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*Full Length Research Paper*

# Optimal food plan for rural households' food security in Kwara State, Nigeria: The goal programming approach

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**This study developed optimal food consumption plan for the rural households in Kwara State, Nigeria. A two-stage simple random sampling technique was employed in collecting data used for the study between October, 2005 and January, 2007. The main tools of analysis used in this study are the Food Security Index and the Linear Goal Programming (LGP) Model. This study reveals that 65.45% of the rural households are food insecure. Rice, maize, cowpea, gari, fish and palm oil consumed at 4.17, 18.59, 2.92, 2.66, 8.53 and 3.10 Kg per week respectively constituted the least-cost food plan for the rural households. With an average household size of eight male adult equivalents, this plan has a cost implication of ₦ 73.73 per person per day. This shows that the cost of meeting this least-cost food plan was 38% lower than the one U.S. Dollar World Bank poverty line per person per day. This study recommends the need for the rural households to be educated on the nutritional implication of the consumption of various food items.**

**Key words:** Goal programming, optimal combination, food plan, rural households, food security, Kwara State, Nigeria.

## INTRODUCTION

### Background to the study

Food security has been described as an important aspect in any consideration of the sustainability of the wealth of a nation. This is in view of its role as a critical factor in economic development, peace and stability (Akanji, 1993; World Food Summit, 1996; Onyido, 1997; Osundare, 1999; Adegboye, 2004). Food is of high importance in matters of human wellbeing and economic productivity. Hence, the need for food in Nigeria, like other parts of the world, has become a policy issue. Besides, the nutrients contained in food are necessary for proper body functions (Olayide, 1982). To be food secure, sufficient resources are usually required to produce or purchase adequate food. However, this does not guarantee good nutrition and health as we can see from the diet-related health problems among even more affluent population groups. Even though eating well is vital for a healthy and active life, many people in virtually all countries do not eat well because of poverty and a lack of nutrition education. To have food security and be adequately nourished, an individual needs an understanding of what constitutes an appropriate diet for good healthy condition as well as the resources, skills and motivation to make good food choices (FAO, 2005a).

Developing policies and interventions to increase food security therefore requires an understanding of each of these factors, their inter-relationships and their relevance to particular groups of people (FAO, 2004) . It can therefore be seen that the task of providing nutrition education especially in the low income countries must be accorded the necessary priority. Since it is important for the people to know how best to use their resources to ensure nutritional wellbeing, nutrition-education is therefore a key for developing the skills and motivation needed for the people to eat well (FAO, 2005a). Bliss and Stern (1978) observed that small increases in food consumption can bring about substantial improvement in productivity.

Goldsmith et al. (1967) and de Ville de Gouyet et al. (1979) observed that given most national food patterns, protein needs can be met if the caloric supply is adequate and the diet corresponds to the national average. This may explain why most studies on food security focus more on the calorie availability and consumption (Feleke et al; 2003, Makinde, 2000). An analysis of trends in the

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supply of dietary energy can therefore help to reveal patterns that provide a basis for assessing the adequacy of the food supply, from which nutritional inferences can be drawn. Carbohydrates, fat and protein comprise the three principal sources of energy in the human diet. Individual foods contain different proportions of the three principal macronutrients. Animal products (meat and dairy) are rich sources of protein and fat, while cereals, fruits and vegetables contain a large proportion of carbohydrate. The quantity and quality of each component is particularly important when analyzing nutritional adequacy (Kennedy, 2001).

In a study on food security, Olayemi (1998) gave the threshold for food security as the ability of a household to meet 2260 Kcal of energy and 65 g crude protein per capita below which a household was classified as food insecure. This is however at variance with Olayide (1982) who gave daily consumption of 2470 kcal of energy and 65 g of protein per capita as the bench mark for food security. In the views of Joseph and Ajayi (2002), the recommended minimum nutrient requirements to be consumed per day per capita includes the 2191 Kcal and 65-86 g crude protein out of which at least 35g or (40%) must be animal protein. Unlike vitamins and minerals, which sometimes perform unique functions to meet the body's needs, fats, carbohydrates, and proteins substitute for one another to some extent to meet the body's energy needs (National Academies of Sciences, 2002). On the basis of the analysis of the recommended daily calorie distribution by the National Academies of Sciences (2002) and Honfoga and van den Boom (2003), 45 to 65% of the calorie supply should be made from carbohydrates including cereals, roots/tubers and fruits; 20 to 35% form fats and oils including lipids from oil crops and animal products; and 10 to 35% from protein including animal products and pulses.

