FOOD SECURITY IN LESS DEVELOPED COUNTRIES: ASSESSING THE EFFECTS OF FOOD AID IN RURAL KENYA AS A FOOD SUPPLY SHOCK ON CONSUMPTION AND NUTRITION.

by

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ABSTRACT

Food Security can be defined in terms of establishing national or regional minimum nutritional standards, or in terms of securing national or regional self-sufficiency production levels. In this research, food security is viewed from a nutritional-economic standpoint. The prevalence of severe malnutrition and food production instability, especially in Sub-Saharan African Countries, creates the impetus to identify the several economic aspects which characterize the overall food sector and its security floor. Hence, LDC governments, drawing on the WFP (World Food Program) and other international agencies, are interested in formulating a desirable national food strategy which, to a certain degree, secures a balanced national food production sector and consumption pattern.

Food aid, in turn, is an essential mechanism designed to serve developmental purposes, such as income redistribution or provision of food as a real resource. Food-for-Work (FFW), as a specific form of food aid programs, represents a short-run food supply shock in the market environment of the recipient country's economy, since it is used as a "bridge" for meeting the basic nutritional requirements of the poorest households in the short-run. In the long-run, FFW can be

used for developing infrastructure, creating jobs and advancing working skills, providing additional income to participants, and further improving the overall nutritional status of the poor.

Recognizing these features of food aid, this research focused on the empirical estimation of the specific nutritional contribution of a FFW project, implemented at the community level in the Ewalel and Marigat locations of the Baringo District, Rift Valley Province, Kenya. The primary objectives were to measure empirically the magnitude of the FFW contribution on the nutritional status of the participant households, and to determine the relationship between consumption patterns and domestic (local) food prices. In this research, FFW participants' consumption behavior was hypothesized to be differentiated from the non-participants in terms of their income elasticities of demand for nutrients. Also, it was hypothesized that the FFW nutritional contribution to participants was greater than the equivalent net income gains through the value of the FFW provided food items (monetary market value of provided food items). Both hypotheses are supported by the analysis.

To determine the course of this research, a two step analytical procedure was followed. First, following Lancaster's conceptual setting on the "Goods' Characteristics Theory"

and its modifications (Ladd and Suvannunt, 1976), a set of Mathematical Linear Programming Models was used to estimate the marginal (shadow) nutrient prices of four consumed nutrients (Calories, Protein, Fat, and Carbohydrates). Second, following the foundation of the Neoclassical Consumption Theory, a set of Linear Econometric Models was used to estimate the own-and-cross price elasticities of demand for nutrients, and the income elasticities of demand for the above four nutrients.

The data set used in the analysis was collected from a random sample of families in Marigat and Ewalel communities in Kenya. A 300-household, random sample, initially, was selected. Of these 300 households, 100 were found to be FFW participants receiving maize, beans, and vegetable oil as FFW payment-in-kind for the participants' work on community projects.

Analyzing the available data, a set of conclusions was drawn. Specifically, it was found:

1. That FFW contributed significantly to calorie and protein consumption by 26.07 and 20.67 percent, respectively;
2. That FFW contributed by 32.69 percent to fat consumption, and 25.45 percent to carbohydrate consumption;

3. Only 5.38 percent of the nutrients provided by FFW commodities were given up in favor of other consumption items;
4. That overall, the FFW participants experienced significant income gains, and even more significant nutritional improvement;
5. The poorest FFW participant households experienced even higher nutritional gains than the "richer" FFW participant households. Indeed, the average FFW nutrient contribution for the poorest was found to be 34.63 percent. This value is higher (in percentage points) than the analogous (corresponding) income gains (22.77 percent) of the poorest households;
6. FFW participant households showed a 90.0 percent higher propensity to spend on nutrients compared to non-FFW participants;
7. The income elasticity of demand for protein of the FFW participants is 74.5 percent higher than the analogous income elasticity of the non-participants;
8. The non-participants' poorest group of consumers responded more strongly to food price changes, than the "richer" non-participant households.

Hence, the significance of the FFW effects refers to participants' increased consumption, advanced nutritional sta-

tus, higher income gains, and higher marginal propensity to spend on nutrient consumption.

"THINGS TAKEN TOGETHER ARE WHOLE AND NOT WHOLE, SOMETHING WHICH IS BEING BROUGHT TOGETHER AND BROUGHT APART, WHICH IS IN TUNE AND OUT OF TUNE: OUT OF ALL THINGS CAN BE MADE A UNITY, AND OUT OF UNITY, ALL THINGS".

HERACLITUS The OBSCURE

(Quoted by ARISTOTLE).

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Chapter I

INTRODUCTION

1.1 FOREWORD

Food aid may play a substantial role in the food security of the Less Developed Countries (LDCs). This happens because Food Aid may especially improve the nutritional status of the low income people in low income countries (S. Lane, 1980). Since caloric deficiencies in LDCs are large, and poor consumers spend a high proportion of their income on food, food aid may assist in eliminating the nutritional gaps (J. Mellor, 1983). In fact, the nutritional consequences of food aid and their correspondence to the food prices in the recipient country have not yet been well documented (B. Deaton, 1985).

One of the most significant contributions of food aid is through the "Food-For-Work", (FFW) program, because FFW projects assist in building LDCs' infrastructure and thus contribute to economic development. The specific aim of the FFW program is to design projects wherein food is directly distributed in exchange for labor. In the process both human and physical capital productivity may be increased at the community level. At the same time, the nutritional consequences of the distributed food and the policy effectiveness

of achieving a certain nutritional status for the participant households are still complex topics (Mellor, 1983) which have not been well documented. Accordingly, economic reasoning calls for direct identification of the FFW program impacts on the nutritional availability to the household unit. The economic need is related to the estimation of the food consumption quantities, caloric consumption, protein, fat and carbohydrates actually consumed. The above nutrients are the most important ones, representing the center of interest for the economic and nutrition planners (See also Mellor, 1983). The nutritional contribution of the consumed food on the overall dietary status of the human capital involved in the FFW project is to be estimated.

FFW is designed to reach the lowest income people, those who are at nutritional risk, and to influence their consumption behavior. At the same time, FFW is used in rural Kenya as payment for work on community infrastructure. Previous work by Bezuneh (1985) indicated that FFW relaxed the capital constraint of participants in their own-farm operations. If such effects lead to eventual self-sufficiency, then FFW can be viewed as a type of food security. Concurrently, even though FFW, and food aid in general, has been criticized for price disincentives, displacement of commercial imports, labor and policy disincentives, much less emphasis has been

given on the nutritional and consumption analysis of such programs.

It is widely declared (Reutlinger, Seminar on Food aid, 1983, The Hague Report) that poor people may have a higher propensity to spend on food when they receive an income transfer in food. But, income transfer efficient food aid project may increase the scarcity of some basic foodstuffs, and raise their prices. At the same time, food aid may decrease the scarcity and depress the prices of other foods in local markets. This shift in consumption behavior will be accompanied by consequent nutritional implications for the poor consumers. Therefore, even though it seems that the primary function of project food aid is the transfer of income to the poor people, it is to be argued that the specific food commodities (provided by the FFW) may have significant consumption (and nutrition) impacts on people's diets and preferences.

Therefore, to understand the contribution of food aid to improved nutritional status of the poorest consumers of an LDC, and to achieve higher food security from the nutritional standpoint, it is necessary to investigate the nutritional implications of recent food for work projects. The latter issues are necessary for economic and nutritional policy planning in developing countries, for food aid agencies, and for food donor countries.

1.2 PROBLEM STATEMENT

Understanding the relationships between food security (from the nutritional standpoint) and food aid (here, FFW, as a specific food "injection" in rural Kenya) requires a detailed knowledge of the extent to which consumers at different income levels change their food intake as available food quantities change.

Now at a local level, an ideal distribution pattern of food aid may be very difficult to reach. But there are certain ways of targeting food aid which are effective in reaching a large share of the poorest people. One way of targeting food aid supplies to the poorer groups consists of projects in which food is distributed on the principle of "food-for-wages" or "food-for-nutrition" or, finally, "food-for-work, FFW". These programs even though costly and demanding in considerable administrative and financial capacities are expected to be nutritionally cost-effective. The purpose of this research is to identify the nutritional (consumption) value of such a program, (especially of food for work), in the process of analyzing the consumption behavior of participant households in rural Kenya.

Food for work (FFW) strategies are conceived as more effective means of reaching the poor, because the lowest income workers receive all or part of their wage payments in

the form of food items. Food for work programs can be used to build physical infrastructure which stimulates economic development. Therefore, such FFW programs can be examined for their potential positive effects (infrastructure, nutritional effects, income streams) versus the possible negative effects. These undesired impacts of FFW (food aid) are mainly producer price disincentives as a greater quantity of food is placed in the domestic market of an LDC driving down prices. Thus, any FFW program in order to be of developmental value should meet a combination of the following objectives:

1. Improved health and nutrition of the recipient families.
2. Greater income earning potentials of participants.
3. New saving and investment streams from the participant families.
4. New training opportunities to participants resulting in more income earning ability of the recipient families.

While one can find a huge theoretical literature on the effects of food aid programs (Maxwell and Singer, 1979) there are unquestionably very little empirical results. Even more, little evidence exists about the nutritional (consumption) patterns of the recipient participants in a FFW pro-

gram in relation to their behavior while receiving the FFW food items.

Recent research (Deaton and Bezuneh, 1985) on the impact of FFW program on production and consumption activities of FFW participant households in rural Kenya, gave the following results:

1. FFW increased marketable surpluses for participant households in the first year.
2. It eased the capital constraint of the participant farm families by the second year of participation.
3. It increased the amount of land cultivated for both participant and non FFW participant households.
4. FFW increased both hired and family labor in farm production.
5. It augmented both own farm output and the marketable surplus from own farm production, on the participants' side.
6. It also increased the demand for food by participants as their income grew due to participation.

Indeed, the nutritional status and patterns of the participant households were not emphasized in the mentioned research. Therefore, the problem of analyzing the consumption (nutrition) impacts of the FFW project in rural Kenya calls for a comprehensive empirical investigation. Thus, to esti-

mate the actual nutritional impacts of the food aid (FFW) programs (such as the specific Kenyan FFW project) there is a clear need for a more in-depth economic and nutrition analysis. In this research, the specific food aid program (FFW in rural Kenya) served as a short-run supply shock to the local food market. Such a change in the local supply was expected to cause changes in local prices also; this potential price change is very important mainly for the poorest consumers who have to pay relatively more of their income for food.

On the other hand, higher prices will have an income depressing effect mainly upon the low income people, who will reduce their consumption levels. This behavior is obvious if we consider the fact that for the poor, food expenditures constitute the greatest amount of their total living expenses (Mellor, 1983). For the above reasons, a food donor agency should target its food aid program in such a way that the desired benefits will reach the poor. This can be achieved through a well designed FFW program, along with effective recipient government programming (The Hague, 1983).

If we accept that food security is a problem of the poor, then the estimation of the food price changes in the domestic market of a LDC, due to a food supply change such as a FFW project, becomes an important problem that needs to be

solved. But, accepting the fact that the goal of the food aid program is to assist mainly the poorest groups, the nutritional (consumption) analysis of the specific FFW program in rural Kenya becomes the core of the researchable problem which will be analyzed in this thesis. The impetus to estimate these economic and nutritional issues comes from the economic planners who are concerned about guaranteeing basic human needs, and from the nutritionists who are concerned about the nutritional status of the at-risk populations. Obviously, international agencies operating in the food trade sector and functioning as the "economic chains" between industrial developed and LDCs are also directly concerned.

1.3 OBJECTIVES

1.3.1 PRIMARY OBJECTIVE

The primary objective of this research is to analyze the consumption impacts and the net nutritional benefits from a short-run food supply shock in the form of a community specific, FFW project in Kenya. The research will concentrate on the changes in caloric and protein intake as a contribution of food consumption resulting from this food supply shock. The primary hypotheses of the study can be defined as follows:

1. It is hypothesized that the structure of nutrient demand between the FFW participants and the non-participants is different. In other words, participants' consumption behavior is expected to be different from the non-participants in terms of their respective income elasticities of demand for the nutrients in question.
2. It is also hypothesized that the FFW nutritional benefits to the poor are more significant than the plain monetary gains represented by the FFW-provided food items. To illustrate, the nutritional gains of participating in the FFW project are expected to be greater than the net market value equivalent (income gains) of the FFW provided foods.

Since participants are being paid in food in exchange for their provided labor, the FFW project is expected to affect their consumption behavior because FFW expands the range of consumption preferences and the amount of the consumed nutrients available to the participant household units (due to participation). On this basis, food products provided as payment-in-kind are hypothesized to affect the consumption behavior of the participants (compared to non-participants). Therefore, the income level difference between participants (lower) and non-participants (higher) along with the specif-

ic FFW payment-in-kind are expected to affect the consumption patterns of the participant households by differentiating their demand for nutrients compared to the non-participants. Along this line, then, if the above distinction (payment-in-kind, and income level difference) is accepted, it is reasonable to interpret the two effects (nutritional advancement, and indirect income gains) separately. FFW food items, by increasing the consumption opportunity set of the participants, are expected to affect the income elasticity of demand for nutrients (protein, calories) of the participants. Next, the indirect income contribution of FFW (income gains representing the market food value) is also expected to affect the magnitude of the differentiated consumption response of the participants which can be measured by comparing the income elasticities of demand between participants and non-participants. The solution to such questions is to be found by evaluating the magnitude of the income elasticities of demand.

Previous research in the area revealed that participant households experienced increased food consumption due to participation in the FFW project (Bezuneh, 1985). Even though the evidence of increased consumption (due to participation) exists, there is no empirical finding to support the assumption that payment-in-kind (FFW) has the same ef-

fects on participants consumption patterns, as payment-in-cash. An alternative view would suggest that food commodities, as payment-in-kind, may have some "intrinsic" properties, which are not present in net cash payments. The latter can be supported by the fact that participants in this FFW project revealed a preference in being paid in cash rather than food (Bezuneh, 1985).

In addition, data on the specific FFW project in rural Kenya is useful for consumption and nutrition analysis in order to address the main objective of the research through the following research questions:

(1). What are the actual nutritional impacts of the specific FFW project in rural Kenya?

(2). To what extent can changes in the nutritional status and food consumption quantities be attributed to the FFW project?

(3). How has consumption of purchased food changed or been affected by the FFW project?

Hence, the approach to answering these questions is to empirically estimate a set of household demand functions for the nutrient components of food (from all sources) actually consumed. Along these lines, the assessment of how the demand for food within the poorest consumption group will be affected by the FFW short-run supply shock becomes a major

purpose of this research. The impacts of food aid on the consumption patterns of the lowest income group, and the policy implications of the food price changes would be identified. The results should provide useful information to guide the economic development strategies which are related to the national consumption and food problems of the country in question.

1.3.2 SECONDARY OBJECTIVE

The secondary objective is to provide insight into the effects of FFW upon food pricing policy decisions in Kenya. Policy options are derived from the results of this study. Hence, the secondary objective depends on the results of the analysis in the first objective. The centerpiece of this second objective can be further clarified through the following research questions:

1. What food pricing policy implications of interest to agricultural and nutrition planners can be derived from the proposed consumption analysis specified in the first objective?
2. Thus, what are the food pricing and nutritional consequences from the specific FFW project in Kenya?
3. Are these nutritional consequences related to the national food issues of the country (Kenya)?

Consequently, a food donor agency can use this information so as to target food aid through the market of the developing country, by concentrating on a specific combination of foodstuffs used as a development tool for specific policy objectives.

The objective of the food donor agency would be an increase in consumption, advancement of the nutritional status of the targeted poorest people, and provision of food aid as a real resource (commodity) (See also G. Nelson, 1980). Additionally, any food donor country at this time, and especially the U.S., is trying to eliminate the harmful effects from food over-supplies and producer price disincentive effects in the domestic market of the developing country (Grigsby and Simpson, 1984). It remains to be considered whether or not the food aid programs in a less developed country will result in extreme domestic food price changes. It is still to be determined whether the specific FFW project had any essential nutritional impacts on the poorest consumers of rural Kenya.

It is expected that this research will provide useful information upon the food policy options for a food donor agency, or a developed country which participates in a food aid program. Moreover, an expected contribution of this research will be to draw policy guidelines and provide specif-

ic details that the country in question will be able to use in order to understand another aspect of its own food policy issues.

In other words, what sorts of policies might show a successful achievement depending on a specific country's objectives and potentials? The research will help identify effective management directions for the appropriate use of food aid under the objective of improving the nutritional status of the poorest people.

Assuming that the structure of food demand is different for different consumer groups, and because of the relatively greater income elasticity of demand for food of the lower income groups of the recipient country, it is hypothesized that the effects of a short run supply shock (in this case food aid donation, in the form of FFW project) are not evenly distributed across the low income consumers.

Therefore, the research will be especially useful in determining the effects of food and agricultural policy options in developing countries, in order to assess the effects of a food aid donation on the consumption behavior, nutritional status and domestic (local) food prices. Specifically, the development of food aid assistance programs, the implications of providing food aid to a country, and the estimation of the efficiency of a food aid program, is very useful for

food aid donor countries, and related agencies, in order to estimate the total food needs of the recipient country in question.

Moreover, it is expected that the results of this research will provide information which can be used in balancing short term commercial, and concessional trade needs which, in turn, are directly related to the food security issues of the specific developing country.

1.4 ORGANIZATION OF THE STUDY

This research is organized into six chapters. These chapters, in sequential order, are:

1. Introduction: this chapter describes the problem statement, the research objectives, and the hypotheses. The organization of the whole study is also described here.
2. Literature Review: The second chapter provides the required definitions of the researchable issues. Food Security and its specification is defined. The possible economic approaches to Food Security are given, and a set of initial conclusions relating Food Aid with Food Security is presented.
3. Economic Environment and Characteristics of the Research Area: this third chapter presents a summar-

ized description of the FFW project area in rural Kenya, and it provides a brief review of previous research done on the FFW project (Bezuneh, 1985).

4. Conceptual Analysis: the fourth chapter explains the conceptual setting of the economic theory behind this research. Specific reference to Lancaster's "Consumer Goods Characteristics Approach" is briefly given.
5. Review of Empirical Approaches: Previous model specifications are described in this fifth chapter. An assessment of the econometric models of related research is provided.
6. Results: the estimated results of the study are presented in the sixth chapter.
7. Conclusions: the last chapter is devoted to the conclusions and the policy implications which are derived by analyzing the research findings.

Chapter II

LITERATURE REVIEW

2.1 FOOD SECURITY DEFINITION

To conceptualize the researchable problem a set of definitions is required. This introductory section clarifies the relationships among Food-Security, Food-Aid, and Food-Supply Shocks. Hence, the following lines of this chapter refer to: (a) Definition of Food Security, (b) Appropriate Economic Approaches to Food-Security; and, (c) A set of initial conclusions concerning the issues stated here.

In principle, food security can be defined as the assurance of a minimally adequate level of food consumption. Food security can be defined also as the satisfaction of the national food consumption needs with a specific degree of certainty (See also Sarris, 1985). The key distinction in this research is that Food Security is viewed from a nutritional standpoint. That means food security is considered as the ability to acquire enough food to satisfy the minimal acceptable nutritional requirements, at national, regional, or household level. Therefore, this research differentiates the terms food security and food (national or other) self-sufficiency. The latter can be defined as the national (or other) production at a level which satisfies the national own consumption.

It should be made clear that sustaining a high degree of food self-sufficiency does not guarantee a desirable level of food security. It is also essential to specify that within developing and less developed countries, even though nutritional aspects are to be recognized, the most urgent priority is to deal with filling the gaps of national food deficits. Hence, the national interest of most countries is to achieve food self-sufficiency with a consequent desirable degree of food security. In this sense, most nations of the less developed countries (LDCs) have developed food policies which attempt to provide some degree of food security to their population. These national food policies are designed in order to provide adequate food quantities to the whole population of an LDC, during the entire year, in order to fulfill basic nutritional needs in cases of unexpected food shortages (See also Mosquera, Seminar on Food Aid, The Hague Report, 1983). A general economic line of argument would seek to clarify the following factors, all of which are important components of food security:

1. Price stabilization mechanisms
2. Mobilization of existing supplies for emergency purposes
3. Instability of domestic and international food supplies
4. Trade policies among developed and less developed

countries

5. Weather cycles
6. International monetary disturbances
7. Exchange rates
8. Population growth rates in relation to food production and consumption levels
9. Wars

The importance of the above factors has been extensively analyzed during the last two decades (Dams, Hunt, and Tyler, World Food Conference, 1976; The Hague Report, 1983; Sarris, 1985). From the above mentioned factors, the foreign exchange rates' fluctuations, the international monetary disturbances, trade policies and international food supplies, all represent a set of food security affecting components associated with the international markets. Concurrently, domestic food price policies, national food reserves, weather cycles, population growth rates, wars (to a certain extent), and production fluctuations belong to the domestically generated food security factors (See also Sarris, 1985). This thesis concentrates on the identification of the nutritional impacts of a specific short-run food supply shock (FFW) on participant peasant households. Hence, food security is viewed from the domestic consumption (nutrition) and

thus economic standpoint. In other words, food security is defined in terms of its nutritional minimum standards which should be established by the country in question (Kenya). Within the nutritional frame of food security, FFW is examined for its nutritional contribution. In addition, the specific FFW can be used as a food insurance, in cases of unexpected low harvests. This latter issue is to be examined, to a certain extent, following the results of this study.

This introductory chapter is divided into the following segments. First, a review of the world food situation is presented. Second, a set of possible economic approaches to national food security is described. Third, major conclusions from recent research and evidence are specified. The conclusions do not present any extensive comparisons between the most preferable economic approaches to food security. Rather, they exhibit implicitly the lack of empirical evidence of existing comparisons among the food security economic solutions.

The general focus of this research will be on the identification of existing interactions among food security and short-run food supply shocks. By short-run food supply shocks, we mean the case of an unusually large disruption of domestic supply, a shortfall in domestic supply due to an

unexpected drought (which is common in Sub-Saharan Africa, (SSA)), monetary policies and economic conditions which can affect the production of some foods, commercial trade, food aid, a specific food-for-work (FFW) project, etc. The short-run food supply shock which is analyzed in this research is a FFW project in rural Kenya. There is a sound micro and macro- economic basis for the relationship between food aid (FFW) and food security. It is the strong perception that food aid agreements should function within a context of supporting the national food strategy objectives; point which motivates this research. The latter reasoning is illustrated in the following section and in the later chapter of conclusions.

