out of the one hundred and thirty five households selected for this study, only seventy-four supplied complete data that could be analyzed.

The data used in this study were obtained from both the primary and secondary sources. The main instrument used for collecting primary data in this study was a well- structured questionnaire. The secondary sources of data used for this study include annual reports and articles whether published and unpublished.

Methods of Data Analysis

To measure household food security, a food security index was constructed. This involved two steps: identification and aggregation. Identification involves defining a minimum level of nutrition necessary to maintain healthy living which is the "food security line" for the population under study, below which households are classified as food-insecure. Aggregation on the other hand derived food security statistics for the households (Makinde, 2000).

For the purpose of this study, a daily-recommended level of 2470kcal and 65g of protein per capita per day (Olayide 1982) defines the food security line. The nutrients content of both produced and purchased food items were used to estimate both calorie and protein availability to the household.

Food security index Z = $\frac{\text{Household's daily per capita calorie or protein availability(A)}}{\text{Household's daily per capita calorie or protein requirement (I)}}$

For the purpose of this study, a household is defined as a group of people living together and eating from the same pot.

Based on Z, several food security measures are calculated; the shortfall/surplus index, p is given as

$$p = \frac{1}{M}\sum_{j=1}^{m} Gj$$

Where Gj = (Xj – I)/I is the deficiency (or surplus faced by household j, Xj is the average daily calorie or protein available to the jth household while M is the number of households that are food secure (for surplus index) or food insecure (for shortfall index). It measures at the aggregate level, the extent to which households are below (or above) the food security line. In implementing food security policies and programmes, the values of the index could be monitored over time and compared among different groups of the population.

The Head count ratio (H) is defined as H = m/N where m = the number of the food–insecure members of the sample population

N = sample population.

Optimal Resources Allocation

To determine optimal resource allocation, linear programming model was fitted and it was estimated as:

$$Max\ z = \sum (P_j q_j - C_j)$$

Subject to:-

$$\sum_{j=1}^{m} aijXij \leq bi$$

Where Z = Gross margin in Naira per hectare

Pj = price of jth crop per unit in Naira

qj = quantity of jth crop in kg

Cj = total variable cost per activity in Naira per hectare. It include the cost of labour, purchased input, tractor, hiring, and transportation

aij is the per unit requirement of the jth activity for the ith resource

xij is the specific level at which jth activity is to be carried on.

bi is the level of ith resources

m is the number of activities and ranges from 1 to 10

ith resource ranges from 1 to 3 where: b_1 = Land available to the average household (Ha); b_2 = Labour available to the average household in man–day. Using Norman's (1973) conversion ratio, 1 day of woman work and 1 day of a child work were estimated at two-third and half man-day respectively. Eight hours of work by man is one man-day.

b_3 = Capital in Naira available to the average household. It covers the costs of purchased inputs such as seeds and chemical. It also covers the cost of tractor hiring.

RESULTS AND DISCUSSION

Following the identification and aggregation procedures outlined in the methodology for this study the results on the extent and magnitude of farming household food security in the study area are as shown in table 1.

Daily per capita calorie and protein availability were estimated by dividing the estimated daily calorie or protein supply to the household by the household size adjusted for adult equivalence. Household protein and calorie availability was estimated using food nutrient composition.

Food security indices for both protein and calorie; headcount ratio and the shortfall index have been summarized in table 1 separately for households that are food secure and those that are food-insecure. Multiple indices were used to provide a basis for examining the extent of food insecurity among farming households from different perspectives.

Table 1: Indices of Farming Household Food Security.

	Households		
	Food-secure	Food-insecure	All
Percentage household	37.84	62.16	100
Mean household size (adjusted)	5.77	7.48	6.84
S.D	3.29	3.38	3.43
Household daily calorie requirement (kcal)	14253.66	18482.01	16882.12
Household daily calorie availability (kcal)	30485.70	16525.64	21812.83
Household daily per capita calorie availability (kcal)	5282.83	2208.54	3190.67
Household daily protein requirement (g)	375.10	486.37	444.27
Household daily protein availability (g)	581.00	274.61	389.78
Household daily per capita protein availability (g)	100.68	36.7	57.14
Food security index (z):			
Mean Energy	2.30	0.89	1.42
S.D	0.9	0.36	0.92
Mean protein	1.72	0.55	0.995
S.D	0.88	0.19	0.80
Headcount ratio (H)	0.32	0.68	
Shortfall/surplus index (p)			
Energy	1.3	0.115	
Protein	0.74	0.46	

Source: Field Survey, 2003.

As shown in table1, even though the aggregate household daily calorie availability exceeded the minimum requirement, the study area could still be classified as food insecure because the daily protein availability per capita was less than minimum requirement. . Nonetheless, 38% of the households are food-secure with an average daily per capita calorie and protein supply of 5282.83kcal and 100.68g respectively.

The headcount ratio shows that 32% of the individuals in the study area was food-secure and 68% was food-insecure. This shows that more than two-thirds of the households were subsisting on less than daily per capita calorie and protein requirement.

The shortfall/surplus index (P), which measures the extent of deviation from the food security line, shows that while those that are food secure exceeded the minimum daily per capita calorie and protein requirement by 130% and 74% respectively, the food-insecure households fell short of the minimum daily per capita calorie and protein requirement by 11.50% and 46% respectively.