Unlike nutrition related studies in the livestock industry, very few studies appear to have been done in the general area of human dietary combination and optimization. Many nutrition-related articles, especially in Africa, report results of studies of the nutrient composition of food without indicating the optimal levels desirable for human consumption, despite awareness about daily recommended levels required of the different nutrients (Ogunyinka and Norman, 2003). In view of this, there is hardly any study that identifies the optimal food consumption plan that will meet the food security need of the rural households at least costs from the locally available food items. Developing optimal food plan for the food insecure households may be needed to reduce the problems associated with ignorance on nutritious and low cost food items faced by some poor rural households. Furthermore, such plan can be useful in determining the costs of living in the rural areas of Kwara State. This study also holds implications for the poor, many of whom are vulnerable to specific health hazards because of their lack of knowledge about the appropriate ( that is, healthy) composition and level of nutrient intake. The results of this study will therefore indicate the least cost diet from among the food items consumed in the rural areas.

Goal programming is an advanced extension of linear programming found to be effective in handling multi objective problems (Njiti and Sharpe, 1994; Adejobi, 2004). It is one of the most widely used techniques for dealing with multiple criteria decision making in management with relevant application to similar farm planning problems (Romero and Rehman, 1985). This is in line with Habeeb's (1989) observation that goal programming has been regarded as the best mode for feasible allocation of resources especially in the Nigerian agricultural sector which have multiple and conflicting objectives.

Goal programming is presented as a decision-making framework that accommodates multiple objectives and explicitly determines how spatial characteristics should be traded off in cases where different, and perhaps opposing, characteristics are important for achieving the distinct management objectives. Goal programming provides a flexible way for decision-makers to incorporate the multiple objectives into a single composite objective. This decision-making framework translates a number of individual objectives into a single overall composite objective and measures how far the results of each strategy fall from the composite objective (Marshall and Homans, 2001).

Under the goal programming framework, a management objective function is created that minimizes a weighted aggregation of the distance of each objective from some pre-specified target level for that objective. In order to standardize the measures of distance across objectives that are measured in different units, this distance is measured as relative deviation from the target level (Marshall and Homans, 2001).

Goal programming model is of wide application as a technique for multiple objective decisions making which has gained increasing amount of attention from management scientists, production mangers and practicing managers with whom it has been formulated to solve operation management problems relating to planning decision making and control (Adewumi, 2002). Goal programming model was applied to a management scenario with multiple objectives in order to explore how important different characteristics of absolute and relative location are at contributing to individual objectives and how that information can be used to create a ranking system with respect to an overall objective (Marshall and Homans, 2001). It can be used to develop optimal level of production activities which will satisfy other concurrent goals (Fiske et. al., 1994). Even though application of goal programming techniques in agriculture is limited in developing countries, Adewumi (2002) reported that Monarchi et al. (1976), Wheeler and Russel (1977), Barlet and Clawson (1978), Bazara and Bouzaer (1981), Barnett et al. (1982), Marton and Sanchohez (1982),

**Table 1.** Sample distribution.

| Zones | Villages distribution | Sampled villages | Households sampled | No of households with valid responses |
|---|---|---|---|---|
| A | 217 | 4 | 68 | 64 |
| B | 237 | 5 | 85 | 84 |
| C | 483 | 10 | 170 | 166 |
| D | 311 | 6 | 102 | 97 |
| Total | 1258 | 25 | 425 | 411 |

Source: Field Survey, 2005/07.

Sandiford (1986) and Aromolaran (1992) have applied goal programming model in one form of agricultural planning decision or the other.