2.2 THE WORLD SITUATION

After the food crisis of the 1973/74 period, it was evident that the future of the food economies of the less developed countries (LDCs) would be characterized by sharply rising food deficits. Recent evidence suggests that even though the post-war trend in real food prices worldwide may be downward, world agricultural commodity prices are characterized by increased instability during the 1970's and 1980's. From the mid-1970's and on, we do not have significant reasons to contradict the observation that real food

prices had already begun to follow a new upward trend which is accompanied by a significant amount of price variability (Fox and Ruttan, 1983, Mellor, 1983).

The importance of this analysis is that it calls for more information and explanation about the relationships between international food prices versus domestic (national) food prices. Specifically, in order to define the international food price trends over the last decades, Schuh (1985) suggests that the U.S. price of wheat and corn represents the international opportunity cost of these grains. Under this assertion, Schuh (1985) accepts that from 1970 through 1983 the real price of wheat in the U.S. declined at an annual rate of 1 percent, while the real price of rice declined by 1.3 percent annually. Consequently, Schuh concludes that the decline in real food prices is due to the production and distribution of new production technology in the world agriculture. Therefore, Schuh perceives a downward real food price trend, indicative of a world abundance of food products.

Nevertheless, it is crucial to realize that extensive research on price changes should be undertaken within the market of a specific country which faces its own production and agricultural technology levels. In addition, one must seek a more comprehensive and detailed explanation than the

supply-side view to account for the observed food price variability. This latter variability of food supplies seems to be of major concern to policy makers in Sub-Saharan African (SSA) countries where food availability continues to be an acute problem.

About 1 billion human beings have inadequate food, and many LDCs' population growth rates are increasing much faster than their food growth rates. The demand for grain of the food deficit countries has increased from 19 million tons in 1960, to 85 million tons in 1980 (for the LDCs). The International Food Policy Research Institute projects an increase in the grain imports of the LDCs to between 125 and 145 million tons by 1990.

The developing countries of the world have received currently financial support of $ 8.6 billion in 1980 prices, as external assistance programs to handle their food production, and food insecurity problems. Still, LDCs need $ 13 billion, in order to catch up with the 4 percent growth rate required by these countries in order to reach a balance with their population growth rates (Tanco, 1983). But, it seems that the main factors which affect the solution of the malnutrition problems in LDCs are not only economic, but also political, social, and organizational. Apart from these, in the past few years the World Bank has tripled its lending to

agricultural programs, while the establishment of a new Food Aid Convention raised the level of guaranteed food aid to 7.6 million tons (Tanco, 1983). In addition, the U.S. represents the largest supplier of food aid by supplying more than 50 percent of the grain imports of the Third World, and about 60 percent of the total food aid programs in terms of commodities.

Under the assumption of the past trends continuing to be the same, FAO projects that by the year 2000 the world would have to feed an additional 9.5 million people in every consecutive year from now. Food demand will increase by 2.9 percent per year, while population growth rate will increase by 2.4 percent every year. In Africa the projected increase in demand for food will be 3.4 percent per year, while the average caloric consumption per capita will decrease below the current level of 2175 calories. The sad projections conclude that the world will have a 150 million increase in malnourished people by the turn of this century (Tanco, 1983).

At this time, it seems quite difficult to anticipate the accurate interactions among the fundamental factors that determine the long-run trends in food production and demand in LDCs. The reason for these difficulties arises mainly from several political and economic factors being involved:

cultural endowments, technological and institutional innovation, price mechanisms, government policies, etc. The fact is that the developing countries themselves will have to solve their own problems, while U.S., EEC, and other developed countries may increase their assistance to those countries which can prove themselves capable of maintaining a successful domestic (national) food policy. An economically successful national food policy might be considered one which eliminates malnutrition through continuous food aid programs, and through the LDCs' domestic production policies (Tanco, 1983).

Evidence shows (Dams, Hunt, 1976) that two-thirds of the world's population living in the developing countries produced only about one-third of the world's food. In 1975 (U.N. Research Statistics, 1980) 71.5 percent of the total world population lived in the less developed countries (LDCs). Projections for the year 2000 (United Nations Statistics, 1970-1980) suggest that the world population may rise up to 6,253 mn, with about 90 percent of this tremendous increase occurring in the less developed countries.

A crucial consideration in relation to the issue of food security is the relationship between population growth rates, and food production of the less developed countries. According to the Food and Agriculture Organization of the

United Nations (FAO, 1974) less developed countries increased their food production at a total rate of 3.1 percent in the 1950s, around 2.6 percent in the 1960s, and 2.8 percent in the 1970s.

The high rates of population growth in the less developed countries were considered to be one of the main factors for the acute malnutrition situation that LDCs face. But, aside from acknowledging these basic trends it should be recognized that the food and population situation in developing countries is significantly related to such issues as political will, government skill in implementing agricultural policy, trade and monetary policies, and technological innovation in agricultural production. All these factors need to be taken into account in order to understand the specific food problems of a less developed country.

One crucial point which is important in economic analysis is the role of the agricultural economists who may assist in addressing the food security issues and identifying the target population groups within each less developed country that potentially suffers from food deficiency. A second role is to specify efficient means of reaching the specific target groups in order to define their nutritional and economic situation (See also Stevens, 1978). Through this approach of identifying target population groups which face a severe

malnutrition problem in a food deficit less developed country, a food program can be organized to reach those individuals who would otherwise suffer from malnutrition (Stevens, 1978). To be successful a food program must actually result in an essential increase in the quantity and quality of individuals' food intake when food deficits would otherwise occur.

Given the problem of a large number of people who are without adequate means of subsistence, many times even without land, an important issue is how extra food supplies will be produced or provided in the long-run. This calls for the agricultural economist to see the problem of food insecurity in terms of long-run food supply (both domestic and imported), income growth and distribution, and price relationships. Agricultural trade and development policies must be viewed as interdependent issues which need to be examined together.

In the short-run the acute problem of malnutrition is concentrated in Sub-Saharan Africa (SSA). Specifically, food availability in Sub-Saharan African LDCs remains a severe problem. The food output per capita in these countries increased at an average annual rate of only 0.55 % during the early 1970s; while, the demand growth is in excess of output growth. Rising real food prices along with the declining

adequacy of food production will cause a serious threat to the economic development of these countries (Fox and Ruttan, 1983). This region represents the least developed countries of the world, along with the South East Asian countries (FAO, 1984). Even if optimal long-run policies are intended, there will be a considerable time lag before food production growth rates match the high population growth rates in these countries. Since demand for food will continue to shift more rapidly than supply in the less developed countries of Sub-Saharan Africa, it is expected that the domestic real price of food will increase, causing a real threat to food security of these countries.

The Sub-Saharan Africa (SSA) faces tremendous food problems, chronic malnutrition, and rising food aid requirements. If we assume that the real 1975 per capita income and price levels will be the prevailing ones in 1990, SSA would require about 11.5 million tons of food imports. SSA, as was mentioned above, would have to face nutritionally unacceptable calorie intake levels. In order to provide nutritionally acceptable levels of consumption, an additional amount of 12.4 million tons of cereals is needed (U.S.D.A., E.R.S., Foreign Agricultural Research Report No. 166, "Food Problems and Prospects in SSA, the Decade of the 1980's). U.S.D.A. projects that if real 1979 conditions prevail in SSA, there

would be an import demand fall of 10.2 million tons and an increase in the calorie gap up to 13.0 million tons. Along these lines, it is crucial to notice the specific reasons which create the difficult food deficit problems in SSA, and the "failure" of the 'Green Revolution' there (U.S.D.A., E.R.S., FARR No: 166). These reasons are the following:

1. Lack of sufficient infrastructure for and experience in the use of irrigation.
2. The geology of the African continent makes water control a very difficult task.
3. Plant diseases do not allow the high-yielding rice varieties to be used.
4. The cloudy skies of the tropical monsoon reduce the amount of sunlight reaching the plants. Thus, photosynthesis is limited.
5. Poor rural road networks are a crucial factor.

Additionally, increased food self-reliance became a national objective in these countries which seem to depend on high food aid donations in order to handle their food security problems. On the other hand, even though the African governments realize that food issues represent the most emerging problem, still the actual linkages between policy instruments and producer's consumer's behavior are topics which need further analysis.

While it is evident that farmers respond to producer price incentives (Deaton and Bezuneh, 1985), other factors are also essential including meeting the subsistence consumption and nutritional needs. There are significant interactions among these factors and the policy instruments of governments, such as development programs, food price policies, and national food production strategies. A set of potentially effective economic solutions for the SSA food deficit problem and agricultural development are the following (U.S.D.A., E.R.S., Report No. 166):

1. A careful coordination of government policies in food production, marketing and trade.
2. Shifting of the urban consumer tastes and development of new processing technologies for foods to make them more palatable. The key is the possible replacement of part of the food imports with domestic production.
3. Improvement of productivity in food production.
4. Investment in education and especially in agricultural research.

During the last decade, countries like Kenya and Zaire both increased official producer prices for some cereals above the world market prices. Kenya, specifically, made significant currency devaluations while, at the same time, food prices were increased as a reaction to food emergencies.

Likewise, frequent price variability in the international food market, combined with the system of flexible exchange rates create unstable market conditions, and force governments to adjust their agricultural policies according to foreign demand and supply trends of agricultural commodities (See also Schuh, 1985).

In contrast to the Sub-Saharan African countries, the rates of growth of food production in other developing countries now exceed population growth. Additionally, the processes for accelerated agricultural growth as well as efforts to control their population growth rates are now an essential part of the development programs in many of these countries (Schuh, 1985; Mellor, 1983). For the next two decades the accelerating growth in the demand for food in the Third World countries will exceed domestic production growth rates. Therefore, the food production self-sufficiency ratios will decline during the next decades (Mellor, 1978).

An important set of issues related to food security arises from macroeconomic considerations and the constraint on the availability of foreign exchange reserves in many developing countries. The encouragement of economic development of an LDC is significantly related to the conservation of foreign exchange reserves. At the same time, the LDCs face national food insufficiency problems. Food deficits repre-

sent the LDCs' most severe problem. This resultant instability of the domestic food supplies force the poor countries to rely on international food markets to fill their consumption (nutritional) needs. This economic tactic of relying on world markets eliminates LDCs' foreign exchange reserves and discourages their economic development.

Consequently, poor countries with open trade economies are vulnerable to the international food price variability. They face extremely difficult problems in conserving foreign exchange reserves and facilitating less reliance on foreign assistance. In this context, an LDC which needs to invest in production of new agricultural technology and needs to generate its own production patterns, has to deal always with adjustments of its trade and monetary policies.

Given this monetary uncertainty, necessary action for developing countries facing their food insecurity problems is to search for cost-reducing technological change in agriculture. In the meantime, LDCs should design their income redistribution policies in favor of the poorest consumer groups (farmers) which need national support to increase their productivity, and nutritional status (Mellor, 1983).

In addition, sudden increases in world food prices, and decreases in export prices of main exported foodstuffs which used to cover the heavy costs of food imports of an LDC,

represent a serious threat to international food security. Moreover, it seems obvious that dealing with the national food insecurity means that effective food policies should be implemented in order to reduce the international food price variability.

Therefore, food-deficit LDCs facing high international food prices will have to deal with reductions in export earnings, imbalances of trade, and resulting deficits which run down foreign exchange reserves, force poor countries to increase borrowing and foreign dependency, and slow down any kind of domestic development programs. Adding to this situation, the emerging economic difficulties like the above mentioned trade deficits, the high rates of inflation along with the minimum investments in their large agricultural sector, and the higher food prices will definitely reduce any remaining purchasing power of the already poor consumers of an LDC. Thus, LDCs having insufficient foreign exchange reserves, and facing possible import food price increases can not cover their increasing food needs. In other words, an LDC increases its food deficit since it has inadequate foreign exchange reserves to cover the increased cost of the demanded foodstuffs.

The following discussion describes the set of the possible economic approaches that can be undertaken in order to

address the food security problem. Specifically, the following discussion refers to:

1. Trade liberalization
2. World Buffer Stocks and Pricing Policies, and
3. Food Aid.

These three factors are important determinants of the national (and international) food security problems as recent research shows.

2.3 ECONOMIC APPROACHES TO FOOD SECURITY

2.3.1 Trade Liberalization

One possible economic approach that can be followed by an LDC to deal with its food insecurity problem is the free food trade strategy. According to Hathaway (p.55) one alternative solution to food security will be free trade among nations, a situation in which food will be allocated by a free market price which, in turn, might be lower or, at least, more stable. In this sense, Hathaway suggests that trade liberalization might assist poor countries to achieve a higher degree of stability of supplies without depleting national reserve stocks. This approach leaves some significant probability that the government can stabilize domestic food prices and organize domestic food production by investing in agriculture. Thus, free world trade with less na-

tional barriers (tariffs, quotas, import levies, etc.) would possibly stabilize the aggregate world grain production. Along this strategy of free trade, international agreements will assist in mobilizing food products to the needy food deficit nations. Therefore, a higher degree of stability of supplies can be achieved and food insecurity may be eliminated. Since free world trade in food products will expand and world food supplies will be moving easier to the needy nations, international food prices might be lower and domestic food price variability might be reduced. In other words, national food needs might be covered through flexible (free) world food trade flows. Domestic production discrepancies (and food insecurity) of an LDC may be handled by increased food imports. Gradually, increased food trade flows will cause a lower food price to be realized in a global sense.

Without free world trade food deficit third world countries may face higher international food prices or at least not as low as they could otherwise be. Indicatively, it is expected that an abundance of increased food trade flows will create a lower international food price, while ways of reducing trade barriers and costs will be examined. In addition, the high food prices absorb the already limited foreign exchange reserves of the LDCs which have to import food products in order to cover their food demand. What actually

happens now in the world markets is the gradual establishment of large and powerful economic groupings (or communities) among nations, such as the European Economic Community. The example of the European Economic Community, where trade barriers among member countries are expected to reach the minimum possible levels, is useful in the sense that the national trade policies of the member countries are designed to stabilize domestic food prices by insulating the domestic (EEC) economy from adverse movements and changes in the international market. The EEC example although it is contradictory to the idea of international free trade, is very indicative of free trade among member countries. At the same time, the trade interactions (or"trade wars" under national perspectives) among large economically controlled markets such as the U.S. and E.E.C. affect food security of the LDCs in many unexplored ways.

2.3.2 World Buffer Stocks & Pricing Policies

The second economic approach to the food security problem is for an LDC to maintain some buffer stock operations and to follow a set of food pricing policies. By stabilizing the world grain price it might be economically affordable for the LDCs to purchase a minimum adequate level of foodgrain supplies so as to secure their minimum consumption levels.

According to S. Reutlinger (1978, p.797-8), by investing in world buffer stocks in a sufficient scale it is possible to stabilize the world grain price.

The possibility of stabilizing world grain price depends on the expense of the undertaking in relation to the national gains of each country participating in the world food-grain trade. Consequently, the implicit recommendation of S. Reutlinger is calling for domestic (national) grain buffer stocks. This specific solution is directly related to (1) very high costs of stock operations, (2) possible economic disincentive effects and, of course, (3) the fact that domestic (national) price controls will have no effect on the international food price variability (since we consider the case of an LDC in which food trade flows represent a minimum amount of the world food trade). This national buffer stock problem indicates that every individual developing country alone faces higher costs of achieving grain stability than it would cost to maintain a buffer stock for many countries together.

To analyze the benefits from a specific price stabilization procedure, Reutlinger (1978, p.799) defines food insecurity as the condition whereby domestic (national) consumption is less than the minimum desired level (C*). Explicitly, Reutlinger defines food insecurity as the prob-

ability of foodgrain consumption in an LDC falling below the minimum desired level (C*) due to a fixed maximum level of the affordable food import bill and an unaffordable combination of poor domestic harvests and world foodgrain prices. Thus, he proposes a combination of a financial scheme and a grain buffer stock on behalf of the developing countries in order to attain food security.

Reutlinger assumes that the case of food insecurity results from a developing country's inability to import the necessary (and sufficient) quantity of foodgrains which is needed to maintain the minimum consumption standard. This happens because of the economic, and financial capacity of the country which does not permit the food import bill to exceed P'I'. According to Reutlinger (p: 799-800; 1978), P' is the median or normal world (or import) price of foodgrains, and I' is the average quantity of imports, defined as the gap between desired consumption (C*), and domestic (national) foodgrain production in a normal year Q'.

Furthermore, Reutlinger notes the national food security would demand imports being:

$I^* = C^* - Q$. and, consumption would be:

$C^* = Q + I^*$. Therefore, the difficult situation of food insecurity arises when actual imports, I, are less than the desired imports, I*, where:

$I = C - Q$. Subject to $PI <= P'I'$ and, actual consumption is:

$C = Q + I$. The extent of food insecurity is estimated by the probability distribution of the desired minus the actual imports: $I^* - I$.

Consequently, according to Reutlinger's definitions, the crucial determinants of food insecurity can be narrowed down to: (1) the amount of normal import requirements as they are defined above, (2) the average world price of foodgrains, P', (3)the extent of instability in developing countries' production, and (4) the probability distribution (instability) of the world price of foodgrains, P.

Recent research (Reutlinger, 1978) points out that under the assumption of a large enough buffer stock operations to completely stabilize the international price of foodgrains, worldwide price stabilization alone has no remarkable benefit for the food security of the developing countries, the latter (food security) being only 20-30 percent. What this result means is that we assume large buffer stock operations as an alternative scheme used to completely stabilize the world price of foodgrains. Under this assumption Reutlinger (1978) found that worldwide price stabilization has very little benefit to the food security of the developing countries up to the level of 20-30 % only. This 20-30 % security

level refers to the estimated scenario (Reutlinger, 1978) under which a shortfall of 20 mn. tons amounting for 7 % of the production and import supplies of the LDCs is assumed to happen (hypothesis followed in the methodology). This condition leads to undesired consequences of widespread hunger, along with the tremendous need for excess import requirements resulting from unexpected poor harvests.

It is obvious, then, that food insecurity is not expected to change over time, unless the ratio of average imports to average production will change. What seems to improve food security very considerably is the fact that assumed buffer stock operations are initiated exclusively for the benefit of the developing countries. These assumed buffer stock operations are expected to be of sufficient magnitude in order to even out the LDCs' aggregate annual supply variations in food grains (Reutlinger, 1978).

Moreover, the major conclusion must be (Reutlinger) that buffer stock operations designed to stabilize import requirements are not likely to become of a sufficient magnitude to assure food security, due to the high costs of such buffer stocks. Even further, a buffer stock which is operated to stabilize the import bill reduces food insecurity much more than a stock which is designed to stabilize import requirements. Additionally, the combination of a food import

bill insurance and a buffer stock designed to stabilize the food import bill proved that payments from the insurance scheme, in order to achieve food security, would be substantially reduced. Finally, Reutlinger concludes that achieving food security partially by means of a buffer stock might be preferable because it stabilizes the exports of foodgrain shipments to the developing countries.

Reutlinger (1978) concentrates heavily on defining the possible ways of stabilizing the world grain price and establishing world buffer stock schemes in order to achieve food security; whereas, Sarris (1985) follows a quite different perspective. Specifically, he accepts the current world agricultural price variability, and the domestic yield risks as being the variables which affect food security. Sarris does not recommend stabilizing the world grain price or the domestic yields. On the contrary, ha advocates adjusting domestic agricultural production structure by reallocating the country's resources, while reducing the national exposure to international price risk (Sarris, 1985; p. 86). To explain, his objective is in agreement with trade theory under uncertainty. In detail, he follows the approach of optimizing the expected production quantities, and the world agricultural prices associated with these domestic production quantities; subject to the fixed average normal con-

sumption level specified by the interested government (Egypt, in this case). A quadratic programming technique was used. The empirical model used results in achieving food security (consumption coverage with certainty) by expanding the production of the staple food crops, in the case of national high risk aversion strategies. In other words, from a national standpoint, given the country's physical capabilities, risk aversion policies lead to producing more of the subsistence crops instead of the cash ones. Hence, the optimistic view is that countries may achieve food security by following specific production strategies within their agricultural sector, even with unstable world food prices or unattainable world buffer stocks.

2.3.3 Food Aid

On the other hand, Food Aid is closely related to the food security issues, since it is meant to be a type of world wide food security for some LDCs. Food aid, in the short-run, can be essential to filling some part of the food deficit gap (See also Austin, and Wallerstein, 1979). In this sense, the use of food aid can be viewed as another specific economic approach to food security.

Austin and Wallerstein (1979) clarify that the overall purpose of food aid should not be to create a permanent in-

ternational welfare program. Clearly, it is not a long-run food security insurance by itself under the recent world food aid schemes. Definitely, the long-run goal of the food aid program is to reduce LDCs' external dependency. Apart from the empirical results briefly described, food aid has been severely criticized over the last three decades. Specifically, it has been continuously argued (Maxwell and Singer, 1979) that:

1. Food aid acts as a disincentive to local agricultural development.
2. It increases external food dependency.
3. It dampens host government and local community initiatives.
4. It also ignores local food preferences in disposing of surpluses.
5. It develops adverse nutritional feeding preferences and patterns.
6. It is used for political and/or military purposes and not for development goals.
7. It does not reach the neediest groups being nutritionally at risk, and therefore it is of no nutritional benefit for the poorest people.

In order to avoid any adverse effects, food aid should follow certain conditions (Schneider, 1984; p. 69):

1. "Non-substitution of food aid for established domestic supplies, but only for domestic shortfalls...".
2. "Food aid should not alter the efforts deployed by a government to develop domestic production".
3. "Food aid should not divert consumers from food products which are or can be produced domestically".

Accordingly, food aid is considered to be a potential instrument for transferring real resources especially for the food deficit countries; while research experience has proved that food aid can indeed promote economic development (Nelson, 1980; Maxwell & Singer, 1979; Deaton and Bezuneh, 1985).