Optimal Resource Allocation

Crop production is the major source of income to the majority of households in the study area. Crop choices and farm management decisions are thus expected to be influenced by farmers' perceptions of crop profitability and income. Given that annual total income is a major determinant of food security situation in the study area and that increased income will probably increase the purchasing power required for enhanced access to food availability necessary for food security, optimal resources allocation in the study area was analysed using linear programming model.

Table 2 presents the summary of linear programming. Enterprises included in the programme were those embarked upon by at least six percent of the households.
A collection of six crops valued at the following prevailing current market prices was used for this analysis: Cassava(X_1) – ₦7/kg , Cowpea(X_2) – ₦46.15k/kg, Maize(X_3) – ₦23.08k/kg, Sorghum(X_4) – ₦21.42k/kg, Yam(X_5) - ₦25/kg Okra(X_6) - ₦20/kg.The following crop mixtures were also included in the linear programming: Cassava/Maize(X_7),Cassava/Yam(X_8),Cassava/Maize/Yam,(X_9) and maize/Sorghum/Yam(X_{10}).Linear programming Model estimated is

$$\text{Max } Z = 8184.79X_1 + 22352.45X_2 + 35267.41X_3 + 23583.53X_4 + 29840.46X_5 + 8833.36X_6 + 15573.70X_7 + 81036.23X_8 + 26229.51X_9 + 57723.42X_{10}$$

subject to :

Land: $1X_1 + 1X_2 + 1X_3 + 1X_4 + 1X_5 + 1X_6 + 1X_7 + 1X_8 + 1X_9 + 1X_{10} \leq 2.236$.Ha

Labour: $72.34X_1 + 75.74X_2 + 65.22X_3 + 76.49X_4 + 125.88X_5 + 130.14X_6 + 108.52X_7 + 115.16X_8 + 108.82X_9 + 175.15X_{10} \leq 271.57$ man-days

Capital : $7601.42X_1 + 5166.54X_2 + 3593.67X_3 + 1809.19X_4 + 17421.91X_5 + 6559.33X_6 + 2871.11X_7 + 23054.06X_8 + 7262.5X_9 + 7710.58X_{10} \leq$ ₦15677.2

Given an average land availability of 2.236 hectares , a household can earn a maximum income of ₦110,473.50 from maize, cassava/yam and cassava/maize/yam enterprises at 1.00, 0.167 and 1.068 hectares respectively (Table 2). This may enable the household have improved economic access to food through higher purchasing power.

Table 3: Resource constraints

Constraints	Status	RHS	Shadow prices	Slack or surplus	Min. RHS	Max. RHS
Land	Tight	≤ + 2.236	+19616.91	0	+1.62	+4.13
Labour	Tight	≤ + 271.57	+128.55	0	+165.44	+349.89
Capital	Tight	≤ + 15,677.30	+2.022	0	+12744.38	+47949.74

Source: Date Analysis, 2003

Table 3 shows that an additional unit of land will increase the value of the program by ₦19616.91, labour by ₦128.55 and capital by ₦2.02k. the range at which resources should be allocated is given by the minimum right hand side (min RHS) and maximum right hand side (max. RHS).

CONCLUSION

This study shows that in spite of the abundant calorie availability in the study area, the area of study could be classified as food-insecure in view of the fact that the average protein availability to the area is less than the minimum per capita requirement.

At household level, the study shows that the majority of the households are subsisting on less than the minimum required calorie and protein per capita per day.

With an average of 2.236 hectares of farmland, 271.57 man-day of labour and ₦15,677.30 worth of capital per household; optimal allocation of resources into production of maize, cassava/yam and cassava/maize/yam at 1.00, 0.167 and 1.068 hectares respectively will yield a maximum annual income of ₦110,473.50k.

RECOMMENDATIONS

To improve the food security status of farming households in the study area, farmers should allocate their resources in such a way that they would realise highest return from their productive activities. Farmers should be assisted to increase their food crop production. This is necessary for improved per capita food availability which is a necessary condition for food security. Finally, farming households should be better educated on the nutritional implications of various food items and the need to include more proteinous food items in their diets.

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Table 2: Summary of Linear Programme.

Variable	Solution	Opportunity Cost	Objective Coefficient	Minimum Objective Coefficient	Maximum Objective Coefficient
X_1	0	+36101.59	+8184.79	–infinity	+44286.38
X_2	0	+17452.04	+22352.45	– infinity	+39804.48
X_3	+ 1.00	0	+35267.41	+2540.10	+51468.21
X_4	0	+9524.43	+23583.83	–infinity	+33107.95
X_5	0	+41185.60	+29840.46	–infinity	+71026.06
X_6	0	+40776.15	+8833.36	–infinity	+49609.57
X_7	0	+23798.95	+15573.70	–infinity	39372.65
X_8	+ 0.167	0	+81036.23	+45468.93	+141415.64
X_9	0	+22061.11	+26229.51	–infinity	+48290.62
X_{10}	+ 1.068	0	57723.42	+44949.96	+92532.56
Maximized objective = ₦110,473.50					

Source: Data Analysis, 2003