Two major variants of goal programming model include the Lexicographic goal programming model and the weighted goal programming model (Romero and Rehman, 1985). The main area of difference between them is that in the Lexicographic Goal Programming Model, priorities are assigned to objectives in a pre-emptive fashion whereas the Weighted Goal Programming assigns equal priorities to all objectives but attaches weight, which reflect the relative contribution of each objective (Adewumi, 2002; Adejobi, 2004). For the purpose of this study, a weighted goal programming model was used to develop an optimum plan for rural faring household food security. This is because rural households are assumed to attach equal priorities to food security goals.

## Objectives of the study

The main objective of this study is to analyse the level of food consumption of rural households.
The specific objectives of the study are to:

1. Determine the level of rural households' food consumption.
2. To determine the food insecurity status of the rural households.
3. Develop optimal food consumption plan for the rural households' food security.

## METHODOLOGY

### Study area

This study was conducted in Kwara State, Nigeria. Kwara state lies within the North Central geopolitical zone of Nigeria. It has a land area of about 32,500 square kilometres. According to the 2006 National Population Census figure, Kwara State has a total population of 2,371,089. This is made up of 1,220,581 males and 1,150,508 females. The State is bounded in the north by Niger State, in the South by Osun and Ondo States, in the East by Kogi State and in the West by Oyo State. Kwara State shares an international boundary with the Republic of Benin (Taiwo, 2005). Kwara State is located between latitudes $7^{O}45$'N and $9^{O}30$'N and longitudes $2^{O}30$'E and $6^{O}25$'E. The topography is mainly plain lands to slight gentle rolling. The annual rainfall ranges between 1000mm and 1500 mm. Average temperature ranges between 30 and $35^{O}$C (KWADP, 1996).

There is a total of One thousand, two hundred and fifty eight rural communities in Kwara State (National Population Commission, 1991). More than 90% of the rural populations who constitute about 80% of the total population are engaged in farming (Yusuf, 2000). Kwara State is divided into four zones. This classification is in consonance with agro- ecological and cultural characteristics of the areas. The zones are as follows: Zone A: Baruteen and Kaiama LGAs; Zone B: Edu and Patigi LGAs; Zone C: Asa, Ilorin East, Ilorin South, Ilorin West and Moro LGAs; and Zone D: Ekiti, Ifelodun, Irepodun, Isin, Offa, Oke-Ero and Oyun LGAs.

### Sampling technique

This study was carried out between October, 2005 and January, 2007. A two-stage simple random sampling technique was employed for this study. The first stage comprised random selection of twenty five villages which constitute about two percent of the total villages in the study area. The selected villages were distributed across the four agro-ecological zones in proportion to the distribution of the villages in each zone. This was done by selecting two percent of the total villages in each zone. This sampling frame for the villages was obtained from the 1991 National Population Commission village listing.

The second stage involves random selection of seventeen households from each of the selected villages. Information on the number of the total households in each village was obtained from the village council. This was used in preparing the list of the households that form the sampling frame from which the random selection of the households was carried out. Every other household was thereafter randomly selected from the list. A total of four hundred and twenty five rural households were selected for this study. Responses from a total of four hundred and eleven rural households were however found useful for this study. This is as distributed in Table 1.

### Method of data collection

Data used for this study were collected over a period of sixteen months, between October, 2005 and January, 2007. The primary source was through the use of a well structured questionnaire administered by trained enumerators.

### Analytical techniques

**Food security index**
This was used to determine the level of food insecurity among the

**Table 2.** Structure of the weighted goal programming model for the rural households' food security.

| Goals | Goal Statement: Achievement of | Objective function to Minimize | Deviational variable in objective function | Priority level | Weight |
|---|---|---|---|---|---|
| Meeting the minimum vegetable protein consumption | 171 kcal per day per adult equivalent from vegetable protein | Under achievement | $d_i^-$ | 1 | 5 |
| Meeting the minimum animal protein requirement | 199.5 Kcal per day per adult equivalent from animal protein | Under achievement | $d_i^-$ | 1 | 5 |
| Meeting the minimum fat requirement | 494 Kcal per day per adult equivalent from fat | Under achievement | $d_i^-$ | 1 | 5 |
| Meeting the minimum carbohydrates | 1605.5Kcal per day per adult equivalent from carbohydrates | Under achievement | $d_i^-$ | 1 | 5 |

rural households. Food security equation used by Feleke et al. (2003) was adopted for this study. The equation is stated as follows:

$C^* = C_j - _j$

Food security indicator for this study is defined by calorie consumption Ci and calorie requirement $_j$ of the $_j^{th}$ household. For food secure households, C* 0 whereas, for food insecure households C*<0

For the purpose of this study, calorie requirement was based on the daily-recommended caloric intake of 2470 kcal per adult equivalent (Olayide, 1982).