A significant amount of analysis has focused mainly on the production effects of such aid on farmers in recipient countries and particularly on the identification of price disincentive effects (See also Deaton and Bezuneh, 1985). Recent research showed that food aid may have no production disincentive effects while it is being used directly to increase agricultural productivity as in the case of Food For Work (FFW) projects (Deaton and Bezuneh 1985; Maxwell & Singer, 1979).

From the consumption perspective which has been much less emphasized in resent research, lower food prices resulting from food aid imports can be of high value to low income consumers including farmers in developing countries who spend most of their income on food expenditures (Mellor, 1983). Therefore, higher prices which encourage production may have a negative effect on consumption of several foodstuffs at least in the short-run under the realistic assumption that farmers (poorest group) are operating in an economy where their production level covers their subsistence and their family's most basic needs. Of course, this statement does not mean that there are not economies (LDCs) where the poorest groups in the society live at their subsistence level, where food aid just helps to prevent any deterioration of human capital by providing the necessary nutrients to the needy people.

Additionally, it is widely expected that people would consume more food when they received a food aid commodity which conveyed to them more income than more calories (The Hague, 1983). In other words, food aid with higher income generating effects may be preferable to food aid providing commodities with higher caloric content. In this sense, income generating food aid may affect people's consumption patterns more than high calorie foodstuffs alone (The Hague,

1983). At the same time, people probably have a higher propensity to spend their income on food when they receive an income transfer in food rather than money. But, at the same time, measuring the income transfer effect of food aid was easier than trying to assess the nutritional impacts of food aid on specific target groups, or households participating in a food aid program.

Therefore, the problem which arises is that every less developed country receiving food aid needs to evaluate the potentially negative effects on domestic producer prices against the real income transfer achieved through the specific food aid donation. At the same time, this evaluation needs to be undertaken by the food donor country (or international agency) in order to target its own food aid donation program so that it contributes substantially to the diet of a given consumer group which is known to be nutritionally at risk. In this sense, emphasis is to be put on the concept of implementing a nutritional and developmental project through food aid (The Hague, 1983). Furthermore, the appropriate food commodities that most nearly meet the nutritional needs of the poorest consumer groups can be programmed into every international food aid assistance agreement (Austin and Wallerstein, 1979).

Accordingly, food aid can be viewed as an economic development tool which may create incentive prices for farmers in the recipient country. Similarly, it can be examined as an external food supply shock which affects domestic food prices and consumers' incomes as well. Therefore, it is up to the LDCs' governments to determine their food pricing policies in order to achieve such policy objectives as earning foreign exchange, avoiding income depressing effects especially among the poorest consumption groups, and finally providing adequate producer incentives. Ideally, farmers (producers) will increase their output while getting closer to filling the gap of their food needs through the food aid programs (Bezuneh and Deaton, 1985).

Specific research which has been done by Hall analyzing the Brazilian case, consistent with the previous work of Maxwell and Singer, revealed that food aid donations had not caused producer disincentives in Brazil. Similarly, Stevens (1978) found no significant disincentives to agricultural production in Botswana, which has received more assistance per capita than any other country.

Likewise, the impact of food aid provided in the domestic market of a less developed country will be reflected in the producers' income changes due to food price changes, and finally upon the changes in food demand. Thus the crucial

problem that needs to be analyzed is that government policies must be maintained in order to protect incentive prices for farmers. Consequently, the estimation of the relative price changes, and the consumption implications from a specific foodstuff marketed in a less developed country under a food aid program is essential for designing a national (domestic) food policy for the recipient country. Additionally, research needs to be undertaken in order to analyze the actual assistance provided to the LDCs governments to establish price stabilization programs at national or local levels, in order to evaluate the significance of a specific food aid program in the country's market environment, and estimate the effects of food aid programs on national or local price movements (See also, Maxwell & Singer, 1979).

Food donor countries will be assured that food aid will not increase external food dependency of the LDCs, since the latter (LDCs) organize their own production and consumption patterns according to their resource endowments. In other words, proper LDCs' government policies can be effectively designed in order to avoid any production disincentive effects from the food aid programs (See also Deaton and Bezuneh, 1985). Moreover, recipient countries can substitute food aid for commercial food imports. Thereby, LDCs can increase their foreign exchange earnings through the food aid

programs, which in turn can be viewed as an alternative development tool. The tremendous need for food aid along with heavy external debt problems are concentrated mainly in the Sub-Saharan Africa (SSA). Therefore, it is useful to estimate the food aid impacts on the economic development of the SSA.

Likewise, the depletion of the LDCs foreign exchange reserves into food import expenditures will be a negative factor to the economic development programs, and the world food price variability will make these countries completely insecure in covering their food demands. Clearly, the lack of foreign exchange reserves and heavy debts are centered around the Sub-Saharan African (SSA) countries more than any other region in the world.

Most LDCs are characterized by an agricultural based economy. Consequently, the macroeconomic forces such as floating exchange rates, foreign exchange reserves, food pricing interrelationships, etc. will affect the patterns of economic development schemes of these less developed countries. The level of food aid donations will affect the nutritional status of different consumption groups which are also directly affected by government's food pricing policies. In this sense, food assistance programs are designed to have a significant impact mainly upon the low income con-

sumer groups by contributing to capital formation and increased food consumption through the changes in food supplies.

Increased food supplies, in turn, affect domestic food prices in the recipient LDC. The food price changes are of greatest importance for the lowest income groups participating in the food aid projects because they spend the larger amount of their income on food expenditures. Concurrently, the lowest income groups are accepted to be the targets of the food aid programs. The special aim of a food donor agency, then, is to address the food needs of the poor, and to provide the necessary assistance to improve farm income, to cover the nutritional needs of the people, and to eliminate yearly food production variability.

Recent research on the developmental role of food aid showed that FFW led to capital formation on own farms and to a higher level of food consumption for the poorest consumer group which received food aid. This was achieved through household income changes which reflected the direct impact of the market value of food aid received (Bezuneh and Deaton, 1985). In other words, participants in the food aid project (FFW) experienced significant income gains and savings (to a lesser extent). Additionally, the participants' consumption level increased due to the acquired food items

received as exchange for their labor provided to the project. The provided food items, in turn, reflected an income value for the participants assumed to correspond to the equivalent market value of the received food aid.

At a national level, food aid will increase the marketed food supply in the recipient country and will cause domestic price changes of complementary and substitute foodstuffs. In fact, the nutritional consequences of food aid and their correspondence to the food prices in the recipient country, along with the dynamic implications of food aid on economic development and long-run policies of the recipient countries have not yet been well documented (Deaton, 1985).

Market variability in food supplies characterizes many developing countries, and this food supply instability causes sharp changes in the domestic food prices. Sharp changes in domestic food prices happen only if the less developed country in question does not belong to the set of food aid recipients which engage in administered prices and other price controls which eliminate the extreme price fluctuations (to a certain degree). Consequently, rapid price rises affect the poorest groups, higher income groups, foreign exchange reserves, and finally commercial trade and the availability of domestic food supplies. Therefore, the specific problem for the economists and the policy makers is to de-

velop the ability to anticipate the net impacts of a short-run food supply shock (here in the specific form of food aid) on the consumer groups in a less developed country. Apart from this, the food supply shocks, domestic or in the form of foreign assistance (food aid), will affect the food prices among different foodstuffs in the LDC, as well.

In the context of these complex interrelationships the important question raised in this research regards the effectiveness of food aid for its nutritional contribution to needy people. In fact, there has been no attempt to measure adequately the actual impact of food aid on the level of malnutrition in the target population groups. Therefore, the linkage of food security to food aid and the nutritional implications of specific food programs, such as FFW projects, need to be analyzed. Thus, the effectiveness of food aid to food deficit countries will be identified. It must be clearly understood, though, that objectives other than nutrition and food security for the less developed countries have been major determinants of food aid allocations (See also Mellor, 1980).

2.4 CONCLUSIONS DRAWN FROM THE LITERATURE

A principal conclusion from the literature is that a serious cause of instability seems to be the LDCs' governments destabilizing trade policies with respect to food imports. Implicitly, the destabilizing trade policies led partially to the consideration of the trade liberalization schemes, the trade role of food aid, and the possible financial schemes which are discussed before as possible solutions to food security problem. The economic contraction of the early 1980s reduced capital flows and export earnings and created a financial crisis in the LDCs, especially in Sub-Saharan Africa.

The economic recession along with the political instability in these countries resulted in sharp reductions in food and fiber consumption and food trade. The resulting mismanagement of food imports affects domestic food security in any sense. Research proved that the establishment of a world financial facility in order to assist LDCs to pay for higher than normal import bills would be the most preferable and effective measure to insure food security (Reutlinger, 1978, 1979, Konandreas, Huddleston, and Ramangkura, IFPRI, 1978). Empirical evidence (Konandreas et al., 1978) showed that to stabilize the international foodgrain price via buffer stock operations is an expensive task. The expected risks and fi-

nancial costs of an international buffer stock scheme prevent an international agreement on this issue. In the end, it seems that national development policies depending on agricultural investment (by restructuring the domestic production patterns) may be the most effective alternative solution to food security (See also Sarris, 1985).

An international financial scheme which will be funded by developed and developing countries together, can sufficiently assist LDCs to pay for unexpected food import requirements (Reutlinger, 1978). Additionally, since LDCs face a dangerous foreign debt at this time, the relation of international financial insurance schemes, as in the form of the World Bank, will provide guidance and assistance to LDCs to overcome their debts. The latter may be done by investing in their (LDCs) large agricultural sector. This world financial insurance, even though promising, is facing obstacles of political will, national interests, conflicts among developed countries, and national trade barriers. Thus, the implementation of such a scheme is to be considered along with other international trade agreements (GATT, etc.).

It is in the LDCs of Sub-Saharan Africa where population growth is rapid and where consumption response to income increases is great, that food import growth will be most important. Whether this region can sustain the essential food

trade without very large amounts of outside assistance will be a very important issue through the decade. Issues about food reserves, stockholdings and possible alternative international financial schemes in order to assist LDCs' economic development will be raised throughout the 1980s.

In LDCs higher priority should be assigned to increasing national agricultural investment and the rate of development. Given each specific country's resource endowments and the world agricultural price fluctuations, a course of optimal agricultural development could depend on the readjustment of the domestic agricultural production structures (Sarris, 1985). This development strategy will assist LDCs to increase their agricultural productivity. Thus, it is possible for the LDCs to obtain a more stable food efficiency. Meanwhile, food aid may play a significant role in cases of unexpected food shortages in the short-run.

It is evident, though, that considerations of poor consumers' needs do not always dominate in food aid allocations (Schneider, 1984). Food aid supplies to Bangladesh, for example, were cut back for political reasons in 1974, a period in which the country was faced with a serious food shortage (Schneider, 1984). The hard lesson of this experience was that food aid supplies cannot be absolutely relied upon by recipients. Likewise, similar evidence is available with

respect to Canadian food aid where political considerations also prevail over LDCs' requirements (Schneider, 1984).

On the other hand, it is clear that even though food aid has been used as a political lever, and there is a lot of agreement on that, it is by any means of great value to consumers who actually receive such food. This reasoning leads to the conclusion that the estimation of the short-run food supply shocks (rather than a long-run food supply shock) is more realistic and appropriate for analysis. At the same time, much less emphasis has been placed in previous research on the consumption and nutrition effects of food aid. Thus, the linkages of food aid and food security in the short-run are still to be explained.

While further empirical research is obviously needed, the elements presented so far help explain the complexity of the food security phenomenon.

Chapter III

ECONOMIC ENVIRONMENT OF THE STUDIED AREA

3.1 INTRODUCTION

The presentation of the economic characteristics of the studied area is very necessary in order to understand the implications of the introduced Food-For-Work (FFW) program. The interest of this research is centered around the consumption (nutritional) analysis of the participant households' behavior in the specific FFW program. Consequently, an attempt is made to understand the structural consumption patterns of the participants in the FFW program. This chapter will be divided in several sections. First, an indication of the natural environment and population is given. Second, data on production activities, labor characteristics, and consumption patterns of the farmers are presented. Third, the implementation of the FFW program in Kenya, along with its operational techniques is explained.

The main objective of this chapter is to provide a detailed explanation of the economic results and findings from previous research on the FFW programs in Kenya.[1]

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[1] This section summarizes the economic characteristics of the area in rural Kenya, and represents a brief presentation of an extensive work on the topic previously done by Bezuneh (1985).

3.2 NATURAL ENVIRONMENTAL CHARACTERISTICS OF THE BARINGO DISTRICT

The studied area is located in East Africa and is the Baringo District in the Rift Valley province of rural Kenya. Figure 2.1 provides the provincial and District boundaries of Kenya, along with the Baringo District location. Figure 2.2 provides the Baringo District separately. The research area is shown by a circle in this Figure (2.2). The total population size of the Baringo District which is one of the largest (9,885 sq. km.) of the whole country was 203,792 in 1979 reports.

About 93 percent of the total regional population is residing in the rural part of the district, while the rest 7 percent lives in the township areas of Eldama Ravine, Kabarnet, Marigat, and three small trading centers. The total number of households in the rural part of the Baringo district was 39,645 with an average family size of 4.76. There were about 2.87 ha. of cultivable agricultural land per person in 1979. Thirty five percent of the district area is characterized as semi-arid and is classified as a livestock-sorghum and livestock-millet producing zone.

Additionally, 15 percent of the district is sub-arid and is classified as a maize-sunflower zone. More detailed characteristics can be found in the recent works of Bezuneh (1985) and previously by Troll (1966). Clearly, the Baringo

district is characterized as a "big-but-poor" district of the rural Kenyan zone where Finger Millet, Sorghum, and Maize are normally grown. Efforts to improve the semi-arid portion of the district area are included in the Perkerra Marigat Irrigation Scheme, the Baringo Semi-Arid Area Project (BSAAP) and the Marginal Land Research Station in Marigat. The researched area constitutes Marigat and Ewalel locations with Tugens residents being the local ethnic group. There are 1030 households with a mean family size of 4.44 (See also Bezuneh, 1985).

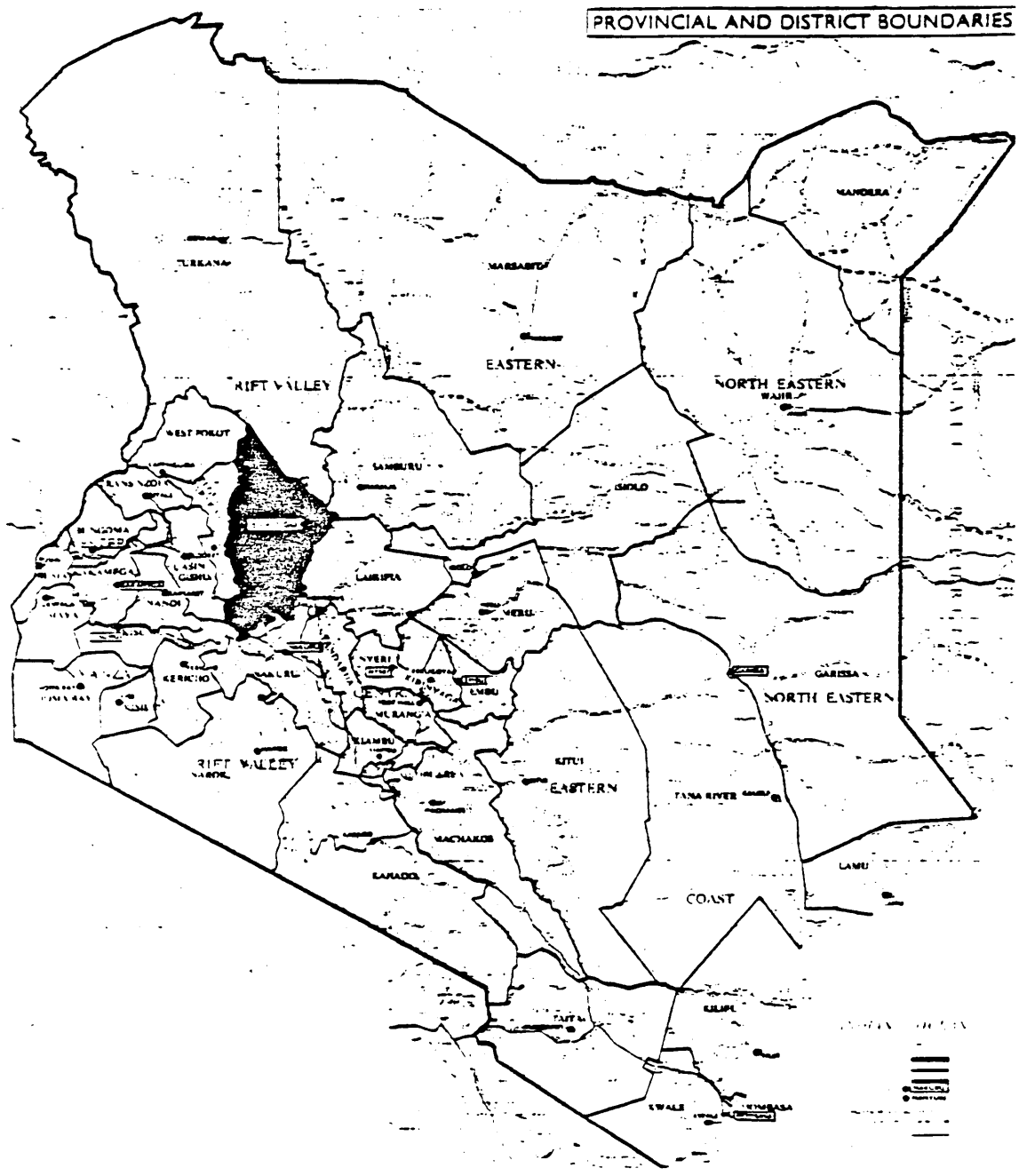

FIGURE 2.1

MAP OF KENYA AND THE BARINGO DISTRICT

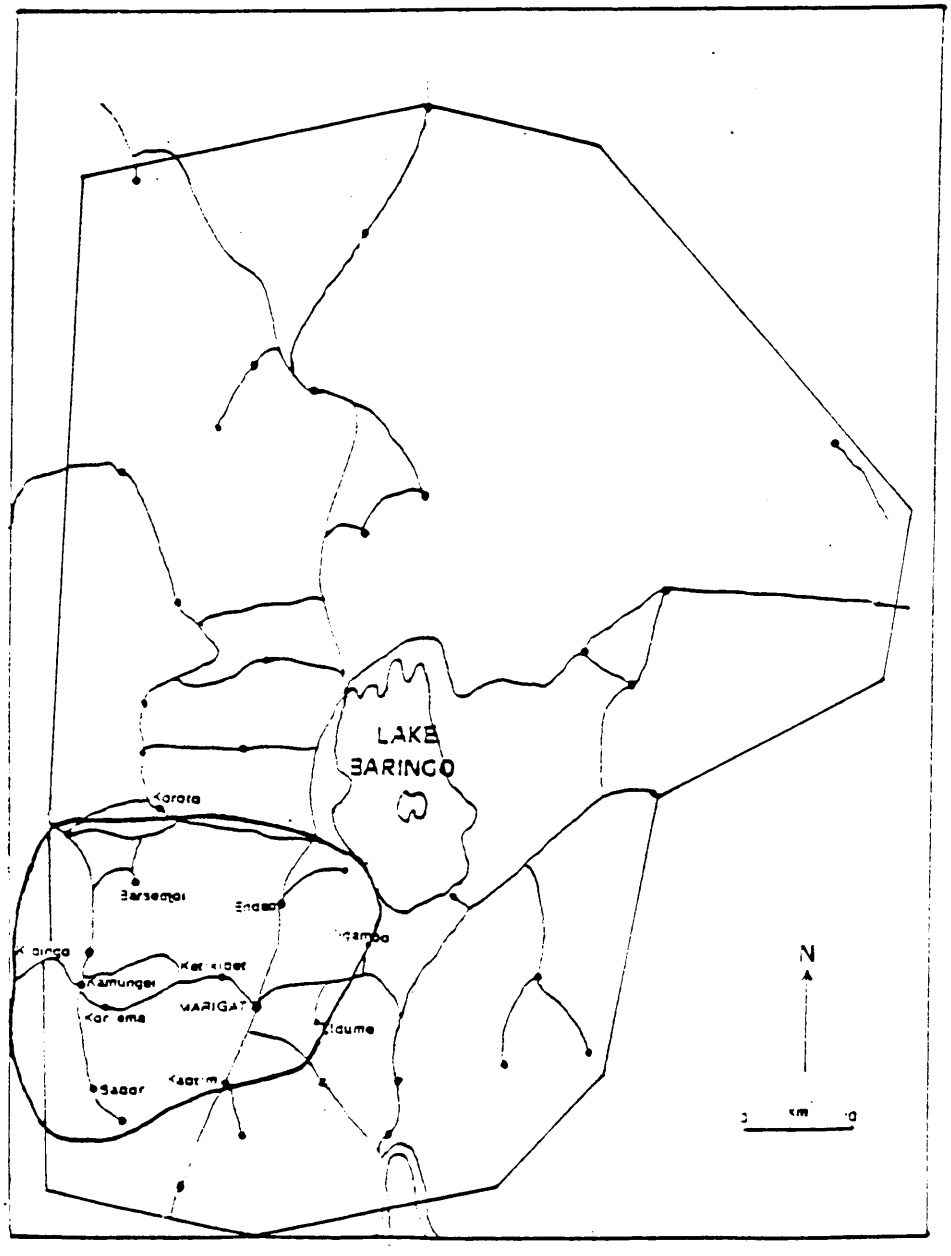

FIGURE 2.2

BARINGO PILOT SEMI-ARID AREA PROJECT (BPSAAP)

3.3 PRODUCTION ACTIVITIES, LABOR AND CONSUMPTION PATTERNS

Traditional production activities with a single production season characterize the research area. An estimate of the mean farm size gave results of about 2.23 ha. (Bezuneh, 1985). A few landless households were found in this area. Livestock represent the main economic activity of the people in the surveyed area.

Goats are considered as a source of continuous income, while the recent survey of 300 households shows that about 2.68 households kept a total of 7776 goats. This estimate gives a number of 14 goats per household compared with an average of 14 sheep and 10 cattle per household. From the nutritional standpoint there is excess milk from goats for human consumption. The basic motive of production is the coverage of the subsistence family needs.

Table 3.1 describes the harvesting, consumption, and selling patterns of the total sample households, FFW participants and non-FFW participants. Additional details on the purchased food products and the expenditures by food items are presented in table 3.2. Kenya is characterized by two marketing channels, a formal and an informal, both of which affect the marketing behavior of the local producers. Specifically, the formal market is controlled by export marketing-boards or other agencies that purchase for domestic dis-

tribution. This formal channel operates for the large scale commercial farmers. The informal market represents the "free market" channel which operates for the traditional small farmers' surpluses. Additional details can be found in the works of Bezuneh (1985) and Singh and Squire (1983).

The producers of the studied area belong to the informal market structure. This "free local market" provides a free market price system faced by the regional farmers. This local free market price may be lower or higher than the formal market price which is being set by the government as a "floor price". The marketed surpluses of the farmers in the studied area have been moved through the informal market channels. Local farmers of the area derive the major portion of their income through their own-farm activities (crops and livestock). For these farmers the main source of income (for about 72 percent) is the own production of livestock. Clearly, the other 28 percent of income comes from own crops production and wage-employment. The labor demand for the own-crops production peaks in March when maize, millet, and sorghum are being planted.

The elements presented so far and a review of several research works being done in the region (Bezuneh, 1985; Little, 1981) provide the following concrete evidence:

1. Own crop and livestock activities are the basic income-generating production activities of the

TABLE 3.1

Crops: Harvested, Consumed, and Sold Quantities (kgr.)

Crops	HARVEST Number of Households.	HARVEST Quantity/ Household.	CONSUMPTION Number of Households.	CONSUMPTION Quantity/ Household.	SELLING Number of Households.	SELLING Quantity/ Household.	Price/ unit*	Average Income (KSHS).
		(A) TOTAL SAMPLE HOUSEHOLDS						
Maize	201	343.12	197	117.39	86	244.97	2.05	502.19
Millet	226	191.95	205	75.58	71	125.07	3.75	469.01
Sorghum	153	108.19	110	54.13	12	168.13	2.45	411.92
Other Crops	181	228.25	159	46.45	73	385.00	5.09	1959.65
		(B) FFW-PARTICIPANTS						
Maize	70	316.00	70	108.31	34	206.57	1.88	388.35
Millet	73	153.00	72	63.41	25	137.10	3.70	507.27
Sorghum	54	81.27	49	42.58	6	122.50	2.96	362.60
Other Crops	57	104.07	57	44.08	20	90.68	3.34	302.87
		(C) NON-FFW-PARTICIPANTS						
Maize	131	376.30	127	128.24	52	285.85	2.12	606.00
Millet	153	209.12	133	80.84	46	120.13	3.81	457.70
Sorghum	99	117.23	61	56.37	6	252.00	2.11	531.72
Other Crops	124	302.72	102	48.52	53	530.61	5.90	3130.60

*Price figures represent Kenyan shillings (KSHS).
Source: Bezuneh, 1985.

TABLE 3.2

Food Products Purchased and Food Items Expenditures

(A) TOTAL SAMPLE HOUSEHOLDS

ITEMS	Number of Households	Quantity (kgr.)	Expenditure (KSHS)
Maize	159	42.75	81.00
Millet	132	16.31	62.70
Beans/ Sorghum.	289	11.00	50.70
Other non-Meat/& Dairy.	289	86.23	157.90
Meat/Dairy Products.	281	19.15	200.50
Non-food.	300	N/A	1144.00
(B) FFW-PARTICIPANTS			
Maize	40	46.10	81.50
Millet	32	78.16	80.00
Beans/ Sorghum.	92	9.17	46.60
Other non-Meat/& Dairy.	92	117.70	170.00
Meat/Dairy Products.	93	13.50	168.50
Non-food.	100	N/A	1261.40
(C) NON-FFW-PARTICIPANTS			
Maize	119	41.62	81.00
Millet	70	16.31	62.70
Beans/ Sorghum.	197	11.81	52.65
Other non-Meat/& Dairy.	197	71.53	152.50
Meat/Dairy Products.	188	22.00	216.30
Non-food.	200	N/A	1028.40

N/A=Not Applicable.
Source: Bezuneh, 1985.

farmers in the district.

2. Households are participants as sellers and/or buyers in the local market for farm products and labor.
3. Partial household income is generated from cash-wage-employment.

3.4 FOOD FOR WORK (FFW) KENYAN PROGRAM

The major developmental project in the region of our interest is the Baringo Pilot Semi-Arid Area Project (BPSAAP). This project is a World Bank one that started in the early 1980s (World Bank Report No. 7635-KE, 1979). The Baringo Semi-Arid Area Project (BSAAP) contributed to the former by ensuring that nutrition requirements are incorporated within the overall planning process of the BPSAAP (See also Bezuneh, 1985; Kwofie, 1983). The BPSAAP is an integrated rural development project (Bezuneh, 1985; Lewis, 1983) which is coordinated in the Marigat town area. The pilot-study project, as its name indicates, was designed as a field tested project for regional developmental purposes. The results from this pilot research are expected to be integrated into an overall development policy for the semi-arid areas of the

country (Kenya) beginning in 1984. Labor being the most abundant and available resource in the area, labor intensive techniques were considered as the essential basis for the activities and the implementation of the program (World Bank, 1980). The whole project activities are coordinated by the Ministry of Agriculture and Livestock Development of Kenya.

The structural characteristics of the project include : soil and water conservation, crop development, livestock and range development, water development, social service and community development, education, health, and forestry. The project area is around 5,000 sq.km. which is approximately 40 percent of the Baringo district. More detailed discussions about the several components of the project itself can be found in Bezuneh, 1985; and BPSAAP, Work Plans and Budget, 1983/84, December 1982.

Additionally, the World Food Program (WFP) in Kenya provides maize, beans, and vegetable oil as the basic food products. Among the above items, maize and beans are purchased by the WFP from Kenya, while the vegetable oil is imported. Details concerning the WFP participation in Kenya can be found in recent works as the Summary of WFP Current Projects in Kenya (May, 1982). The Food For Work (FFW) project within the BPSAAP is a World Food Program (WFP) supported rural-de-

velopment project identified as the "Baringo Soil and Water Conservation Project". The project is designed to utilize 800 workers per month within the BPSAAP program by paying food items for their participants' labor. Crop production, soil and water conservation activities that have been affected by national (Kenyan) treasury budget cutbacks were supported by the WFP contributions (FFW).

The previously mentioned food items (maize, beans and vegetable oil) are made available to the project through the National Cereals and Produce Board in Nakuru which is the nearest store to the BPSAAP region. Sixty nine (69) percent of maize, fifty eight (58) percent of beans, and forty nine (49) percent of vegetable oil had been utilized by food for work participants in the study area, while the food for work activities are found to be spread throughout the year (Bezuneh, 1985). Every participant worker received maize, beans, and vegetable oil for a family size of five persons for a month in the proportion of : 45 kgr. of maize, 4 kgr. of beans, and 1.5 kgr. of vegetable oil. In daily proportions, the analogy was 2.25 kgr. of maize, 0.2 kgr. of beans, and 0.075 kgr. of vegetable oil.

Table 3.3 shows the average food receipt for the study period as food items per month and the equivalent income generated. The criterion for the FFW project participation

was the "first come-first serve" approach based on the belief that FFW activities will depend upon the residual labor force which was not engaged in any own activities or in any kind of wage earning activities at the participation time.

In order to specify the economic characteristics of the FFW project, the following factors were considered:

1. Households' characteristics.
2. Average size of land holdings.
3. Average number of livestock holdings.
4. Production activities.
5. Purchasing activities.
6. Income and labor productivity.

Depending upon the above factors, research showed the following results as the characteristics of participants (Bezuneh, 1985):

1. The average harvest of the participant households is less than the average harvest of the non-participant households for all crops.
2. The average consumption from own production, and income generated from crop activities is significantly lower for participant households.
3. The total average purchase for all food items for participants is 265 kgr., while the equivalent items for non-participants is 163 kgr.

TABLE 3.3

AVERAGE FOOD RECEIPTS AND GENERATED INCOME FROM FFW

ITEMS BY MONTH

Month	Maize (kgr.)	Beans (kgr.)	Oil (kgr.)	Income-Equivalence. (KSHS)*
JAN.	112.5	10.0	3.7	274.70
FEB.	137.2	12.2	4.6	335.60
MAR.	175.5	15.6	5.8	428.70
APR.	177.7	15.8	5.9	434.20
MAY	184.5	16.4	6.1	450.70
JUNE	157.5	14.0	5.2	384.70
JULY	175.5	15.6	5.8	428.70
AUG.	182.2	16.2	6.1	445.60
SEPT.	180.0	16.0	6.0	440.00
OCT.	168.7	15.0	5.6	412.20
NOV.	85.5	7.6	2.8	208.70
DEC.	72.0	6.4	2.4	176.00
TOTAL	1808.8	160.8	60.0	4419.80

*While converting food receipts into income, maize was evaluated at 1.85, beans at 4.25, and vegetable oil at 6.50 KSHS. per unit.

Source: Bezuneh, 1985.

4. Livestock activity represents the major source of income for the participant households (79%), and crop activity represents the least source of income (9%). Consequently, wage-employment contributed 12 % of the total household income. On the other hand, livestock was also the major income source (65%) for the non-participants, and crop production represents 19 percent of their income Wage-employment for the non-participants was 16 percent.
5. Finally, and most important, participants have less income (excluding FFW income) than non-participants.

Maize and beans represent important parts of the local diet of the people. Maize is locally produced, while beans are purchased from the Marigat center. At the same time, the Ministry of Health along with the Ministry of Culture and Social Service provided useful information on how to use vegetable oil and what the nutritional benefits of using it are. Therefore, the vegetable oil consumption was not a problem, in any sense, to the local consumers' preferences since it did not diversify domestic tastes away from the locally produced items (such as maize). Consequently, vegeta-

ble oil contributed positively to the diet of the poorest consumers. Recent research (Bezuneh, 1985) showed that 73 percent of the participant households in the FFW program consumed the whole quantity of the food items. Fifteen percent changed it for other foodstuffs, while only 12 percent of the participant households sold some quantity of the received food aid.

Chapter IV

CONCEPTUAL ANALYSIS AND RESEARCH PROCEDURE

4.1 INTRODUCTION

This study is concerned, primarily, with the identification of the nutritional impacts of food aid/FFW programs on FFW participant households in rural Kenya. The ultimate goal is to explore the nutritional (consumption) and food pricing relationships between the domestically consumed (and produced) foodstuffs and the FFW goods provided through the food aid program. The food policy linkages among the consumption (nutritional) patterns of the participant households and the implications of the food aid/FFW program on domestic food security (from the nutritional standpoint) will be clarified. Consequently, it is imperative to analyze micro-data relating to consumption behavior of participant households.

The specific reasons for selecting Sub-Saharan Africa, and Kenya especially, as the focus of this research are the following:

1. First, Sub-Saharan Africa faces tremendous food deficit problems, chronic malnutrition, and rising food aid requirements.

2. Second, and equally important, specific research results from recent work (Bezuneh, 1985) referring to the production and consumption characteristics of the participant households in the FFW project in rural Kenya are available. Therefore, the nutritional and food pricing analysis of the food aid/FFW implications at the household level is considered as the next necessary step. The reason for the latter step is to understand what the exogenous food aid "injection" means to the nutritional status of the participant households and to determine the policy implications for the Kenyan food programs.
3. Third, recent micro-data on consumption behavior of participant households in the food aid/FFW program are available. The latter reason is also important, because data on FFW consumption behavior are indeed very limited. Significantly, lack of the necessary data base has been the scientific bottleneck in determining the consumption (nutrition) parameters.

In this chapter, a conceptual analysis of the economic reasoning behind this research is developed, and a theoretical model is described.

4.2 THE ANALYTICAL FRAMEWORK

4.2.1 Introductory Setting

Research on the Indian case showed that a 10 % increase in food grain prices reduced the expenditure on food grains by 5.9 %, and the consumption by 6.6 % of the bottom two income deciles (Mellor, 1980). Similarly, a 10 % increase in food grain prices caused a reduction in the consumption of milk and milk products by 33 % in the two lowest income deciles. The nutritional consequences of food aid allocations on the low income consumers include, first, a possible significant reduction of the caloric intake; second, foods of lower quality in nutrient values may be substituted for those of higher nutritional value. Generally, the greatest amount of adjustment to reduced food grain supplies is made by low income consumers. Thus, food aid by providing food products in the recipient country is expected to affect substantially participants' income, consumption, and the nutritional status of the low income consumers.

Mellor (1980) raises two questions on the nutritional topics that this research is concerned with. The first question is to consider if we can narrow down the food aid intervention to those targeted groups being nutritionally at-risk. A second question is whether a particular food aid intervention can indeed increase the nutritional impacts

(benefits) to the poorest people. Mellor (1980) concludes that even though several ways exist to reach the poor (food subsidy schemes, food stamps, etc.), in practice food aid has been inefficient in reaching nutrition based objectives. Nevertheless, one logical and realistic approach in order to focus total benefits (such as nutrition and income streams) on the poorest consumers is to use specific FFW programs. The approach of examining food-for-work under a clearly nutritional-economic perspective (in this research) is due to the fact that FFW represents one of the most narrowly targeted nutrition and development programs.

In order for the food aid programs to be nutritionally effective and satisfactory, several distinct points should be considered as necessary in the food aid programming process. These points include (See also S. Lane, 1980; p.982):

1. More food aid should reach the poor.
2. Food aid should indeed provide ..."financial resources that would allow a subsidized consumer price and a considerably higher producer price".
3. For food aid to contribute significantly to improved nutritional status, .."it must be reliable, and must counter domestic supply fluctuations".
4. "Since holding domestic stocks is extremely expensive, trade can be a cost-effective means of dealing

with production fluctuations. Consequently, food aid can encourage intervention programs which facilitate substantial nutritional impacts".

5. "In case of domestically controlled markets, food aid can be distributed through separate channels, farm prices can be supported, ...and funds from government sale of the food commodities can be used in agricultural development programs".
6. Food-for-work can be viewed as one of the most important food aid contributions, since it can be used for infrastructure, and development programs by increasing the agricultural output, and contributing to farmers' nutrition.

Conclusively, food aid, and food for work especially, can indeed have a positive effect on the nutritional status of the malnourished, if it is handled properly.

4.2.2 The Economic Reasoning

In Sub-Saharan Africa an increased food self-reliance became a national objective. At the same time, these countries (SSA) seem to depend on high food aid donations in order to handle their severe food security problems (Christensen and Witucki, 1982). On the other hand, even though African governments realize that food issues represent the most emerg-

ing problem, still the actual linkages between policy instruments and producer's-consumer's behavior are topics which need further analysis for the benefit of the SSA countries.

While it is evident that farmers respond to producer price incentives (Deaton and Bezuneh, 1985), other factors are also essential including meeting subsistence consumption and nutritional needs. There are significant interactions among the mentioned factors and the policy instruments, government development programs, food price policies, and national food efficiency. This research is focusing on the implications of the food aid programs for the nutritional status of the participant households in rural Kenya. The linkages among food aid, its nutritional (and consumption) implications on the participants' diets, and the objective of achieving food security conditions in rural kenya will be investigated.

FFW proved to have a positive effect on income in our research area by first contributing to meeting the basic nutrient requirements and diet needs (which in turn lead to increased market surplus), and second by relaxing the capital constraint (Bezuneh, 1985). Real income gains are expected to result in greater quantity and higher quality of the consumed food. The quality factor of the nutritional character-

istics of the consumed food products through the FFW project are to be examined. Along these lines, the research question which leads the conceptual analysis can be addressed as : "What is the effect of increased food supplies, through the FFW project, and the corresponding changes in food prices, on food consumption and the nutritional status of the low-income people?". Therefore, the conceptual analysis of this chapter refers to the economic reasoning behind the nutritional concepts of the FFW projects. Concurrently, this section serves the purpose of summarizing the several economic factors affecting the nutritional concepts of the FFW projects. Consequently, the economic reasoning presented here, leads to the next section of the theoretical model identification which integrates the conceptual setting of the analysis followed in this thesis.

4.3 THE THEORETICAL (NON-MATHEMATICAL) MODEL PRESENTATION

In the analytical modeling the household unit represents the centerpiece of interest. While dealing with semi-subsistence farm households, it is assumed that each household minimizes its total expenditure on food commodities necessary to obtain the levels of food nutrients actually consumed. Households are also assumed to maximize their utility by allocating their monetary budgets (total food expendi-

tures) subject to nutrient constraints. Implicitly, it is accepted that farmers are allocating their available resources reacting as rational utility maximizing consumers. FFW is viewed as a means to expand the opportunity set of the participant households in terms of consumption preferences. In other words, since participants are paid in food in exchange for their provided labor, the FFW program expands the number of consumption (nutritional) preferences available to the participant households. Thus, it is implied that the FFW activities (food products exchanged for labor services) will affect the consumption behavior of the participants and, consequently, affect the nutritional status of the people. Therefore, each participant household's consumption decisions (and nutritional condition) are based on the specific budget constraints that they face, and the food preferences that they have. Assuming that the participants are indifferent between being paid in food and being paid in cash, they will minimize their total food expenditures while consuming the preferred amount of food. Obviously, the particular food amount that each household consumes corresponds to a specific amount of nutrients.

It is also assumed that the participant household's utility is a function of consumption of the own produced agricultural outputs, consumption of the market goods, and con-

sumption of food obtained from participating in the specific FFW programs. The model that will be used is a one production-consumption period (one agricultural season, short-run) model. Implicitly, households are assumed to function under certainty and rationality in preferences, participating in a market environment condition. Consequently, a theoretical approach of the household's utility condition can be defined as follows:

$$U=U(OC_i, CM_i, CF_i, CP_i, CL_i) \text{ where:}$$

U= utility of each individual household.

OC_i= consumption of own agricultural outputs.

CM_i= consumption of non-food market goods.

CF_i= consumption of food from FFW project.

CP_i= consumption of purchased food items.

CL_i= consumption of leisure.

This utility maximization condition will be specifically transformed into a nutrient equivalence approach (See also Lancaster, 1971) in the following chapter of the empirical analytical presentation.

In this study of household consumption (nutritional status), price data were collected simultaneously with the corresponding consumption data. But, at the same time, the available consumption data refer to only one time period. Additionally, it is assumed that, given the budget available

for food expenditure, each participant household will consume food in such a way as to minimize the cost of the food (actually, nutrient equivalence) which is, in fact, consumed through own-produced food items, marketed goods, and preferred FFW foods (beans, maize, and vegetable oil).

Thus, food cost will include the price actually paid for the purchased market food plus the opportunity cost of home grown food consumed, along with the FFW items actually consumed. Consequently, it is assumed that participant households adjust their market basket of foods consumed according to their real income (including FFW income), and the cost of food available to them. Therefore, they behave in a rational and efficient manner by buying the cheapest bundle of food commodities which will provide them the specific nutrient combinations that they indeed consume. The cornerstone of the "first step" estimation procedure will be a set of linear mathematical programs and this "step" is thoroughly explained in the next chapter. The shadow price (marginal cost) of each nutrient type consumed by each household unit can be determined by the following data sets:

(1) Observed food prices, including opportunity costs of own produced and consumed food, along with FFW foods.

(2) Food quantities consumed.

(3) Technical coefficients which show the amount

of each nutrient per unit in each food type actually consumed by the participant household.

By using these household data sets, one can estimate the various demand elasticities for the corresponding nutrients. Estimating the demand elasticities for each nutrient directly, rather than observing the estimates on a commodity by commodity basis has a set of advantages (See also, Foster 1978):

1. Every major nutrient is consumed by all participant households in the survey period. This specification (LP model) avoids the serious econometric problem of blanks in the data sets.
2. The conventional food commodity demand approach of calculating the demand elasticities on a commodity basis is inappropriate to be used in the case of a new food commodity (vegetable oil, in our case) being introduced. This happens because with a new commodity the available consumption data may not exist.
3. If the number of nutrients being examined is less than the number of the commodities actually consumed, the LP model for the nutrient analysis is very efficient in terms of time and computer facilities.

4. We avoid the unnecessary (in this case) intermediate step of first estimating the commodity consumption responses, and then converting the commodity consumption responses into nutritional equivalence. Thus, we can estimate the desired values directly. In doing so, we can solve the problem directly and sufficiently.
5. Price differentials associated with different types (qualities, etc.) of food items consumed, and blanks in the available data will be avoided. The estimation will be targeted on the nutrient analysis, and not on the commodity by commodity comparisons.

While these advantages of using an 'LP' model approach are encouraging in order to estimate the demand for nutrients, more detailed mathematical definitions are obviously needed. Accordingly, the next chapter serves the purpose of describing the detailed mathematical definitions (LP models) which are used in this research. The following 'second step' after estimating the optimal nutrient shadow prices through the 'LP' models is to implement an econometric approach according to consumption theory for the nutrient quantities (See also, Lancaster, 1971, Ladd and Suvannunt, 1976). According to Lancaster's theory, each household's demand for several food products is a function of the implicit demand

for each product's characteristics (here, nutrient values). While this statement represents the core of the "non-traditional" consumer approach of Lancaster's work, more specifications on his theoretical definitions are needed. The directly following section refers to the latter reasoning.

4.4 DEPENDENCIES ON LANCASTER'S APPROACH TO CONSUMER THEORY

By using the term "dependencies" it is meant that this research derives some essential ideas in its theoretical background directly from the Lancaster's "New Approach To Consumer Theory". These useful ideas, as an extension to the fundamentals of the consumption theory, helped conceptually in the model specification which is used in this thesis. Along these lines, it is thought that making a reference on the "non-traditional" consumption theory is a necessity. At the same time, it is obvious that only specific "segments" of the main theoretical body of Lancaster's approach will be presented. The single reason behind the simplification of the material presented here is that describing the whole body of this consumption approach requires a different research by itself.

Accordingly, Lancaster (1966, 1971) refers to the "intrinsic" properties of the particular goods as the specific quality variations which characterize these goods from which

utility is derived. Traditional consumption theory has nothing to say on these goods' quality variations or, simply, goods' characteristics. In this sense, "...utility or preference orderings are assumed to rank collections of characteristics, ...while the consumption of several goods provides an output as a collection of goods' characteristics" (Lancaster, 1966; p. 133).