**Linear goal programming model**

This was used to develop optimal food plan for rural households in Kwara State. Following Manyong and Degand (1995), the model was used as follows:

$$\text{Minimize } Z = \sum_{i=1}^{g} (W_i.n_i + W_i.p_i)$$

Subject to

$$\sum_{i=1}^{g} a_{ij}X_j + d_i^- - d_i^+ = a_i$$

$$\sum_{j=1}^{m} a_{kj}X_j \quad bk$$

$$X_j, d_i^-, d_i^+ \quad 0$$

Where Z = Objective function. It includes the total cost per kilogram in grain of food items available to the households as well as the positive and negative deviations for the goals.
$d_i^-$ = negative deviation if $a_i$ is under-achieved
$d_i^+$ = positive deviation if $a_i$ is over - achieved $W_i$
= weight attached to deviation $d_i^-$ or $d_i^+$
$a_{ij}$ = matrix of the marginal contribution of $X_j$ to satisfying $a_i$.
$X_j = _j^{th}$ food item consumption measured in kilogram. In line with United State Department for Agriculture (USDA, 2007), food items consumed by at least twenty five percent of the sample were included in this analysis.
$a_{kj}$ = coefficient of use of $b_k$
$b_k$ = available level of resource k. This was determined by the average food consumption in Kilogram;
m = number of resource(s) which in this study equals 1;
$a_i$ = aspiration levels for the $i^{th}$ goal. i is the total food consumption and it measured in Kg.
g = number of goals. Given that household calorie requirement is estimated at 2470 kcal per day per adult equivalent, there were four goals to be achieved.

These according to the National Academy of sciences (2002) are given as follows:

65% of calorie estimated at 1605.5 Kcal per day per adult equivalent from carbohydrates.
20% of calorie estimated at 494 Kcal per day per adult equivalent from fat.
15% of calorie estimated at 370.5 Kcal per day per adult equivalent from protein. Since protein comprises both animal and vegetable sources, energy supplied from protein was estimated at 171 kcal per day per adult equivalent from vegetable protein; and
The remaining 199.5 Kcal per day per adult equivalent from animal protein.

Matrix of the model for rural households' food security is as presented in Table 2.

**Limitations to the study**

There is a general lack of accurate data on the number of households in the rural areas of the study area. In developing the sampling frame, this study relies on information given by the members of the village councils. The accuracy of such data however depends on the ability of the council to recollect all the households in the village. In preparing food with least cost to the rural households, the study assumed that the prices of the food items remain constant. Besides, the study assumes that the food items are available in the rural households all year round.

**Table 3.** Distribution of food consumption in the rural households in Kwara State.

| Food items | Percentage calorie (%) | Quantity consumed (Kg) | Value (₦ ) |
|---|---|---|---|
| Rice | 11.46 | 5.77 | 646.24 |
| Sorghum | 9.26 | 4.66 | 199.72 |
| Maize | 10.47 | 5.12 | 196.92 |
| Cowpea | 4.81 | 2.56 | 216.62 |
| Gari | 7.11 | 3.68 | 184.00 |
| Lafun | 9.18 | 4.75 | 158.32 |
| Yam | 13.33 | 21.33 | 888.82 |
| Elubo | 5.79 | 3.19 | 348.00 |
| Meat | 1.42 | 1.11 | 555.00 |
| Fish | 0.77 | 1.03 | 257.50 |
| Egg | 0.14 | 0.26 | 62.40 |
| Milk | 0.04 | 0.13 | 119.99 |
| Palm oil | 6.55 | 1.28 | 223.26 |
| G/nut oil | 2.66 | 0.52 | 104.00 |
| Orange | 1.39 | 6.13 | 559.79 |
| Okra | 0.08 | 0.45 | 60.00 |
| Tomato | 0.14 | 1.19 | 96.22 |
| Onion | 0.12 | 0.68 | 57.63 |
| Vegetable | 0.15 | 0.54 | 17.82 |
| Melon | 0.03 | 0.21 | 80.00 |
| Pepper | 0.06 | 0.40 | 72.23 |
| Sugar | 1.32 | 0.60 | 69.23 |
| Bread | 1.28 | 0.99 | 176.00 |
| Others | 12.45 | 20.58 | 1,418.50 |
| **Total** | **100** | **87.16** | **6,768.21** |

Source: Data analysis, 2007.

## RESULTS AND DISCUSSION

### Rural households' food consumption

In view of its importance to the nutritional wellbeing of individuals, food constitutes a larger proportion in the expenditure pattern of most rural households. Food consumption levels of rural households in Kwara State, Nigeria are as presented in Table 3.

Table 3 shows the percentage distribution of food consumption among the rural households in Kwara State. Food items which are consumed by less than 25% of the rural households in Kwara State were categorized as others. The food items are millet, soyabean, groundnut, cheese, bush meat, margarine, mango, pawpaw, cashew, beverage, honey, soft drink and alcohol. It can be seen that the rural households in the study area did not comply with dietary recommendation which specifies a minimum requirement for the supply of energy from carbohydrate, legumes, animal protein and fats/oils. For the purpose of this study, carbohydrate food includes cereals, fruits and vegetables. Rural households derived more of their energy from carbohydrates at the expense of other classes of food items. The study reveals that cereals together with root and tuber products contributed 67.88% of the households' weekly calorie intake. This was followed by fats and oils with 9.21%, animal products with 2.37% and lastly fruits and vegetables with 1.97% of the total weekly calorie intake among the rural households.

This study also shows that a rural household had an average weekly expenditure of ₦6,768.21 on food items. This was estimated at a sum of ₦119.96 daily per capita food expenditure. Hence, the next sub-section of this study was embarked upon with a view to developing least cost-food items that would include the right proportion of energy from the various food classes highlighted.

### Rural households' food insecurity status

Food security index with a food security line of 2470 Kcal daily per capita consumption was used to classify the rural households either as the food secure or food insecure. Rural households' food insecurity status is as presented in Table 4.

The study shows that the rural households with a mean daily per capita calorie consumption of 2290.60 Kcal are food insecure. Table 4 shows that about two-third of the rural households with an average daily per capita calorie

**Table 4.** Households' food insecurity situation.

| Food Security Status | Frequency | Percentage | Daily per capita energy consumption | | | |
|---|---|---|---|---|---|---|
| | | | Min | Max | Mean | Std. Dev |
| Insecure | 269 | 65.45% | 191.88 | 2461.19 | 1403.56 | 600.24 |
| Secure | 142 | 34.55% | 2479.93 | 14682.92 | 3970.98 | 1701.82 |
| Total | 411 | 100% | 191.88 | 14682.92 | 2290.60 | 165.48 |

Source: data analysis, 2007.

**Table 5.** Optimal food consumption plan for the average rural household.

| Food items | Optimum quantity (Kg) |
|---|---|
| Rice | 4.17 |
| Maize | 18.59 |
| Cowpea | 2.92 |
| Gari | 2.66 |
| Fish | 8.53 |
| Palmoil | 3.10 |

Value of the Plan: ₦ 4159.30.
Source: Data Analysis, 2007.

**Table 6.** Goals attainment.

| Goals | Target | Optimal plan Value | Under achievement | Over achievement | Degree of attainment |
|---|---|---|---|---|---|
| Rice Calorie | 14589.73 | 14589.73 | 0 | 0 | Achieved |
| *Gari* Calorie | 9056.32 | 9056.32 | 0 | 0 | Achieved |
| Other Carbohydrate Calorie | 66917.15 | 66917.15 | 0 | 0 | Achieved |
| Animal product calorie | 11253.41 | 11253.41 | 0 | 0 | Achieved |
| Legume Calorie | 9645.79 | 9645.79 | 0 | 0 | Achieved |
| Fat and oil Calorie | 27865.60 | 27865.60 | 0 | 0 | Achieved |

Source: Data Analysis, 2007.