In this research, the specific goods' characteristics are assumed to be the nutrients that food products possess. This crucial assumption is realistic enough, if we consider that semi-subsistence peasant households will be interested in their available food having an "amount" of valuable nutrients. In simple words, the available food products to the participant households will possess some significant nutritional value, so that households do not consume food for nothing.

The 'breakthrough' assumptions that Lancaster proposes are in contrast to the classical consumption theory. These assumptions are indeed in direct agreement with the conceptual setting of this research. They are the following ones (Lancaster, 1966; p. 134):

1. "The good, per se, does not give utility to the consumer; it possesses characteristics, and these characteristics give rise to utility".

2. "In general, a good possess more than one characteristic, and many characteristics will be shared by more than one good".
3. "Goods in combination may possess characteristics different from those pertaining to the goods separately" (Lancaster, 1966; p. 134).

These assumptions come as a scientific and detailed "new approach" to the consumer theory. Since the above assumptions are clearly understood, one can easily see that the "classical" consumption theory exposes its weaknesses. One of the main weaknesses is when the classical theory tries to operationalize the predicting process of the relationship between consumer's preferences before and after the change of consumer's taste (See Lancaster, 1966).

Modeling the consumer behavior, Lancaster (1966; p. 135-137) assumes that "...the relationship between the level of activity A, x_A, and the goods consumed in that activity to be both linear and objective" (Lancaster, 1966; p. 135). Hence, for y_j being the jth commodity, we get:

$$y_j = \sum_A a_{jA} x_A ,$$

while, the vector of total goods, which is required for a given activity vector is defined as:

$$y = Ex$$

Assuming that each consumption activity produces a fixed vector of goods' characteristics, the linear relationship holds again for simplicity. Clearly, relaxing of the specific assumptions of linearity may be treated as a case of model extension; while, the model's flexibility allows easily for such extensions. Indeed, if c_i is the amount of the ith characteristic, then

$$c_i = \sum_A b_{iA} x_A,$$

$$c = Tx$$

Lancaster also assumes that each individual will choose a consumption situation which maximizes U(c) with the ordinary properties of the known utility function (classical theory). The author defines E, T, as the consumption technology matrixes, as stated in the above equations.

Simplifying the model, and supposing a one-to-one correspondence between goods and activities (as collection of goods), Lancaster proposes a model of the form (Lancaster, 1966; p. 136):

Maximize	U(c)
subject to	py <= k
with	c= Ty
	c, y >= 0.

As one can see, U is defined on characteristics space (C-space); while, the equation system c= Ty represents a transformation between goods space (G- space) and (C- space). In addition, we see that the budget constraint py <= k is defined on goods space (G- space). The case of the complex mathematical derivations of the utility spaces and utility transformations is indeed interesting. But, since it is considered as a special section of interest to the consumption analysts, it will not be described here.

Again, for purposes of clarification, Lancaster defines the two choices that we have while dealing with the latter utility maximization model.

1. "We may either transform the utility function into G-space, and relate it to the budget constraint, or..."
2. "We can transform the budget constraint into C- space and relate it to the utility function U(c)" (Lancaster, 1966; p. 137).

Finally, given a price vector and the characteristics vector, the consumer will choose the most efficient combination of goods in order to achieve the desired collection of characteristics (in our case, nutrients). Along the consumer's decision, the criterion of the efficiency condition will be the minimum cost (food expenditure), (Lancaster, 1966; p. 139). Accepting a c^* vector of characteristics,

the linear program that we get for the efficiency condition will be as follows:

$$\begin{aligned} &\text{Minimize} && py \\ &\text{subject to} && Ty = c^{*} \\ & && y \geq 0. \end{aligned}$$

Now, given the case of a new product (such as vegetable oil from FFW, in our case), where we do not have any consumption (demand) data along a long period of time (years), new activities (in terms of a new individual good) are added to the consumers consumption. Hence, we need to simply add this new one (or probably, more) activities in the consumption technology. This is exactly the case of vegetable oil in this research, where for a new commodity such as this one we do not have any available long-run data. This data condition creates serious problems if we want to apply an econometric approach in the demand analysis as the "first-step" of the empirical procedure. Detailed explanations on this topic are presented in the following chapter, where the empirical steps of the analysis are exposed.

Lancaster's consumption approach does not end here. It goes into the analysis of areas such as consumer durables, assets and money, general equilibrium and welfare considerations, etc. all clearly available to interested researchers

(Lancaster, 1966, 1971). The elements of the "new consumer approach" are incorporated into the linear programming modeling, which is analytically explained in the following chapter on the empirical setting.

Based on Lancaster's characteristics theory approach, household utility is assumed to be a function of total quantities of product attributes (nutrients) actually consumed. The product attributes (nutrients) are derived from the quantities of the several foods consumed via the linear programming model 'LPM' specification through the use of a set of technical coefficients (See next chapter for empirical definitions). Through the linear programming procedure, the estimation of the resulting marginal shadow prices of the products' attributes is amenable. Accordingly, allowing for the consumers' preference structures to vary among the participant peasant households, the quantities demanded for the specific attributes (nutrients) would be affected by the implicit prices of product characteristics, household income, and household demographic variables.

Briefly and precisely, the characteristics approach is based, as we have seen so far, upon the idea of obtaining a set of characteristics variables that explains the differences in the products' prices. This fundamental idea leads to the specification of a set of equations which can be es-

timated via standard econometric techniques, where the actual product characteristics (nutrients, here) are regressed on characteristics' prices. Along these lines, each coefficient (estimated through the above regression procedure) can be interpreted as an estimate of the marginal implicit (shadow) price that the Kenyan consumer is willing to pay for an additional unit of the respective good's characteristic while minimizing his total food expenditures. Hence, the implicit marginal (shadow) price for each specific nutritional attribute (characteristic) is to be obtained for the participant households, by using all food actually consumed in a month. These estimates then are to be entered as the independent variables along with households' total income from all sources, and demographic variables, into the household demand for the nutritional attributes' equations (See also, Ladd and Suvannunt, 1976).

Therefore, the leading idea of this analysis is that household's total demand for each specific nutrient actually consumed can be formulated as a function of the implicit marginal prices of other nutrients, total income from all sources, and specific demographic household's characteristics. It is the acquisition of the nutrients which gives value to the food demanded and motivates consumers. As it was mentioned before, the marginal nutrient (shadow) prices will

be estimated through the Linear Programming approach, at the "first step" of the empirical procedure.

4.5 CONCEPTUAL SETTING SUMMARY

Summarizing the main points of the Lancaster's consumer approach we see that:

1. The ultimate proposition is that goods can be treated as the subject of what consumers would like more of. Thus, "goods are what are thought of as goods" (Lancaster, 1966; p. 132).
2. Goods possess multiple characteristics in specific proportions. Consumer's preferences depend on these characteristics, and not on the goods themselves.
3. The goods' attributes (characteristics) produce the consumer's utility levels.
4. Household's utility may be assumed, realistically, to be a function of the quantities actually consumed of the product attributes (characteristics) which are derived from the quantities of the consumed goods.
5. Accepting the preference structure variations among the examined households, one can estimate the demands for products' characteristics as specific functions of the implicit prices of products' attributes, food expenditure, and demographic household variables.

6. In this analysis, it is assumed (in direct relationship to the Lancaster's approach) that consumers (FFW participant households) consume food items because of the nutrition value associated with them.
7. Hence, food products, including FFW items, are desired because of the collective nutritional utility that their characteristics provide.
8. Finally, the nutrients shadow prices treated as implicit ones, reflect the direct valuations that consumers place on the products' characteristics for which goods are desired, and for that are purchased and consumed.

The following chapter derives from this conceptual reasoning and presents the empirical modeling applied in this thesis; thus, it presents the mathematical model and explains the previous empirical findings.

Chapter V

AN ASSESSMENT OF PREVIOUS MODEL SPECIFICATIONS

5.1 INTRODUCTION

This chapter presents empirical model specifications along with previous research approaches to nutritional analysis. The next step is the detailed presentation of the linear programming model (LPM), and the econometric model (EM) which will be used in this thesis. Since the research is not focusing on the production side of the households, it is assumed that participant[2] farm households maximize their utility by minimizing their total expenditures in food commodities necessary to obtain the levels of nutrients actually consumed. Along this line, the linear programming model (LPM) with its specific nutrient constraints will be identified. Consequently, this chapter of the empirical analysis is organized as follows:

1. Presentation of the empirical studies on the nutrition-consumption economic research.
2. Linear Programming Model (LPM) specification.

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[2] Clearly, the same set of assumptions refers to the 172 non-participant households in the FFW project.

3. Utility framework and empirical econometric approach to consumption (nutrient values).
4. Data collection and estimation procedure.

5.2 PREVIOUS EMPIRICAL APPROACHES

Balintfy, Neter, and Wasserman (1970) used a Linear Programming approach for an exploratory experimental comparison between Fixed Weight and Linear Programming food price indexes. Their model is consistent with the previous work of Balintfy (1964) who developed a linear programming model to determine minimum cost regular diets in several hospitals in the United States. The minimum cost regular diets were estimated subject to constraints involving the structure of menu, nutrient composition, and food variety measures based on expressed preferences of the several institutions' patients.

The linear programming solution was obtained for each period's prices, with the available food items set, and the nutrient and structural constraints constant. The minimum cost per person-day was, then, determined. The linear programming approach, unlike a fixed weight price index, incorporates substitution effects in food quantities consumed arising from both long term price changes, as well as from seasonal price movements.

According to Balintfy, Neter and Wasserman (1970, p.49-50), let us suppose that there are "n" food items, and x_j is the number of units of the jth item included in the market basket for the given time period. The set of the utility affecting constraints c_i (i= 1, ... , m) developed by the authors took the form of $\Sigma_j b_{ij} x_j (<=, =, >=) c_i$. These constraints, c_is, represent the minimum requirements of the nutritional elements being satisfied by the foods included in the market basket for the given time period. The b_{ij} coefficients reflect the amount of the particular nutritional element supplied by a unit of the jth food item. The total cost, TC, of the foods purchased is expressed as $TC= \Sigma p_j x_j$, where p_j is the price of a unit of the jth food item.

Thus, the mix or market basket $x_1, x_2, \ldots, x_4$ can be obtained by minimizing the total cost $TC= \Sigma p_j x_j$ at the base period prices, subject to the constraints $\Sigma b_{ij} x_j (<=, =, >=) c_i$ (i= 1, ... , m), and $x_j >= 0$, (j= 1, ... , n). By using the linear programming approach one obtains the basket $x_1', x_2', .., x_n'$, which satisfies the above mentioned nutrient constraints and minimizes the total cost $TC= \Sigma p_j x_j$ at the prices of the given study period. Definitely, for a comprehensive analysis of the seasonal price and preference variations, data values are needed for a greater than a month's span used in the previously described research.

Prato (1973) proposed a method for reducing dietary deficiencies for low income families. Under his method a diet is composed for a family by minimizing the food expenditure subject to pre-established dietary constraints. Prato (1973, p. 15) argues that the reasons for nutrient deficiencies are the following:

(1) "Inadequate knowledge of proper nutrition"

(2) "Poor food preparation and eating habits", and

(3) "Insufficient income and inefficient food choices"

Prato specified a minimum cost diet model by minimizing food expenditures subject to diet technology and utility constraints. His basic constraint was the amount of nutrients contained in the minimum cost diet. The level of nutrients was set equal to two-thirds (2/3) of the family's RDA (Recommended Dietary Daily Allowances).

By setting the level of nutrients equal to (2/3) of the family's RDA, Prato (1973, p.16) intended to analyze the operational aspects and the feasibility of reducing nutrient deficiencies through the use of nutritious economic diets and of food assistance. Hence, Prato defined the set of the diet characteristics (nutrition, palatability, and variety) as a linear combination of the selected food items, as:

$$\begin{matrix} n \\ v \end{matrix} = Tq$$

where, n is a vector (mx1) of food nutrients, v is a vector (sx1) of foods defining diet variety and palatability, and q is the vector (zx1) of foods. T is the diet technology matrix. The family budget constraint was defined as p'q<= k, where p is a vector (mx1) of food prices, and k is food expenditure. The diet choice model was stated as (Prato, 1973; p. 17):

$$\begin{aligned} &\underset{n,v}{\text{MAX:}} && U = U(n, v) \\ &\text{subject to:} && (n, v)' = Tq \\ & && p'q \leq k \\ & && n, v, q \geq 0. \end{aligned}$$

Where, U(n, v) is the utility of consuming different diets (i.e., combinations of n and v). The difference between Prato's approach and Lancaster's theory is that the consumption technology matrix (here, diet technology matrix) is not the same for all consumers. Thus, Lancaster's approach can not be applied here.

Prato (1973; p.17-18) followed an alternative formulation of the diet choice problem to overcome the solution of the unknown mathematical specification of the utility function U(n, v). Thus, he proposed to minimize food expenditure subject to diet technology and utility constraints, as:

$$\text{MIN:}_{q} \quad p'q \quad \text{(food expenditure)}$$

$$\text{subject to:} \quad (n^{*}\ v^{*})' - Tq$$

$$v^{*},\ n^{*},\ q >= 0.$$

for specific values of n^{*} (vector of food nutrients) and v^{*} (foods defining variety, and palatability). By implementing the above specification, the amount of food assistance to a family can be estimated by the amount of the desired dietary improvements.

Prato and Bagali (1976) defined four areas in which studies of nutritional and non-nutritional determinants of food demand are based. These areas are (p. 563):

(1) "The estimation of conventional food demand and expenditure relationships".

(2) "The estimation of nutrient demand relationships".

(3) "The formulation of minimum-cost human diets", and

(4) "The specification of impacts of food and nutrition programs on nutrient intake".

The two researchers state that their effort was to develop a model for measuring the nutrition and non-nutrition components of demand for food products. Their motive was the lack of behavioral models and previous empirical studies that deal specifically with the nature and relative importance of the nutritional and non-nutritional factors affecting food demand. For purposes of simplicity they assumed that the consumption of any food item could be decomposed

into nutrition and non-nutrition components. Their data were from the USDA Household Food Consumption Survey of 1965. These data contained 104 region-urbanization income (RUI) classes. The national (U.S.) survey (1965) reported the average quantity consumed and expenditure per household per week on each of the forty-two (42) food items in the red meat, poultry, and fish group.

A Linear Programming Model (LPM) was used to obtain the minimum-cost diet (nutrition component) for each of the 104 region-urbanization income (RUI) classes. Prato and Bagali (1976, p.564) estimated eleven nutrients z_1=energy (calories), z_2=protein (grams), z_3=fat (grams), z_4=carbohydrates (grams), z_5=calcium (milligrams), z_6=iron (milligrams), z_7=vitamin A (international units), z_8=thiamine (milligrams), z_9=riboflavin (milligrams), z_{10}=niacin (milligrams), and z_{11}=ascorbic acid (milligrams). In order to analyze the non-nutrition components two statistical models were used. The first model was a Linear Expenditure system estimated by the use of ordinary least squares. The second statistical model consisted of a single econometric equation for each commodity. Even though the work of Prato and Bagali (1976) was not the first one in the area, it combined the experience of previous studies of George and King (1971); Gifft, Washbon, and Harrison (1972); and before them by Stone (1954).

Specifically, for the nutrition component, Prato and Bagali (1976, p. 564) assumed that consumers are selecting those foods that provide "n" (nutrients) at minimum cost. Thus, they set n=Tq, where n is an rxl vector of nutrients actually consumed by each individual. T is the rxz matrix of nutrition coefficients assumed constant over all consumers, and q is an zxl food consumption vector. Since the data contained 104 region-urbanization income (RUI) classes, the linear programming models used were of the following form:

$$\text{MIN} \qquad p'^{*}_{rkc} q^{*}_{rkc}$$

$$\text{subject to} \qquad Tq^{*}_{rkc} >= n^{*}_{rkc}$$

where (*) means average values, and (r) denotes region, (k) urbanization, and (c) income class. For the analysis of the non-nutrition component of food, the researchers used two statistical models of the following form:

$$X'_{irkc} = \beta_{irk} m'_{rkc} + u_{irkc}$$

where (') denotes average values, X'_{irkc}=(sq.root n_{7rkc})e'_{irkc}, n_{irkc}= number of families consuming good (i) in each (RUI) class, e'_{irkc} is the average food expenditure on good i for each (RUI) class, and

$$m'_{rkc} = \sum_{i=1}^{42} X'_{irkc}$$

The second model was a single equation estimation for each commodity for observations over all (RUI) classes, as:

$$X'_{irkc} = \mu_i + \alpha_{ir} + \gamma_{ik} + \beta_i m'_{rkc} + \varepsilon_{irk} + u_{irkc}.$$

where μ_i is the overall mean, α_{ir} is the region effect γ_{ik} is the urbanization effect, β_i is the residual expenditure slope, ε_{irk} is the interaction term, and u_{irkc} is a disturbance term (See also, Prato and Bagali, 1976; p. 564).

Per Pinstrup-Andersen and Elizabeth Caicedo (1978) working on the impact of changes in income distribution on food demand and human nutrition suggested that changes in income distribution can effectively improve human nutrition. They explain that average national figures for many developing countries might be misleading while showing little or no nutritional deficiencies of the whole population. On the other hand, when national figures are disaggregated by consumer-income group, then severe nutritional deficiencies are observed. Thus, the problem of nutritional deficiencies is one of "unequal distribution of available nutrients" and not an overall nutrient scarcity (Andersen and Caicedo, p. 402).

Following this idea, Andersen and Caicedo (1978), Reutlinger and Selowsky (1976) and others, all accept the fact that studies of the relationship between income distribution

and human nutrition are scarce. Thus, Andersen and Caicedo (1978) suggested an approach for estimating the nutritional impact of income distribution changes. Their model is based on neoclassical demand theory. By using a comparative analysis they estimated the impact of alternative changes in consumer income distribution on calorie and protein intake.

Their analysis was based on cross-sectional data from Colombia. Their data were quantities consumed and prices paid for each of twenty-two (22) foods, family incomes, size, and age distribution. These data were collected from a 230 families sample selected from the population of Cali, in Colombia.

By using a set of simultaneous equations they estimated the income elasticities of demand for the various commodities. Then, these income elasticities were weighted by the calorie and protein content in order to estimate the income elasticities of calorie and protein intake, respectively, for each income stratum. Obviously, their estimates were based on the cross-sectional data within each income stratum (the population was divided in five (5) income strata). Their basic estimated equation is of the following form:

$$\Delta q_{is} = b_s N_{is} q_{is}^0 + \\ +(p_i^1 - p_i^0)/p_i^0 \ (e_{is} q_{is}^0)$$

where, q_{is} is the total change in quantity of commodity (i) demanded by stratum (s). Additionally, $b_s = (\Delta I/I)_s$ where (I) stands for income of stratum (s). N_{is} is the income elasticity of demand, q_{is}^0 is the initial quantity of commodity (i) consumed by stratum (s). P_i^1 is the new equilibrium price after shifts in the food supply, and e_{is} is the price elasticity of demand for stratum (s) (See also, Andersen and Caicedo, 1978; pp. 404-405).

One basic limitation of their research is that their empirical analysis is limited to caloric and protein intakes only. At the same time, the employed methodology is valid for those consumers who do not produce the particular food commodities that they actually consume. The latter disadvantage of their methodology does not allow the Andersen-Caicedo approach to be used in this research. Additionally, the Andersen and Caicedo approach did not take into account the nutritional implications of the multiplier effects of changes in food supply and consumer income, as well as the possible expansion of food supplies. Nevertheless, their work is valid and it can be expanded to incorporate more nutrients.

Consistent with the ideas of Andersen and Caicedo, Timmer and Alderman (1979) propose that the estimation of the con-

sumption parameters for food policy analysis must be income-strata specific. In this sense, Timmer and Alderman used a cross-section analysis in order to estimate the income-class specific income and price elasticities. To a certain extent, income-class specific price elasticities have an extremely limited use. The simple reason for their limited use is the lack of observed price variation, due to the brief estimated time period.

The data that Timmer and Alderman used were from the Indonesian Socio- Economic Survey V-(1976)-SUSENAS. A total of (54,000) households were surveyed. From these households (18,000) were surveyed in each trimester of 1976. Their analysis dealt with rice, fresh cassava, and corn. These three major foodstuffs account for an amount greater than two-thirds of the average caloric intake. Consequently, the authors expect that any possible nutritional and national food policy issue would deal with these commodities. Depending upon their judgement, the two researchers determined a specific functional form for their food policy analysis.

According to the neoclassical consumption theory, the quantity consumed of each commodity by each household can be determined as a function of the prices of various commodities, household income, household size and tastes. Accordingly, Q_i can be expressed in the following form:

$$Q_i = f(P_1, P_2, \ldots, P_n, Y, H, T)$$

where, Q_i is the quantity of the commodity (i) consumed by each household; P_i= prices of several commodities; Y= household income; H= household size; and, T= household tastes.

In this order, they estimated the 'log' of per capita commodity consumption (Q) in kgr. per week for each income class. This per capita commodity consumption was determined as a function of the 'log' of total expenditures, 'log' of own price of commodity for each observation, 'log' of cross-price terms, and a set of variables for regional and sample characteristics.

Depending upon their judgement and empirical model fit, Timmer and Alderman (1979) used the following form for their analysis:

$$C= \beta_0+S_i+ \beta_1 TE+ \beta_2 TE^2+ \beta_{3i} P_i + \\ + \beta_{4i} XP_i+ \beta_{5i} R_j+ \beta_{6k} T_k+ \beta_{7h} I_h+ e$$

where, C is the log of per capita commodity consumption (kgr. per week) for each income class. S_i is the income class specific intercept; TE is the log of total expenditures, P_i, log of own price of commodity for each observation calculated as commodity value divided by commodity quantity; XP_i is the log of cross price term; R_j, (0-1) dummy variable for (j) region; T_k, (0-1) dummy variable for

time period; I_h, (0-1) dummy variable of interaction, and (e) is the error term (See Timmer and Alderman, 1979; p. 983). Their data, as it is mentioned before, are cell means for twelve income classes for twenty-four (24) provinces (18,000 obs in each trimester of 1976).