**Table 7.** Analysis of constraint to optimal food plan.

| Constraint | Status | RHS | Slack or surplus | Shadow price |
|---|---|---|---|---|
| Available food | Loose | <= 66.603 | 26.638 | 0 |

Source: Data Analysis, 2007.

consumption of 1403.56 Kcal are food insecure. With a daily per capita calorie consumption of 3970.98 Kcal, about 35% of the rural households are food secure. This shows that food insecure households are 43.18% short of the food security line while the food secure households are above the food security line by 60.77%.

## Optimal food plan for rural households in Kwara State

Rural households require good health to be able to carry out agricultural production activities which are usually labour intensive. The optimal food plan ensures that resource-poor rural households meet their minimum food requirements at least possible cost. Apart from having the least cost to the rural households, the plan also satisfies the food preferences of the rural households. This is because the plan was based on the commonly consumed food items in the study area. Table 5 presents the optimal food plan.

The minimized value for the food plan in the study area was ₦ 4159.30 per week. With mean adjusted household sizes of eight male adult equivalent, this amount to ₦

73.73 per person per day. The food plan has cost implication that is below the poverty line set by the World Bank at One U.S. Dollar per person per day.

## Attainment of goals

The extent to which the food plan satisfies the goals of rural households' food consumption is as presented in Table 6.

As shown in Table 6, all the goals of the rural households' food consumption are achieved. As such, the plan satisfies the minimum food requirement neces-sary for the rural households' food security. This shows that the goals of meeting the minimum calorie require-ment from carbohydrate, animal products, legumes and animal products are achieved without any deviation.

## Constraint to the attainment of optimal food consumption plan

Attainment of optimal food plans among rural households is affected by the level of available food. Table 7 presents the results of the analysis of the constraint to the attainment of optimal food plan among the rural households.

The average food available was in excess by the amount indicated in the slack/surplus column. This implies that the available food can be combined in such a way that an average rural household can meet the minimum food requirement with the possibility of such household having some returns from the sale of the surplus.

## Conclusion

There is high incidence of food insecurity among the majority of rural households whose calorie consumption comprise about 70% carbohydrates. Optimal food plan for the rural households in Kwara State is about 38% lower than the one U.S. Dollar World Bank poverty line per person per day. With a food expenditure of just about ₦ 73.73 per person per day, poor rural households may be food secure by merely readjusting their food combination toward rice, maize, cowpea, *gari* , fish and palm oil which constitute the least - cost food items for the rural households.

## Recommendations

Considering their limited resource base, rural households need to be educated on the nutritional implication of the various food items. This is necessary for the food insecure households to be able to make appropriate choices in matters of food consumption.

Farmers should be assisted to embark on dry season farming. This is to guarantee that the necessary food items are made available for the rural households at reasonable prices all year round.

There is the need for improvement in the processing of the local food produce. This is with particular reference to *gari* to minimise contamination and impurity. This is parti-cularly necessary as the food item is an important component of the least cost food items in the rural areas of Kwara State.

Since agriculture constitutes the main stay of the rural households' livelihood, their food security may be seriously threatened in event of crop failure due to bad weather or pests and diseases. It may therefore be necessary for the efforts at improving food security in rural areas to put in place functional and accessible agricultural insurance scheme for farmers in the rural areas. Apart from helping the farmers to improve their agricultural production activities, it will enable the rural households to gain better economic access to their food need.

Rural households should be educated on the need to diversify their source of income from agriculture. This will ensure regular incomes for the households. Participation of poor rural households' in cooperative societies may be necessary for them to be able to acquire the necessary funds required. Besides, agencies of government such as the National Directorate of Employment should be made to go and give training to rural households on small scale enterprises.

## REFERENCES

Adegboye RO (2004). Land, Agriculture and Food Security in Nigeria. Faculty of Agriculture Lecture, University of Ilorin, Feb. 25th p. 27.