Chavas and Keplinger (1983) in agreement with Adrian and Daniel (1976), and Allen and Gadson (1982), suggested that there is a need to further investigate possible interaction effects between variables that influence nutrient consumption. In this sense, they used cross-sectional data from the Spring quarter of the USDA 1977-1978 Nationwide Food Consumption Survey in order to estimate the impact of domestic food programs on nutrient intake of low-income persons. Consistent with the classical consumption theory, Chavas and Keplinger formulated a model for individual nutrient intake as a function of a set of socio-demographic variables, a set of anthropomorphic variables, income, and domestic food program variables. They estimated twelve nutrients by the use of 'ordinary least squares'.

Their model formulation for individual nutrient intake was defined as:

$$Z_i = Z_i(SOC, ANTR, INC, DFP);$$
$$i = 1, 2, \ldots, 12.$$

where, (Z_i) are the nutrient intakes, SOC socio-demographic variables (household size, occupation, education, race, etc.); ANTR anthropomorphic variables (age, height, sex, etc.); INC income, and, DFP is the domestic food program (food stamp, lunch, etc.). They estimated the demand for twelve nutrients. The basic limitation of their analysis, which they accept, is the need for including a greater set of additional nutritional factors (dietary, etc.).

In order to estimate the total food needs (nutrients) and the effects of short-run food supply shocks on various consumer groups, Yetley and Tun (1985) used a classical consumer theory model. Yetley and Tun estimated the quantity of a food purchased as a function of its own price, prices of other goods, and buyer's income. Considering a system of "n" equations for "n" food products, the researchers employed the Seemingly Unrelated Regressions technique.

In order to calculate the national aggregate elasticities for each consumer group for each of the ith foods, the researchers employed the following formulation:

$$E_{ij} = (e_{ij(m)} P_m Q_{im}) / P_{(m)} Q_{i(m)}$$

where, E_{ij} is the aggregate level of the own-(i) and cross-(j) price elasticity values, e_{ijm} is the own- and cross- price elasticity values specific to consumer group m.

P_m is the population of consumer group m, and Q_m is the average daily per capita quantity purchased by group m (See Yetley and Tun, 1985; p. 4). Thus, by using the weighted sum of the parameters of each consumer group, Yetley and Tun estimated the aggregate (country level) parameters. The data that they used were cross-sectional, one year period, carried out in 1969/70 by the Department of Census and Statistics in Sri Lanka. The researchers determined the percentage changes in aggregate market prices and demand for food commodities (and nutrient equivalents, afterwards), assuming that a hypothetical P.L. 480 food aid shipment of commodities is placed into the market system of Sri Lanka.[3] The derivation of the nutrient food equivalence was estimated indirectly by using a table of nutrient composition.

The limitations of the study were the estimation of the protein and caloric quantities only, while the method employed may be criticized in terms of the commodities aggregation. The technique used by Yetley and Tun does not help identifying the nutrient values directly, but it goes through the commodity (consumption) analysis first. This technique, of course, is not a research weakness but rather a preferred research direction. Finally, their approach re-

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[3] This latter hypothetical P.L. 480 food aid shipment is assumed to have increased the national supply of the provided food commodities by 3-percent.

quires an extremely costly data collection process, since large data quantities are required.

5.3 METHODOLOGY

5.3.1 Linear Programming Model Specification

In this thesis, it is assumed that each participant household in the FFW project, minimizes its total food expenditures in order to obtain the levels of nutrients actually consumed. Thus, households are assumed to:

$$\underset{X}{\text{MIN}} \quad \sum_{i=1}^{N} P_i X_i = Y_E$$

subject to

$$\begin{aligned}
&a_{11}X_1 + a_{12}X_2 + \ldots\ldots + a_{1N}X_N \geq b_1 \\
&a_{21}X_1 + a_{22}X_2 + \ldots\ldots + a_{2N}X_N \geq b_2 \\
&\quad\vdots \qquad\qquad \vdots \qquad\qquad \vdots \\
&a_{K1}X_1 + a_{K2}X_2 + \ldots\ldots + a_{KN}X_N \geq b_K \\
&X_1, X_2, X_3, \ldots\ldots X_N \geq 0.
\end{aligned}$$

where

X_i = amount of food commodity i purchased by household.

P_i = market price of the food commodity i purchased.

b_j = level of the j nutrient actually consumed by the participant household.

a_{ji} = technical coefficient

representing the amount of nutrient j per unit of food commodity i.

The vector of (X_i's) consists of the food commodities' levels purchased by the participant household. The vector of (b_i's) is the amount of nutrients, here proteins, calories, fat, carbohydrates, all actually consumed by the household unit. The estimation of these particular nutrients depends first on the available data on food nutrient values (Food Composition Tables for use in Africa, FAO, Rome, 1968). Second, these nutrients represent the center of controversy concerning the recent most severe malnutrition case problems (See also Mellor, in Food and Nutrition Issues, publication of FAO, 1984; Falcon, 1984). The DUAL problem of the PRIMAL linear programming model (LPM) can be specified as follows:

$$\underset{Y}{\text{MAX}} \quad \sum_{K=1}^{K} Y_K b_K = Y_E$$

$$\text{subject to} \quad a_{11}Y_1 + a_{21}Y_2 + \ldots\ldots + a_{K1}Y_K \leq P_1$$

$$a_{12}Y_1 + a_{22}Y_2 + \ldots\ldots + a_{K2}Y_K \leq P_2$$

$$\vdots \qquad \vdots \qquad \vdots$$

$$a_{1N}Y_1 + a_{2N}Y_2 + \ldots\ldots + a_{KN}Y_K \leq P_N$$

$$Y_1, Y_2, Y_3, \ldots\ldots, Y_K >= 0.$$

where: Y_E= total food expenditures of each household.

The Y_K variables represent the shadow prices of the constraint vector (b_i's). Thus, Y_1 for example can be explained as the shadow price of nutrient b_1. In other words, Y_1 is the marginal cost of the b_1 nutrient. Therefore, the purpose of solving the DUAL problem is to obtain the vector of nutrient shadow prices for each household participating in the FFW program. Hence, the fundamental assumption behind this LPM specification is that participant households[4] adjust their market basket of the preferred foods consumed according to their real income and the cost of food available to them. It is accepted that participant households are indeed efficient in the sense that they buy the cheapest bundle of food products which will give them the specific combination of food nutrients which they actually consume.

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[4] Essentially, the same course of assumptions, along with the accompanying conceptual setting holds for the non-participant in the FFW households.

5.3.2 Utility Framework

5.3.2.1 Utility Maximization

The next 'second' step is to assume that each household will maximize its utility, subject to the total food expenditures which were minimized by the linear programming model (LPM) before. Thus, we get:

$$\underset{b}{\text{MAX}} \quad U(b_1, b_2, b_3, \ldots\ldots b_k; D) \quad (1)$$

$$\text{subject to} \quad \sum_{K=1}^{K} Y_K b_K = Y_E$$

where: Y_E = total food expenditures

D= demographic characteristics

The specification of the above utility function (1) is in agreement with the 'new approach to consumer theory' as it is described by Lancaster (1966), and the empirical work of Ladd and Suvannunt (1976). Hence, the utility function (1) is defined in terms of the good's characteristics; here, nutrient values (b_i's). As we know, the LP approach specifies that the PRIMAL and DUAL problems provide the same value of the objective functions, as:

$$\sum_{K=1}^{K} Y_K b_K = \sum_{i=1}^{N} P_i X_i = Y_E$$

Moreover, problem (1) defines an indirect utility function $F(Y_1, Y_2, Y_3, \ldots\ldots Y_K, Y_E, D)$ from which one can der-

ive via the Roy's theorem the optimal demand for nutrients (b_i^*s). Thus we get:

$$b_1^* = E_1(Y_1, Y_2, \ldots\ldots Y_k; Y_E, D)$$

$$b_2^* = E_2(Y_1, Y_2, \ldots\ldots Y_K; Y_E, D)$$

$$\vdots \qquad \vdots \qquad \ldots\ldots \qquad \vdots$$

$$b_K^* = E_K(Y_1, Y_2, \ldots\ldots Y_K; Y_E, D).$$

Where, the optimal quantities of the food nutrients (b_i^*s) were assumed to be functions of implicit prices of protein, fat, carbohydrates, vitamins, etc., total food expenditures, and demographic characteristics (See also, Lancaster, 1971). The b_i^*s estimation states that the household's total demand for a specific nutrient (such as protein) is affected by the implicit marginal nutrient shadow prices of the several food nutrients, total food expenditures, and demographic characteristics such as family size.

The utility maximization framework presented so far is a conventional maximization problem except for the fact that the utility is defined in terms of nutrient values instead of commodities. The budget constraint also is defined in

terms of nutrient consumption and nutrient shadow prices. The latter (nutrient shadow prices) were estimated through the linear programming process as defined before in this chapter. Implicitly, all the theoretical and empirically useful properties of the consumer theory, and the commodity demand systems, apply to the nutrient demand analysis for the estimation of the demanded b_is (nutrient quantities) (See also, Lancaster, 1971; Varian, 1984). Consequently, assuming that consumers have a form of utility function of the Cobb-Douglas type, as:

$$U(b_1, b_2, \ldots\ldots, b_K) = \sum_{j=1}^{K} a_j \ln b_j$$

Where, b_is represent the demanded nutrient quantities to be estimated, and j is the jth nutrient (i.e., proteins, etc.); then, maximization of utility subject to the budget constraint Y_E (estimated minimum food expenditure per household) gives us the demand functions of the jth nutrient, as:

$$b_j(Y, Y_E) = a_j(Y_E/Y_J); \qquad (2)$$

$$j=1, 2, \ldots, K.$$

Observing i=1, 2, ...,n households, the above functional demand equation (2) takes the empirically estimated form:

$$b_{ij}(Y, Y_{Ei}) = a_j\ (Y_{Ei}/Y_{ij}) + \varepsilon_i$$

where: i=1, 2, ...,n households.

and, j=1, 2, ...,K nutrients.

The above demand forms can be estimated using standard econometric techniques (See also Varian, 1984).

In this model, a nutrient demand analysis is to be used. By imposing a commodity by commodity analytical basis, we accept very restrictive assumptions about the separability of the impact of price changes for one commodity class on changes in demand for other commodity groups. Timmer (1979) suggests that obtaining the full price and income elasticity matrix for dissagregated income classes requires innovations in modeling consumer reactions to price and income changes; facts which are not within the scope of this research at this time, but obviously represent the logical expansion of this analytical demand procedure (See also the later section on Research Limitations, Chapter VI).

From the previous LP model we can see that changes in food commodity prices will affect the nutrient demand by affecting the nutrient shadow prices. This LP flexibility helps us to determine the effect of specific food price policy changes on the nutritional levels of different types of households for each nutrient category.

5.3.3 Empirical Econometric Model (EM) Specification

Since the mathematical form of the Utility function is unknown, the proposition for the empirical analysis, through the implementation of an econometric approach (See also, Lancaster 1971; Ladd and Suvannunt 1976;) is as follows. Household's total demand for the jth nutrient b_i actually consumed can be expressed as:

$$b_j = f_j(Y_1, Y_2, \ldots\ldots Y_K, Y_E, D) \quad (3)$$

where: Y_i's, Y_E, and D are as specified before. For purposes of convenience, it is reminded that Y_is are the nutrient (b_is) shadow prices; Y_E here is the total household income[5] from all sources including FFW benefits, and D represents demographic characteristics (mainly, household size).

Thus, equation (3) states that the participant household's total demand for a demanded nutrient (b_i) is affected by the implicit prices of other nutrients, income, and household's demographic characteristics. Consequently, equation (3) can be transformed into an empirically estimable econometric relationship, and can be specified as follows:

[5] It should be made clear to the reader that the focus of this research is the estimation of the income elasticities of demand for nutrients. Hence, even though food expenditure values could be used instead, unnecessary transformations should follow in order to convert the food expenditure elasticities into the corresponding income ones.

$$b_j = \beta_0 + \beta_2 Y_1 + \beta_2 Y_2 + \ldots + \beta_K Y_K + \beta_{K+1} Y_E + \beta_{K+2} D \quad (4)$$

All variables have been specified before, while β_s represent the parameters to be estimated econometrically.[6] Preference structures of the participant households are included in (4) by incorporating the household size to be the main demographic variable (D). This alternative formulation of the demanded nutrient quantities' estimation is definitely more amenable (and precise) to empirical analysis, since it takes into account the optimal nutrient price variations. Along this line, the demanded nutrient relationships will be specified, and the nutrients contained in the food products provided through the FFW project will be compared to the estimated ones (normative approach). In other words, according to the main (primal) objective, the net nutritional impacts of the FFW provided foods on the participant peasant households will be identified. It is important to notice, though, that the latter nutrient demand estimation depends on the initially described LP assumption. Simply, this essential assumption states that consumers are buying the

[6] The same functional form is to be used for the non-participants (172) in the FFW households, so that the corresponding comparisons in their overall consumption behavior will be specified.

cheapest bundle of food commodities which provide them with the particular combination of nutrients that they, indeed, consume.

5.4 DATA COLLECTION AND PRESENTATION

The data used in this research were collected from the Ewalel and Marigat locations of the Baringo District, Rift Valley Province of Kenya by a former graduate student at Virginia Tech, during the period of seven months[7] (August through February, 1984). The faculty of the economics department at Egerton College, and the WFP (World Food Program) at Nairobi consulted on the location selection and the data collection. The collaboration of these institutions and organizations in the primal research was due to the following factors:

1. The FFW project at Ewalel and Marigat locations was the pilot study to determine the effectiveness of the FFW program in improving the living status of the participant households in a food deficit area.

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[7] Dr. B. J. Deaton as the principal investigator and primal organizer of the research was on site for three (3) weeks (Sept. 13- Oct. 8) assisting in the pre-testing process, data collection and enumerator's training.

2. All the interested bodies in this project suggested that the FFW program at Ewalel and Marigat locations be examined from the economic standpoint.

The data period covers the calendar year (February 1983 to January 1984). The specification of the above study period is due to the need of covering the harvesting season (June - August) closer to the enumeration period for easier data recalling. A representative random sampling procedure (30 percent) gave a 300 households sample out of the 1030 identified households. Thirty three (33) percent of the 300 sample households were participants of the FFW project. The final number of households[8] examined was 323. Of them (323) 123 were FFW participants. The final sample households used in the analysis were 80 FFW participants.[9] In order to estimate each household's expenditure values on food items, the researchers visited the participants once per month[10] (Octo-

[8] The Soil and Conservation Department of Kenya provided a list of all 397 participant households. Out of this total list of the 397 participants, 50 FFW participants were selected randomly. The purpose was that future research would demand an equal number of participant and non-FFW participant households to be used in the estimation procedure. Further illustrations on the process can be found in Bezuneh, 1985 (p: 117-120).

[9] The final sample of all households used in this research was 80 FFW-participants, and 172 non-participants. The same estimation procedure was followed for both household samples.

[10] The interviews happened between the enumerators and the head of the household unit. Previous research (Bezuneh,

ber through December). Even though the overall data base relied on recalled information through the use of specific questionnaires, the reliability and validity of the used data depend on the set of the following factors:

1. The participant enumerators were local residents who were trained and monitored continuously.
2. Data from the Farm Management Division of the Ministry of Agriculture and Livestock Development at Nairobi were used for comparisons.
3. Two technical field assistants of the Ministry of Agriculture and Livestock Development stationed in the Marigat and Kibingor area checked the employed enumerators for the data collection process.
4. The average information provided by the interviewed households was relatively similar to every normal production year figures. Hence, household farming activities were, at least, repetitive from year to year, and hence easier to be remembered and checked.

The estimation of the household food consumption figures depends on the disappearance (residual) method. The reason for selecting this process was the fact that household res-

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1985) found that 98 percent of the heads of the households were males. In case of female household head, the nutritional status and the consumption behavior of the household unit might be different.

ponses on quantities sold was considered to be more reliable. For the estimation of the average monthly purchases, the average of the post-harvest periods (October/ December) on a monthly basis was used. Annually consumed quantities of market foods were estimated by summing the above constructed monthly purchases. Specific commodities were selected for the estimation of the final total consumption data.

The total receipts of FFW for each participant household were estimated by multiplying the number of days of work on the FFW project times the daily maize ratio (2.25 kgr.), the daily beans ratio (0.2 kgr.), and the daily vegetable oil ratio (0.075 kgr.). Total receipts minus the quantities sold or bartered gave the total quantities consumed out of the received FFW food. The estimated average prices were different for each household for similar transactions. The reason was the different market locations that each interviewed household faced. Thus, the heterogeneity of the market centers affected the food price levels that each household faced.

Transportation costs also were accepted as the other major factor affecting the different food prices at the different market locations (centers). The evaluation of the own and purchase prices depends on the sales prices. Additional-

ly, the own and purchase food prices are the ones that have been used to evaluate the purchased consumption. Additional information on the quantities and price data, along with the specific steps of the formal survey can be found in recent research (Bezuneh, 1985).

Chapter VI

RESEARCH RESULTS

6.1 INTRODUCTION

International food aid to the poorest and starving has been supported for humanitarian and other objectives. Food aid is essential in Sub-Saharan Africa which faces a severe economic and food crisis. Food aid, especially long-term aid, is a controversial topic. It is severely criticized on the following grounds: (a) reducing pressure for the implementation of needed government reforms to improve food production and food self-sufficiency; (b) since it is unreliable it may create food price uncertainty; (c) it may also depress producer prices; and (d) it may diversify the domestic food preferences and needs, which cannot be met by domestic production. Hence, in turn, food aid may introduce inevitable dependencies from the poorest countries to the benefit of the developed ones.

In Colombia, subsidized wheat imports (PL 480) depressed the domestic prices. In Brazil, on the contrary, the government generated revenue by selling subsidized wheat to the mills at a higher price than the PL 480. In turn, the Brazilian government using this revenue offered a higher producer price than farmers could otherwise obtain from the

mills (Hall, 1980). In the Kenyan case, it was found that the essential effects of FFW are increased consumption and saving for the participants without resulting in any disincentives to either own-farming or to local agricultural production (Bezuneh, 1985).

This research traces the linkages between food security and food aid in the form of a FFW project in rural Kenya. National food security depends on the specification of the consumption needs of the whole country (Sarris, 1983), or of a regional group within the country. In order to specify the national nutritional levels, the research attention here is directed to the empirical estimation of the consumption effects of the FFW project on the participant households in Kenya.

The leading objectives are twofold. First, to measure empirically the magnitude of the FFW contribution on the nutritional status of the participant households. Second, to determine the consumption effects of FFW, in relation to the domestic food prices. The rationale for the second objective is to define implications for national food pricing policies. This objective can be achieved by interpreting the income elasticities of demand for the various nutrients. Hopefully, these implications may help shape the food strategies of the country in question by coordinating the amenable food

policies and available resources. Following these lines, this chapter presents the results of the analysis in three segments:

1. FFW nutritional contribution.

2. Nutrient demand, results I.
   (Nutrient prices analysis)

3. Nutrient demand, results II.
   (Nutrient -food commodity prices analysis)

6.2 FFW NUTRITIONAL CONTRIBUTION

The estimated quantities of the four nutrients consumed by the 80 FFW participant households, and the corresponding quantities of the same nutrients consumed by the 172 non-participants were analyzed. All consumers (households) are located in the Baringo District, Rift Valley Province of rural Kenya. The four nutrients analyzed in this research are: calories (cal, as energy nutrient), protein (grams), fat (grams), and carbohydrates (grams). The specific reasons for selecting these nutrients were explained in the "Empirical Analysis" fifth Chapter. Simply put here, these four nutrients represent the center of the recent controversy around the most crucial malnutrition situation in Sub-Saharan African countries (Mellor, FAO; 1984). The nutritional

content of the several food products consumed was estimated by using the actual original primary data-questionnaires of previous research in rural Kenya (Bezuneh, 1985). The technical coefficients, used in the LP-Models specification, (nutrient values/ per food unit) were calculated by using the Food Composition Tables for Use in Africa (FAO, 1968).

Accordingly, table 6.1 shows the specific nutrient content of each food item analyzed in this research. Indicative of this table is the fact that vegetable oil provided through the FFW project represents the source of the highest calorie content in comparison to all other food items. Similarly, it represents the only food item with zero (0) content in protein and carbohydrates. Vegetable oil is also the source of the highest content in fat (1000 gr/kgr). It is worth noticing that vegetable oil was not consumed by any of the non-FFW participant households. These figures are important in the later analysis of the results, while comparing the households' nutritional status. Table 6.2 shows the statistics (at the means) of the four nutrients' quantities consumed by the FFW participant households (80), and the corresponding values of the non-FFW participants (172), on a monthly basis. Next, table 6.3 describes the income levels of participant households versus the non-participants. The participants' income gains, representing the

TABLE 6.1

Food Nutrient Content Per Food Item Consumed

FOOD ITEM	CALORIES (Cal/kgr)	PROTEIN (gr/kgr)	FAT (gr/kgr)	CARBOHYDRATES (gr/kgr)*
BEANS	1110	109	3	229
MAIZE	3570	94	42	736
MILLET	3410	104	40	716
MEAT	1220	206	38	0
MILK	790	38	48	54
VEG. OIL	9000	0	1000	0
SORGHUM	3420	103	29	744
FLOUR**	3530	93	38	734
FINGER MILLET	3290	74	13	777
WHEAT	3220	128	16	695
POTATOES	820	17	1	189
TOMATOES	210	10	2	48
PEPPERS	400	13	2	98
PEAS	820	67	5	172
CASSAVA	910	70	10	183
VEGETABLES	250	20	1	54
RICE	3440	66	19	741

* The estimates are in grams per kgr. of each food item.
** It refers to the Ground Maize (flour).
Source: FAO, Food Composition Tables for Use in Africa, Rome,1968.

market value of the FFW provided items, are given in a separate column. Based on these income levels, comparisons between the two groups of consumers (farmers) are examined in relation to their nutrient consumption levels (table 6.2).

In other words, table 6.2 statistics are the mean values of nutrients consumed per household and month. Testing the difference of the two groups' means (population means), the statistical question of whether the two means are essentially equal is answered. Comparing the four nutrients' means, the null hypothesis of equal means is rejected (5 percent significance level). Therefore, all four mean nutrient values between the two groups are found to be statistically different.