Adejobi AO (2004). Rural Poverty, Food Production and Demand in Kebbi state, Nigeria, Unpublished Ph.D. Thesis, Department of Agricultural Economics, University of Ibadan. Unpublished.

Adewumi MO (2002). A Multi- Objective Approach to Small Scale Farm Planning in Kwara State, Nigeria. Unpublished Ph.D. Thesis, Dept. of Agric. Econs. and Farm Management, University of Ilorin. Unpublished.

Akanji B (1993). "Some critical considerations in rural nutritional health status in Nigeria" Perspectives on Food Security in Nigeria. Olomola A. and S. Nwosu (eds) Nigerian Rural Sociological Association pp. 39-51.

Aromolaran AB (1992). Multiple Objectives And Resources Allocation Behaviour of Small Farmers in Ifedapo Area Of Oyo State, Nigeria, Unpublished Ph.D. Thesis, Department of Agricultural Economics Univeristy of Ibadan.

Barlet ET, Clawson WT (1978). Profit, Meat Production or Efficiency Use of Energy in Ranching, J. Anim. Sci. 46: 812-818.

Barnett D, Blake B, Mc Carl BA (1982). Goal Programming Via Multi-Dimensional Scaling Applied to Senegalese Subsistence Farms, Am. J. Agric. Econ. 64: 720-727.

Bazara MS, Bouzaer A (1981). A Linear Goal Programming Model for Developing Economies with an Illusion from the Agricultural Sector in Egypt, Science. 27: 396-413.

Bliss C, Stern N (1978). Productivity, Wages and Nutrition, J. Dev. Econs. North–Holland Publishing Company 5: 363–398.

De ville de Gouyet C, Seaman J, Geifer U (1978). The Management of Nutritional Emergencies in Large Population WHO Geneva pp. 88-89.

FAO (2004a). Food Insecurity and Vulnerability in Vietnam: Profiles of Four Vulnerable Groups Food Security and Agricultural Projects

Analysis Service (ESAF), ESA Working Paper, Agricultural and Development Economics Division The Food and Agriculture Organization of the United Nations. www.fao.org/es/esa. Retrieved on 05/12/2005 pp: 4-11.

FAO (2005a). FAO Warns World Cannot Afford Hunger", FAO Newsroom retrieved on December, 2005. www.fao.org Retrieved on 05/12/2005.

Feleke S, Kilmer RL, Gladwin (2003). Determinants of Food Security in Southern Ethiopia. A selected paper presented at the 2003 American Agricultural Economics Association meetings in Montreal. Canada. retrieved on 12th December, 2005 from http://ageconsearch.umn.edu/bit stream/22010/1/sp03fe02.pdf .

Fiske WA, D'Souza GE, Fletcher JJ, Philips TT, Bryan WB, Prigge EC (1994). "An Economic and Environmental Assessment of Alternative Forage- Resource Production Systems: A Goal-Programming Approach" Agricultural Systems 45 Elsevier Science Limited pp. 259-270.

Goldsmith GA, Revelle R, Beale CL, Brackett JW, Engel RW, Gartner WA, Johnson OC, Meyers T, Milner M, Shank RE (1967). The World Food Problem: Report of the Panel on the World Food Supply volume 11.the White House.

Honfoga BG, Van den Boom GJM (2003). Food-Consumption Patterns in Central West Africa, 1961 to 2000, and Challenges to Combating Malnutrition. Food and Nutrition Bulletin, The United Nations University 24(2): 167-182.

Joseph JK, Ajayi S (2002). Agricultural Products and Man. History and Philosophy of Science: General Studies Approach: Akanji MA, Jolayemi ET (eds.) pp. 118-141.

Kennedy G (2001). Global Trends in Dietary Energy Supply from 1961 to 1999, Paper prepared for the FAO/WHO/UNU, Expert Consultation on Energy in Human nutrition. retrieved on 12th December, 2005 from www.fao.org/DOCREP/005/Y3800M/y3800m07.htm.

Kwara State Agricultural Development Project (KWADP) (1996). Agronomic Survey Report, KWADP, Ilorin.

Makinde OK (2000). Determinants of Food Security in Bauchi Area of Northern Guinea Savanna of Nigeria. Unpublished Ph.D Thesis University of Ibadan, Nigeria, April. Unpublished.