Comparing and evaluating the two columns of table 6.2 of the nutrients' statistics at the sample means, the following results arise: the ratio of the non-FFW participant households' consumption with respect to the analogous FFW participants' consumption of calories is 74.35 percent . In the same manner, the ratio for the protein quantity (gr./month) is 80.77 percent; for fat (gr./month) is 65.99 percent; and for carbohydrates the analogous ratio is found to be 74.86 percent. These comparisons, at the means, reveal that the largest difference of the four most important nutrients' consumption between participants and non-participant house-

TABLE 6.2

Statistics of the Consumed Nutrient Quantities

VARIABLE	FFW PARTICIPANTS	NON-PARTICIPANTS
CALORIES *		
SAMPLE SIZE	80	172
MEAN **	461593.3935	343187.1465
STD.DEVIATION	229940.7450	198356.0338
MIN.VALUE	35050.0000	61468.3000
MAX.VALUE	1342173.8000	1033485.0000
STD.MEAN ERROR	25708.1568	15124.5058
PROTEIN *		
MEAN **	15214.8267	12288.6010
STD.DEVIATION	6886.0815	6457.6178
MIN.VALUE	6694.1000	2531.0000
MAX.VALUE	41519.0000	31810.5000
STD.MEAN ERROR	769.8873	492.3887
FAT *		
MEAN **	6996.4712	4617.5078
STD.DEVIATION	2906.8124	2464.4205
MIN.VALUE	2625.0000	1016.3000
MAX.VALUE	17255.2000	11456.5000
STD.MEAN ERROR	324.9915	187.9103
CARBOHYDRATES *		
MEAN **	90116.5301	67461.9658
STD.DEVIATION	47009.0251	40596.5342
MIN.VALUE	28353.4000	10538.0000
MAX.VALUE	280033.0000	213615.0000
STD.MEAN ERROR	5255.7688	3095.4567

* Nutrient' values are estimated, here, on a monthly and household basis.

**Statistically significant at the 5 percent level.

TABLE 6.3

Household Income Levels per Quartile

VARIABLE	PARTICIPANTS	FFW-MARKET-VALUE	NON-PARTICIPANTS
QUARTILE 1			
SAMPLE SIZE*	20		43
MEAN	1001.3100	492.3030	1185.5828
STD.DEVIATION	396.4821	433.6881	285.8746
MIN.VALUE	330.0500	26.9300	495.0000
MAX.VALUE	1708.0600	1341.6000	1618.0000
QUARTILE 2			
MEAN	1949.8075	505.8390	2170.7191
STD.DEVIATION	407.3862	344.8078	334.4834
MIN.VALUE	1100.6000	98.5400	1660.9000
MAX.VALUE	2675.0500	1485.0000	2790.0000
QUARTILE 3			
MEAN	2867.2275	962.7720	3388.2547
STD.DEVIATION	914.5080	746.4186	339.7667
MIN.VALUE	982.5000	53.8600	2797.5000
MAX.VALUE	4262.3800	2766.7500	4125.0000
QUARTILE 4			
MEAN	5833.4575	1128.2525	7622.7054
STD.DEVIATION	3231.7804	745.7560	4296.3399
MIN.VALUE	2853.4800	113.2500	4192.0000
MAX.VALUE	14595.1500	2826.0000	21807.3000

* It represents the sample size per quartile.

holds is the fat nutrient value (34.01 percent). All the above figures correspond to estimates on a monthly and household basis.

Similarly, the smallest difference in nutrient consumption was found to be 19.23 percent for protein (gr./month). More important figures for the nutritional evaluation of the consumption behavior of the two household "groups", (FFW-and, non-FFW HH's), are the nutrient values per person, and per day (Q nutrient/person- day). The key in this specification is the fact that food policy analyses go along with specific nutritional (per person-day) standards. Accordingly, all Recommended Dietary Daily Allowances (RDA's) are estimated on a person-day basis, following scientific procedures for comparisons (country-to-country comparisons, etc.). The latter results are shown in table 6.4. According to this table, FFW HH's are found to consume 3213.8 calories, per person and day; while the corresponding value for non-FFW HH's is 2555.3 calories (per person-day).

The calculated ratios (table 6.4) of non-FFW HH's with respect to the FFW participants' nutrient consumption (on a person-& daily basis) are: 79.5 percent on calorie (cal) consumption; 86.40 percent on protein (gr.) consumption; 70.64 percent on fat (gr.) consumption; and, 80.10 percent on carbohydrates (gr.) consumption. The resulting differenc-

TABLE 6.4

Ratios of Non-FFW/FFW-Participants Nutrient Consumption

NUTRIENT	RATIOS PER HHD&MONTH*	RATIOS PER PERSON&DAY*
CALORIES	74.35	79.50
PROTEIN	80.77	86.40
FAT	65.99	70.64
CARB/TES**	74.86	80.10

OVERALL INCOME GROUP
NUTRIENT CONSUMPTION PER PERSON & DAY

NUTRIENT	FFW-PARTICIPANTS	NON-PARTICIPANTS
CALORIES	3213.8 cal.	2555.3 cal.
PROTEIN***	105.9	91.5
FAT	48.7	34.4
CARB/TES**	627.4	502.3

* Ratios represent percentage points.
** Carbohydrates.
*** Protein, fat, and Carbohydrates' values are estimates in gr. per capita and day.

es between the monthly, and person-day ratios, are due to the different sample mean household size. The household sizes, as they were estimated by analyzing the 80 FFW, and the 172 non-FFW HH's, are 4.787 and 4.476, respectively. Statistics on the HH's demographic characteristics are presented in the following section of this chapter. Table 6.5 defines the corresponding nutrient consumption ratios for the analogous lowest income group estimates between participants and non-participant HH's. Again, the largest ratio difference is for fat, at the level of 29.36 percent, overall (table 6.4); and, 22.18 percent difference for fat consumption of the lowest income group (lowest income quartile; table 6.5).

Next, table 6.6 shows the results of the FFW contribution on the four nutrients' consumption. In agreement with the first objective, the contribution of FFW on calorie consumption was found to be 26.07 percent; on protein (gr.) 20.67 percent; on fat 32.69 percent; and, on carbohydrates 25.45 percent. Given the above results, the largest contribution of FFW is on the fat consumption (32.69 percent). Indicative of table 6.6 is that the FFW nutritional contribution is 32.46 percent (in average) higher for the lowest income group (lowest income quartile), than the overall contribution. Moreover, the nutrient contribution "picture" has

TABLE 6.5

Ratios of Non-FFW/FFW-HHDS Nutrient Consumption

LOWEST HHDS INCOME GROUPS' NUTRIENT RATIOS*

CALORIES	PROTEIN	FAT	CARBOHYDRATES
91.75	99.71	77.82	90.09

LOWEST HHDS INCOME GROUPS' NUTRIENT CONSUMPTION PER PERSON & DAY*

NUTRIENT	FFW-PARTICIPANTS	NON-PARTICIPANTS
CALORIES	2484.14	2279.10
PROTEIN**	85.42	85.17
FAT	39.58	30.80
CARB/TES***	488.31	439.90

* All nutrient ratios and consumption levels refer to the LOWEST INCOME groups. Comparisons are made between the participants' lowest income group, and the analogous non-participants' income group.
** Protein, fat, and carbohydrates estimates are in grams.
*** Carbohydrates.

changed. To clarify, for the lowest income group, FFW contributed more on carbohydrates (42.68 percent) than on fat. Table 6.7 describes the statistics of the variables (consumed nutrients) of the FFW provided nutrients, in relation to the overall consumed food nutrients, on a monthly and household (HHd) basis, for the case of the participant HH's.

6.3 NUTRIENT DEMAND ANALYSIS, RESULTS I

The main interest, in this section, is to compare the participant with the non-participant households (HH's) in the project, by the use of selected elasticities (own and cross-price, income elasticities, etc.). Since one of the main objectives of this research is to assess the overall significance of the nutritional effects due to participation in the FFW program, two sequential steps should be followed: (1) to estimate the actual FFW nutritional contribution; (2) to describe the consumption behavior of the FFW participants versus the non- participants.

The first step is presented in the previous section. Here, the empirical model which is used to explain the nutrient consumption behavior is as follows. The quantity of protein, QPR, which was consumed by each participant household on a monthly basis, was regressed on a set of independent variables including: the price of protein, PPR; the

TABLE 6.6

NUTRIENT CONSUMPTION OF PARTICIPANT HOUSEHOLDS

NUTRIENTS	NUTRIENT CONTRIBUTION	
	OVERALL*	LOWEST INCOME**
CALORIES	26.07	32.43
PROTEIN	20.67	24.63
FAT	32.69	38.76
CARBOHYDRATES	25.45	42.68

* FFW nutrient contribution on all income groups combined (80 households).
**FFW nutrient contribution on the lowest income group alone. All values represent percentage points.

TABLE 6.7

Variable Statistics of Participant HHDs Consumed Nutrients

VARIABLE	FFW-PROVIDED-FOODS	OVERALL-CONSUMED-FOODS*
CALORIES		
MEAN	120314.8500	461593.3935
STD.DEVIATION	83826.9546	229940.7450
MIN.VALUE	14879.0000	35050.0000
MAX.VALUE	357180.0000	1342173.8000
STD.MEAN ERROR	9372.1384	25708.1568
PROTEIN		
MEAN	3144.7575	15214.8267
STD.DEVIATION	2189.2517	6886.0815
MIN.VALUE	388.5000	6694.1000
MAX.VALUE	9332.0000	41519.0000
STD.MEAN ERROR	244.7657	769.8873
FAT		
MEAN	2287.6250	6996.4712
STD.DEVIATION	1600.3635	2906.8124
MIN.VALUE	283.5000	2625.0000
MAX.VALUE	6804.0000	17255.2000
STD.MEAN ERROR	178.9261	324.9915
CARB/TES**		
MEAN	22938.8825	90116.5301
STD.DEVIATION	15969.5523	47009.0251
MIN.VALUE	2836.0000	28353.4000
MAX.VALUE	68072.0000	280033.0000
STD.MEAN ERROR	1785.4502	5255.7688

* All income levels of the 80 participants are included, and the nutrient quantities are on a monthly per HHd basis.
** Carbohydrates.

price of fat, PFAT; household income from all sources, YINC; household size, HHSIZE; the level of education of the homemaker, EHR; and the age of the homemaker, AGEHR. Except for the prices of protein and fat, the other variables represent the currently available demographic characteristics of the interviewed households. The prices of protein and fat represent the estimated nutrient shadow prices being calculated by the use of a set of Mathematical Linear Programming Models (LPM). The set of the LP-Models was 80 for the FFW-participant households, and 172 for the non-participants. Each LP-Model was run for every single household specifically. Every household had a different set of food items consumed, and a different set of food prices paid. Hence, each household faced its own objective function in its own LP-Model specification. Detailed descriptions on the LP-Models can be reviewed in the previous "Empirical Analysis" Chapter.

Hence, the best econometric model estimate for the protein analysis of the FFW-participants was found to be of the following linear form:

QPR= F(PPR, PFAT, YINC, HHSIZE, EHR, AGEHR)

The analogous best model estimate for the protein analysis of the non-participants was found to be:

QPR= F(PPR, PFAT, YINC, HHSIZE, AGEHR)

The statistics of the variables of these two econometric models are presented in the following table 6.8. In these two econometric models only the price of protein and fat was included. The marginal shadow prices of the other two nutrients (calories, and carbohydrates), as they were estimated through the LP-Models, were of zero value, or their (price) variability was insignificant to be included. The variables of these two models are QPR= quantity of protein; PPR= price of protein (nutrient shadow price); PFAT= price of fat (nutrient shadow price); YINC= household income from all sources (including FFW-income); HHSIZE= household size; EHR= education level of the homemaker (years of education); AGEHR= age of the homemaker (years of age).

Table 6.9 presents the two econometric models with their statistical properties. In both models, all independent variables are statistically significant, as the p-value (prob> |T|) reveals. R-squares and adjusted R-squares (ADJ R-SQ) values are acceptable. Quite extended reference on the statistical values of similar parameters, in agreement with this research, can be found in M. Pitt (1981).

All parameter signs are in agreement with economic consumption theory. Tracing the own and -cross price elasticities of demand and the income elasticities of demand for protein, the following table 6.10 was constructed. According

TABLE 6.8

Variable Statistics of the two* Econometric Models

VARIABLE	FFW-PARTICIPANTS	NON-PARTICIPANTS
SAMPLE SIZE	80	172
QPR		
MEAN	15214.8277	12288.6011
STD.DEVIATION	6886.0803	6457.6177
MIN.VALUE	6694.1000	2531.0000
MAX.VALUE	41519.0000	31810.5000
STD.MEAN ERROR	769.8871	492.3887
PPR		
MEAN	0.01495	0.01660
STD.DEVIATION	0.00495	0.00878
MIN.VALUE	0.00000	0.00000
MAX.VALUE	0.03191	0.03191
STD.MEAN ERROR	0.00055	0.00066
PFAT		
MEAN	0.00450	0.01140
STD.DEVIATION	0.00291	0.01968
MIN.VALUE	0.00000	0.00000
MAX.VALUE	0.00650	0.07225
STD.MEAN ERROR	0.00032	0.00150
YINC		
MEAN	3685.2422	3591.8154
STD.DEVIATION	2551.5550	3266.4291
MIN.VALUE	721.5000	495.0000
MAX.VALUE	15369.9000	21807.3000
STD.MEAN ERROR	285.2725	249.0628
HHSIZE		
MEAN	4.7875	4.4767
STD.DEVIATION	1.7040	1.8526
MIN.VALUE	1.0000	1.0000
MAX.VALUE	9.0000	10.0000
STD.MEAN ERROR	0.1905	0.1412

Table continues on following page.

Variable Statistics of the two* Econometric Models

VARIABLE	FFW-PARTICIPANTS	NON-PARTICIPANTS
EHR		
MEAN	0.8750	1.0116
STD.DEVIATION	2.1428	2.3718
MIN.VALUE	0.0000	0.0000
MAX.VALUE	7.0000	11.0000
STD.MEAN ERROR	0.2395	0.1808
AGEHR		
MEAN	38.1250	42.4593
STD.DEVIATION	10.8059	13.9054
MIN.VALUE	22.0000	20.0000
MAX.VALUE	80.0000	87.0000
STD.MEAN ERROR	1.2081	1.0602

* Both these models refer to protein demand estimation.

TABLE 6.9

Pairwise Statistical Models Specification*

MODELS FOR PROTEIN DEMAND

FFW-Participants' Model

VARIABLE"	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0	PROB> |T|
INTERCEPT	1	17147.683	4194.3	4.088	0.0001
PPR	1	-304818.000	136163.0	-2.239	0.0282
PFAT	1	-640224.000	248881.0	-2.572	0.0121
YINC	1	0.987	0.274009	3.605	0.0006
HHSIZE	1	974.725	398.1	2.449	0.0167
EHR	1	568.771	324.8	1.751	0.0842
AGEHR	1	-86.634	64.8	-1.337	0.1889

F-VALUE	PROB>F	R-SQUARE	ADJ R-SQ	D-W D**
6.993	0.0001	0.3650	0.3128	1.429

NON-Participants' Model

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0	PROB> |T|
INTERCEPT	1	11665.312	2786.76	4.186	0.0001
PPR	1	-253550.000	86197.66	-2.941	0.0037
PFAT	1	-177722.000	38064.85	-4.669	0.0001
YINC	1	0.47064900	0.135713	3.468	0.0007
HHSIZE	1	809.442	236.73	3.419	0.0008
AGEHR	1	36.325	31.54	1.152	0.2512

F-VALUE	PROB>F	R-SQUARE	ADJ R-SQ	D-W D**
11.652	0.0001	0.2598	0.2375	2.105

* These two models refer to the protein estimates.
**Durbin-Watson statistic.
" Model variables have been specified before as: Dependent variable= QPR (Quantity of Protein); PPR= price of protein; PFAT= price of fat; YINC= household income; HHSIZE= HH'd size; EHR= education of homemaker; AGEHR= age of H/maker.

to this table (6.10), the income elasticity of demand for protein was found to be 0.239 for the FFW- participants, and 0.137 for the non-participants: thus, a difference of 74.45 percent higher response in terms of the income elasticity of demand for the FFW-participants is detected. Hence, for protein demand a more elastic consumption response from the FFW-participants' side is found.

Table 6.10 describes the own-and cross price elasticities of demand for protein, both distinguished as uncompensated, or (gross, ε_{ij}'s), and compensated ones as (net, ε''_{ij}'s). The compensated elasticity forms were estimated by the use of the classical Slutsky's equation (Phlips, 1983; Varian, 1984). The values of the elasticities show that protein and fat nutrients are complementary goods, for both participants, and non-participant households. FFW participants showed a more elastic response (higher estimate) (ε''_{CPF}=-0.187), than the non-participants group, ε''_{CPF}=-0.163, in terms of consuming protein and fat as complementary goods.

Table 6.11 presents the analogous econometric model for the fat demand equation, for the non-participants. Insufficient fat price (marginal shadow-price) variability, as it

TABLE 6.10

Pairwise Table of Elasticities for Protein Demand

ELASTICITY*	FFW-PARTICIPANTS	NON-PARTICIPANTS
UNCOMPENSATED		
OWN- PRICE	-0.299	-0.340
CROSS-PRICE	-0.189	-0.165
COMPENSATED		
OWN- PRICE	-0.284	-0.330
CROSS-PRICE	-0.187	-0.163
INCOME ELASTICITY	0.239	0.137

* Elasticities were estimated at the sample means.

was estimated by the use of the LP-Models, did not allow for the corresponding estimation of the fat demand equation for the FFW-participants' fat consumption. The compensated own price elasticity of demand for fat,

(ε''_{OF}=-0.101), shows that non-participants are less sensitive in their preference concerning fat as compared to protein consumption. To illustrate further, they are more sensitive (and hence responsive) to protein being a complement to fat nutrient (ε''_{CFP}=-0.320), rather than fat being a complement to protein (ε''_{CPF}=-0.163). In this sense, non-participants show a stronger tendency for protein being a complement to fat by 96.3 percent, than vice-versa (fat being complement to protein). As supporting evidence to the above, non-participants revealed an income elasticity of demand for protein of 0.137, compared to 0.176 for fat.

Disaggregating the sample of the 172 non-participants' group into four quartiles, and subtracting the higher income group (fourth) quartile, the effect of the higher income consumers on the overall consumption behavior can be identified. Hence, in order to evaluate the significance of the higher income group, (25 percent fourth income quartile), on the protein and fat consumption behavior of the 172 non-participant households, table 6.12 was constructed. On protein consumption, the highest income group was found to affect

TABLE 6.11

Econometric Model for Fat-Demand

NON-PARTICIPANTS MODEL

VARIABLE*	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO PARAMETER=0	PROB>|T|
INERCEPT	1	3791.104	1081.633	3.505	0.0006
PPR	1	-91600.357	33456.072	-2.738	0.0069
PFAT	1	-42320.691	14774.185	-2.865	0.0047
YINC	1	0.226	0.053	4.293	0.0001
HHSIZE	1	290.034	91.881	3.157	0.0019
AGEHR	1	16.918	12.244	1.382	0.1689

F-VALUE	PROB>F	R-SQUARE	ADJ R-SQ	D-W D
10.162	0.0001	0.2343	0.2113	2.060

* All variables have been specified in table 6.9

the own-price elasticity of demand by 90.91 percent; the cross-price elasticity of demand (protein demand with respect to fat price) by 26.99 percent; and, the income elasticity of demand by 2.238 percent. The own and cross price elasticities' estimates above refer to the net (compensated) elasticities.

Similarly, the analogous own, cross, and income elasticity proportions of the highest income group impact on fat, were estimated as 30.34 percent; 46.67 percent; and, 36.43 percent, respectively. In conclusion, the highest income non-participants' group has the following effects: (a) significantly more consumption of protein (with respect to its own price) than fat; (b) significantly less consumption of protein with respect to fat price changes, than the opposite; and (c), significantly more sensitivity of fat consumption with respect to income changes than the corresponding protein consumption with respect to income changes.

Therefore, it is evident that the poorest non-FFW participant households, as rational consumers put greater emphasis on the protein consumption than fat. As evidence, the income elasticity of demand for fat consumption of all income groups combined (all non-participants) is n_{ALL}=0.176; while, the analogous value for the household income group remaining after subtracting the highest income consumers'

group (3/4ths of the overall income sample of the non-participants) is found to be $n_{3/4}$=0.129. The respective values for protein were almost identical (n_{ALL}=0.137; $n_{3/4}$=0.134). To illustrate further, consuming more protein already (42.75 % more than the lower income), the higher income group (non-participants) is more responsive in buying more fat than protein when their income increases. But, when income is assumed constant, the higher income group of the non-participants is more responsive to protein price changes than fat (price changes). So, if income increases, the higher income non-participant households will buy more fat than protein. Additionally, they will also prefer to increase more their consumption of fat, and increase less their consumption of protein.

The possible explanation for this behavior is that non-participants, in general, have neither information nor knowledge of the specific nutrient composition of each food item. For example, a decrease in the price of meat may increase the consumption (demand) for meat significantly more than the analogous increase in sorghum consumption (due to sorghum price decrease). In support of this possibility, previous research (Bezuneh, 1985) showed that the compensated own price elasticity of demand for meat, milk, eggs, and fish (-.75161) is higher than the analogous elasticity for

millet and sorghum (-.49313). But, lack of specific income elasticities on meat and milk demand restrict additional information on the two food items (meat-milk). The point is that an income increase may create an impetus for the higher income non-participants to increase significantly the consumption of milk, for example, which contains more fat than protein compared to meat items. Hence, an income increase may result in consuming more fat than protein for the higher income group of the non-participants.

Table 6.13 describes the two econometric models of the protein and fat demand of the combined three lower income group quartiles of the non-participants' group. In other words, this latter table presents the statistical properties of the two nutrients' demand (protein, and fat) of the non-participants' group, after subtracting the highest income group. The elasticities described in the previous table 6.12 have been estimated using the latter econometric models (table 6.13).