Manyong MA, Degand J (1995). Sustainability of African Smallholder Farming Systems: Case Study of Highland Areas of Central Africa. J. Sustainable Agric. 6(4): 17- 41.

Marshall EP, Homans FR (2001). A Spatial Analysis of the Economic and Ecological Efficacy of Land Retirement. Paper prepared presented at the 2001 Annual Meeting of the American Agricultural Economics Association, Chicago IL, August 5-8. on 12th December, 2005 from http://agecon.lib.umn.edu/cgi-bin/pdf_view.pl?paperid=2501.

Marton GG, Sanchohez LA (1982). Economical land use planning and carrying Capacity evaluation in the Jalapa region, Veralcruz, Mexico. Agro- Ecosystems 8: 83-124.

Monarchi DE, Weber JF, Duckstein I (1976). An interactive multiple objective decision – making aid using non linear goal programming. Multiple Criteria Decision Making (Zeleny M. (ed.) New York, springer-verlag.

National Academies of Sciences (2002). Dietary Reference Intakes For Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids, Press Release Institute of Medicine National Academies of Sciences available., http://www.nap.edu.

National Population Commission 1991: Census `91 Final Results, Kwara State National Population Commission.

Njiti CF, Sharpe DM (1994). A Goal Programming Approach to the Management of Competition and Conflict among Land Uses in the Tropics: The Cameroon Example Ambio. 23(2): 112-119.

Ogunyinka EO, Norman DW (2003). Optimal Dietary Blending for Household Food Security in South Western Nigeria: Lessons from Published Data Selected Paper Prepared for Presentation at the Western Agricultural Economics Association Annual Meeting at the Denver Adam's Mark Hotel, Denver.Colorado July 11-15. retrieved on 15th December, 2005 from www.ageconomics.ksu.edu/DesktopModules/ViewDocument.aspx?... 4176.

Olayemi JK (1998). Food Security in Nigeria Research Report N0 2. Development Policy Centre, Ibadan p. 88

Olayide SO (1982). Food and Nutrition Crisis in Nigeria Ibadan University Press.

Onyido (1997). Poverty Alleviation: Agenda for Food Security, Integrated Agricultural Production in Nigeria: Strategies and Mechanisms for Food Security NARP and FMANRP., pp. 114-130.

Osundare F (1999). Analysis of the Demand for Certified Maize Seed in Ondo State: Implications for Food Security, Poverty Alleviation and Food Security in Nigeria Fabiyi Y.L. and E.O Idowu (eds.) Nigeria Association of Agricultural Economists pp. 238-242.

Romero C, Rehman T (1985). Goal Programming and Multiple Criteria Decision Making in Farm Planning: Some Extensions, J. Agric. Econs. 136: 171-185.

Sandiford F (1986). An Analysis of Multi Objective Decision Making for the Scottish on Shore Fishery, Am. J. Agric. Econs.

Taiwo S (2005). Rapid Assessment of The Impact of Liberalization and Foreign Private Investment in Agriculture for Food Security and Food Sovereignty in Nigeria: A Case Study of Kwara State Report of a research conducted as part of the "right to food as human right" project, Trade and Sustainable Development Series No. 2, Development Information Network and Heinrich Boll Foundation.

United State Department of Agriculture (USDA) (2007). Food Distribution Commodity Acceptability Processing (CAP) Report (for Institutions and Households). Food and Nutrition Service Retrieved on 17th May, 2007 from www.fns.usda.gov/fdd/forms/FNS-663.pdf

Wheeler, B.M. and J.R.M. Russel, (1977). Goal Programming and Agricultural Planning, Oper. Res. Q. 28(1): 21-32.

World Food Summit (1996). World Food Summit Plan of Action FAO, Rome. 13th – 17th November, 1996 retrieved from http://www.fao.org/docrep/003/w3613e/w3613e00.HTM

Yusuf TM (2000). Socio – Economic Analysis of Poverty Level among Rural Dwellers in Kwara State, Nigeria, Unpublished M. Phil. Thesis in the Department of Agric. Economics, University of Ibadan.