6.4 NUTRIENT DEMAND ANALYSIS RESULTS II

The analysis presented so far focused on the economic relationships among the consumed nutrient quantities, and nutrient price effects along with demographic influences on nutrient consumption. Recent debates on the food security

TABLE 6.12

Pairwise Elasticities of Non-Participants Groups*

ELASTICITY	3/4TH'S GROUP	OVERALL GROUP
PROTEIN DEMAND ELASTICITIES		
UNCOMPENSATED		
OWN- PRICE	-0.640	-0.340
CROSS-PRICE	-0.210	-0.165
COMPENSATED		
OWN- PRICE	-0.630	-0.330
CROSS-PRICE	-0.207	-0.163
INCOME ELASTICITIES	0.134	0.137
FAT DEMAND ELASTICITIES		
UNCOMPENSATED		
OWN- PRICE	-0.147	-0.104
CROSS-PRICE	-0.610	-0.330
COMPENSATED		
OWN- PRICE	-0.145	-0.101
CROSS-PRICE	-0.600	-0.320
INCOME ELASTICITIES	0.129	0.176

* The two compared non-participants' groups are the overall (all) income group, and the 3/4ths' income group (or, the remaining three income groups combined, after subtracting the highest fourth non-participants' income group).

TABLE 6.13

Models of the Lower* Non-Participants Income Group

MODEL FOR PROTEIN DEMAND

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0	PROB>|T|
INTERCEPT	1	16055.02	2682.26	5.986	0.0001
PPR	1	-405918.00	95285.98	-4.260	0.0001
PFAT	1	-225274.00	43229.10	-5.211	0.0001
YINC	1	0.6598510	0.503765	1.310	0.1927
HHSIZE	1	677.39	264.22	2.564	0.0116

F-VALUE	PROB>F	R-SQUARE	ADJ R-SQ	D-W D
9.881	0.0001	0.2417	0.2172	2.295

MODEL FOR FAT DEMAND

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR HO: PARAMETER=0	PROB>|T|
INTERCEPT	1	5552.64	1047.74	5.300	0.0001
PPR	1	-142955.00	37220.29	-3.841	0.0002
PFAT	1	-59506.64	16886.01	-3.524	0.0006
YINC	1	0.234620	0.196779	1.192	0.2354
HHSIZE	1	255.77	103.21	2.478	0.0146

F-VALUE	PROB>F	R-SQUARE	ADJ R-SQ	D-W D
6.672	0.0001	0.1771	0.1506	2.214

* The estimated non-participants' income group is the one that represents the lower income HH's, after subtracting the highest income group (highest fourth quartile).

and nutrition planning literature put a substantial emphasis on the estimation of income elasticities of demand for nutrients. Consequently, to analyze further the income elasticities of the rural households in Kenya, the next steps were followed. For the FFW-participant households the amount of calories consumed (QCAL) on a monthly basis was regressed on the Beans' price (BEPPRI); the Maize and Millet price (MAPPRI); the Maize-Flour (Ground Maize) and other Crops price (OTPPRI); the FFW provided food items price (FWPRI); the price of Meat, Milk, Eggs, and Fish (PPRI); Household income (YINC); and a set of demographic characteristics (Household size (HSIZE); Education of the Homemaker (EHR): and, the Age of the Homemaker (AGEHR)). An equivalent econometric approach was followed for the non-participant household analysis. Of course, no FFW-items' price was included in the non-participants' analysis.

The first table which follows (table 6.14) describes the statistics of the econometric models presented in table 6.15. Table 6.15 presents the outcome of the above regressions. The variables included in the models are all statistically significant at the 10 percent level. The objective here was the estimation of the income elasticities of demand for those nutrients on which estimates were not observed in the previous section. This estimation comes as an additional

procedure to help identify the income elasticities which were not found before. Along this line, table 6.15 reveals the significance of the calorie consumption of FFW-participant households, and the calorie consumption of the non-participants.

Following the parameter estimates of table 6.15, it can be seen that the income elasticity of demand for calories of the FFW-participant households is n_{FFW}=0.299; while, the analogous income elasticity for the non-participants is found to be n_{NON}=0.137. Analyzing the variable statistics (table 6.14), the researcher can compare the average (mean) household income between the two HH's groups. So, the mean income of the FFW-HH's is 3685.24 (including FFW-income), and of the non-participants is 3591.82 Kshs. These results show that a 25 percent increase in income due to the FFW value of the provided food items increases the sensitivity of consumers' calorie consumption (with respect to income changes) by 118.2 percent. Accordingly, the following chapter clarifies the conclusions derived in this study, and refers to the policy implications of the conclusions.

TABLE 6.14

Variable Statistics for Calorie Demand Models

VARIABLE	FFW-PARTICIPANTS	NON-PARTICIPANTS
SAMPLE SIZE	80	172
QCAL		
MEAN	461593.3750	343187.2290
STD.DEVIATION	229940.7074	198356.0060
MIN.VALUE	35050.0000	61468.0000
MAX.VALUE	1342174.0000	1033485.0000
STD.MEAN ERROR	25708.1526	15124.5037
YINC		
MEAN	3685.2422	3591.8155
STD.DEVIATION	2551.5550	3266.4291
MIN.VALUE	721.5000	495.0000
MAX.VALUE	15369.9000	21807.3000
STD.MEAN ERROR	285.2725	249.0629
HSIZE		
MEAN	4.7875	4.4767
STD.DEVIATION	1.7040	1.8526
MIN.VALUE	1.0000	1.0000
MAX.VALUE	9.0000	10.0000
STD.MEAN ERROR	0.1905	0.1413
EHR		
MEAN	0.8750	1.0116
STD.DEVIATION	2.1428	2.3718
MIN.VALUE	0.0000	0.0000
MAX.VALUE	7.0000	11.0000
STD.MEAN ERROR	0.2396	0.1809
AGEHR		
MEAN	38.1250	42.4593
STD.DEVIATION	10.8060	13.9054
MIN.VALUE	22.0000	20.0000
MAX.VALUE	80.0000	87.0000
STD.MEAN ERROR	1.2081	1.0603

Variable Statistics For Calorie Demand Models

VARIABLE	FFW-PARTICIPANTS	NON-PARTICIPANTS
BEPPRI		
MEAN	3.7842	4.2478
STD.DEVIATION	1.4949	1.5056
MIN.VALUE	1.3300	0.8900
MAX.VALUE	8.0000	10.0000
STD.MEAN ERROR	0.1671	0.1148
MAPRI		
MEAN	2.5009	2.9244
STD.DEVIATION	1.0541	0.9834
MIN.VALUE	1.0500	1.0000
MAX.VALUE	7.4700	6.3900
STD.MEAN ERROR	0.1179	0.0750
OTPRI		
MEAN	2.8427	2.7578
STD.DEVIATION	1.6168	2.3836
MIN.VALUE	1.1100	0.2800
MAX.VALUE	12.3100	29.6000
STD.MEAN ERROR	0.1808	0.1817
PPRI		
MEAN	15.2966	14.6272
STD.DEVIATION	10.7516	7.2466
MIN.VALUE	2.0000	1.0500
MAX.VALUE	64.2800	44.4400
STD.MEAN ERROR	1.2021	0.5525
FWPRI		
MEAN	2.1112	N/A*
STD.DEVIATION	0.4792	
MIN.VALUE	1.2100	
MAX.VALUE	3.9700	
STD.MEAN ERROR	0.0536	

* N/A= not applicable.

TABLE 6.15

Econometric Models for Calorie Demand

FFW-PARTICIPANTS' MODEL

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB>|T|
INTERCEPT	1	100651.00	54685.40	1.841	0.0696
YINC	1	37.39	8.69	4.301	0.0001
HSIZE	1	23799.44	12170.46	1.956	0.0542
PPRI	1	4630.02	1874.55	2.470	0.0158

F-VALUE	PROB>F	R-SQUARE	ADJ R-SQ	D-W D
9.947	0.0001	0.2846	0.2560	1.955

NON-PARTICIPANTS' MODEL

VARIABLE	DF	PARAMETER ESTIMATE	STANDARD ERROR	T FOR H0: PARAMETER=0	PROB>|T|
INTERCEPT	1	184343.00	38708.64	4.762	0.0001
YINC	1	13.06	4.46	2.930	0.0039
HSIZE	1	25007.33	7855.92	3.183	0.0017

F-VALUE	PROB>F	R-SQUARE	ADJ R-SQ	D-W D
11.359	0.0001	0.1185	0.1081	2.026

Chapter VII

RESEARCH CONCLUSIONS AND POLICY IMPLICATIONS

7.1 CONCLUSIONS

7.1.1 Introduction

Food Security should not be confused with Food Self-Sufficiency, since the latter does not necessarily imply the first. To indicate, food security is characterized as such in terms of the minimal acceptable nutritional requirements, being concepts involved in a national food policy context. In this research, the concept was to analyze FFW as a food aid program functioning as a short-run food supply shock in the market environment of a LDC (Kenya). The objective was to evaluate the nutritional impacts of FFW within the overall frame of food security specified on nutritional grounds. Food aid has been used in agricultural development programs which have significant effects on the nutritional status of the malnourished. Hence, the specific objectives of this research were to:

1. Analyze the nutritional contribution of Food-for-Work (FFW) on the participant households, and
2. Describe the nutrient consumption (demand) behavior of the participant versus the non-participant households, in rural Kenya.

Consequently, the intent was to understand the nutritional (and, thus economic) role of FFW within the overall context of food security issues which, in turn, form the basis for economic development and national food strategies.

7.1.2 Explanation of the Main Research Findings

Given these considerations, FFW was found to, indeed, make a significant nutritional contribution to FFW-participant HH's. On a monthly per household unit basis, the highest FFW contribution was to fat consumption (32.69 percent). This figure seems to be mainly due to the vegetable oil contribution, a new food item provided through the FFW project. Indeed, vegetable oil has the greatest content in fat compared to all other food items (Results' Chapter, table (6.1)). This finding indicates that properly designed FFW projects, and gradually introduced new food items (such as vegetable oil) can have an essential nutritional impact.

The existing controversy of calorie versus protein consumption needs supports the notion that even when the minimum calorie needs are met, this condition does not imply that people get enough protein. Given the controversy over the nutritional significance of estimating calorie versus protein consumption, FFW, in this case, contributed a high proportion to calorie (energy) intakes (26.07 percent). Si-

milarly, the protein contribution of FFW was high at 20.67 percent of the overall diet. The mean household size for both consumption "groups" was found to be similar (4.78 for participant HH's; and 4.47 for non-participant HH's). Nevertheless, a 25 percent increase in participants' income[11] due to participation in the project resulted in 25.77 percent higher calorie and 15.74 percent higher protein consumption[12] than the non-participants.

Significantly also, the average age of the head of the participant household was found to be 38.13 years, compared to the 42.46 years of the non-participant. This indicates that the younger the consumers, the higher the degree of participation in the infrastructure project of FFW, and the higher the food energy consumed. These figures are consistent with a priori expectations.

Tracing the percentage points of the overall FFW nutritional contribution, and comparing them with the ratio of the non-participants versus the participants' nutrient consumption, a set of important conclusions is revealed. By using the per capita daily ratio of the two "groups" nutrient consumption, it appears that no substantial degree of sub-

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[11] In evaluating the overall participants' income, FFW income gains through the food aid provision are included.

[12] The above consumption levels refer to the per capita daily nutrient consumption.

stitution for FFW food items exists.

To illustrate, the nutritional status difference between the FFW participants versus non-participants (on a monthly-and-household basis) is equivalent to the FFW nutritional contribution to the participant households. The nutritional intakes, as they were estimated, were higher for the FFW-participants. In addition, analyzing the per person and per day nutritional status of the two consumer groups,[13] it seems that a slight degree of substitutability of other goods for FFW food items exists. Specifically, there is found to be a 5.57 percent of substitution for calories; a 7.07 percent of substitution for protein; a 3.33 percent for fat; and, a 5.55 percent of substitution for carbohydrates. Hence, the results lead to the conclusion of an average (overall) degree for FFW food items' substitution of 5.38 percent, in terms of the four consumed nutrients' estimates.[14]

Therefore, it is evident that no exceptionally significant FFW substitution trends were detected. FFW foods were mainly consumed; and, as seems to be the case, other non-

[13] As before, it is meant that the comparisons are made between the group of FFW-participants versus the non-participant households in the FFW project.

[14] These figures are estimated by comparing the FFW contribution on the four nutrients, with the ratio of the non-FFW participants to the participants nutrient consumption level, on a per capita and daily basis.

food items were not substituted for the FFW foods extensively. In conclusion, household consumption was increased essentially, and household nutritional status was elevated.

Comparing the ratios of non-FFW participants to the participant households' nutrient consumption (table 6.4, Results' Chapter) on a per person-and-day estimation, it is concluded that a small degree of substitution for food existed. This degree, however, is found to be as low as 5.4 percent on average for the four consumed nutrients. Similarly, the values of the nutrient consumption levels (table 6.4, Previous Results' Chapter) of the two groups, indicate that the overall nutritional status of the participants is higher by a 20.8 percent level on average, for the four nutrients. Even though the highest nutritional difference was found to be for fat consumption (41.57 percent), mainly due to vegetable oil, the energy (calorie) nutritional difference is also significant (25.77 percent).

Previous research in Kenya (Bezuneh, 1985) showed that the lower income groups are the major beneficiaries of the FFW program. Evaluating the income effect of the FFW by quartiles for the same households, revealed that the lowest income groups participated more in FFW, and hence they experienced more significant income gains due to the value of the food items received. In order to clarify the FFW nutri-

tional contribution to the overall diet of the participants, this research was directed to the lowest income "groups" consumption behavior.

This analysis revealed that the FFW nutritional contribution to the poorest was 32.46 percent higher, on average, for the four nutrients, in comparison with the overall nutritional contribution of the program to all 80 FFW participating households. FFW benefited the poorest participants by 42.68 percent for carbohydrates; 38.76 percent for fat; 32.43 percent for calories; and, 24.63 percent for protein. Thus, the FFW nutritional contribution to the poorest consumers is indeed higher than the analogous average all-income groups contribution. Specifically, the higher values of nutritional benefits (compared to the all-income FFW participants' group; 80 HH's) are for carbohydrates (67.70 percent), for calories and fat by 24.40 and 18.57 percent, respectively; and 19.16 percent higher benefit value for protein consumption.

In this order, the lowest income group which participated in the FFW project, experienced significant income gains due to the added market value of the food received in exchange for their provided work. In addition, equally important is the fact that this lowest income group experienced essential nutritional gains due to the substantial nutritional value

of the consumed food items. It was concluded before that a low degree of non-food items' substitution for FFW food commodities exists. This finding along with the higher (32.46 percent) overall nutritional contribution of the FFW to the poorest consumers' group indicate that the FFW provided payment in kind (food items) results in higher food consumption.

This research revealed that the ratio of the poorest non-participants' to the poorest participants' nutrient consumption (on a person-day basis) shows a nutritional status difference of 105.2 percent less than the analogous overall nutritional status difference among all income groups combined. To illustrate, for the poorest income groups, the ratio of non-participants to participants' nutrient consumption is found to be 89.84 percent. Hence, a nutritional status[15] difference of 10.16 percent between the two poorest groups[16] exists. The corresponding nutritional level difference between participants and non-participants (for all income groups combined) is 20.85 percent, for the four consumed nutrients respectively.

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[15] The terms nutritional status, and nutrient consumption levels are used interchangeably, in this research.

[16] Wherever the term "two poorest groups" is used, it is meant that the comparison holds for the non-participants' lowest income group, and the FFW participants' lowest income group, respectively.

Therefore, the participants' and non-participants' lowest income groups showed, first, almost identical income levels. Second, this research shows that the FFW nutritional contribution is significantly higher than the existing nutrient consumption difference between the poorest non-participants' group and the poorest participants' group consumption level. Specifically, the average FFW contribution is found, here, to be 34.63 percent, for the poorest participants (four nutrients' estimate). In comparison, that the nutritional status difference between the lowest income non-participants and participants is 10.16 percent (four nutrients' estimate). Hence, the nutritional contribution of the FFW project is even more significant for the lowest income group than the overall contribution on all income groups combined (all participants). To conclude, the nutritional contribution of FFW on the lowest income group is 34.63 percent, for calories, protein, fat, and carbohydrates in average. Additionally, the FFW provided food items in terms of their monetary value, have contributed by 50.28 percent to the poorest consumers' income gains.[17]

[17] The income quantiles evaluations were estimated on a sample size of 100 FFW participants, and the lowest income group refers to the 20 percent of those households (See also Bezuneh, 1985). The nutritional consumption quantiles evaluations, in this research, were estimated on a sample size of 80 FFW participants, and the corresponding lowest income-nutrient consumption- group refers to the 25 percent of the households. In this sense, tak-

These latter details support the notion that in the specific case of the FFW project in rural Kenya, the nutritional gains of the participant households are seem to be of greater importance than the net monetary- income gains (market value of the FFW provided foods). This supporting indication comes to present a specific verification to what Reutlinger proposed as a possibility in Hague (The Hague Report, 1983). Nevertheless, the latter issue is considered as being more of a policy implication, rather than a conclusion statement alone. So, the illustration on the topic is defined in the following section of the policy implications.

Analyzing the econometric results of the nutrient demand estimations, a set of significant conclusions arises. Specifically, one of the recent most controversial parameter to estimate is the marginal propensity to spend; which is defined as MPS. Accordingly, the importance of this parameter (MPS) relies on the project food aid evaluation, policy implications on targeting nutritional intervention programs, food demand comparisons among trading nations, etc. FFW participants showed a value of MPS equal to 0.0148; while the

ing the average group income as the comparison ground between the two sample sizes (80 vs. 100), the corresponding income contribution of the FFW is only 22.77 percent for the poorest, instead of 50.28 percent for the 20 percent lower income group (100 HH's sample). Hence, this essential distinction makes even greater the importance of the nutritional contribution of the FFW project, over the net market value of the provided food items (FFW).

analogous (corresponding) value of the MPS for the non-participants was found to be 0.0078. Both these MPS estimates refer to the protein demand estimation. The ratio of the MPS for non-participants to the FFW participants' MPS is 52.70 percent. Hence, it is evident that FFW participant households experience a 90 percent higher marginal propensity to spend on protein. At the same time, the income elasticity of demand for protein or, equally stated, the sensitivity of protein demand with respect to marginal income changes, is 74.5 percent higher for the FFW participants. Indicatively, the income elasticity of demand for protein for the FFW participants is n_{FFWP}=0.239; while, for the non-participants' side is n_{NFFWP}=0.137. Similarly, FFW participants behave in a more sensitive way, (more responsively), in complementing protein and fat, compared to non-participants.

Subtracting the highest income group of the non-participants, the remaining consumer groups showed the highest sensitivity in complementing protein to fat. Their observed cross-price elasticity was found to be ε_i"=-0.207. Hence, comparing the own and cross compensated price elasticities of demand for protein, between the overall 172 non-participants and the remaining non-participants group (after subtracting the highest income group), the poor consumers respond more strongly to price changes than the "richer"

consumers. Indeed, the own-and cross- compensated price elasticities for protein demand of the poor non-participants (in relation to the overall 172 non-participants) were found to be 90.91 percent, and 27.0 percent higher, respectively. Obviously, the poorest consumers respond more strongly; or, in other words, reveal more sensitive response to food price increases. All cross price elasticities of the FFW participants and non-participants were of smaller absolute magnitude, in comparison to the own price elasticity; indicating that indeed the price of one good (fat price) and the quantity of the second good (protein quantity) have weaker correlation in consumers' behavior, than do the price and quantity (protein price & quantity) of the same good.

The results are very consistent with the theory and the conclusions are illustrative for the income elasticity for calorie consumption (demand). FFW participants showed a 118.2 percent higher income elasticity of demand for calories, in relation to the non-participants. Specifically, the income elasticity for calorie demand is found to be $n_{FFWC}=0.299$ for the FFW participants; and $n_{NFFWC}=0.137$ for the non-participants, respectively. An underlying indication of the income effects is again brought into play to distinguish FFW-participants from the non-participants.

Accordingly, in agreement with the primary objective of this research, the results show that FFW made an essential contribution to the participant households. Concurrently, both research hypotheses were supported by the results of the analysis. In detail, participants showed a quite different demand structure and consumption behavior compared to non-participants. Indeed, the income elasticities of demand for the most essential (and controversial) nutrients verify the expectations set as the guideline of this research. First, the income elasticity of demand for protein is found to be 74.5 percent higher for the FFW participants. Second, the analogous income elasticity of demand for calories is detected to be 118.2 percent higher for the FFW participants compared to the non-participants.

In sequence, according to the second hypothesis, FFW provided a substantially higher benefit to the lowest income group of participants, in terms of the nutritional contribution. This nutritional contribution is found also to be significantly higher than the net income gains of participating in the project. The latter comparison refers to the corresponding percentage points estimated here.

In this case, holding income level constant, the lowest income group showed a particularly higher income elasticity of demand for nutrients. Hence, a great proportion of the

additional income earned in-kind (FFW food items) resulted in a higher proportion of the consumed food as compared to the amount of food that would have been consumed out of net cash earnings (payment-in-cash). One reasonable explanation for this behavior is the fact that existing high local transportation and transfer costs along with lack of sufficient local market structures may eliminate the actual cash value of the received commodities (FFW). Thus, participants consumed more food items instead of exchanging them in regional (local) markets, since the effective price of the food items is essentially lower. In addition, the greater amount of food items available at the household unit may have been distributed in a different manner compared to cash-income, because the decision making process of the household may be different in the case of food distribution rather than cash-income spending.

Next, following the second objective, policy implications are derived by analyzing the results of the study. The points include the results of (a) the higher propensity to spend on nutrients of the FFW participants; (b) the stronger response of the lowest income group of participants to food price changes compared to the higher income participants; and, (c) the fact that the higher degree of participation of the lower income participants goes along with higher nutri-

tional benefits provided by the project. These points are explained also in the following chapter of policy implications.

7.2 POLICY IMPLICATIONS AND FURTHER RESEARCH DIRECTIONS

National food policies may focus on the identification of the several causes of national or regional food deficits and malnutrition. In sequence, the primary purpose of a successful national food management system may be defined in terms of achieving food self-reliance in domestic production; in food imports on commercial grounds; and in nutritional advancement. This developmental direction in agriculture is necessary because of the prevalence of malnutrition, the low level and unbalanced pattern of food production, and the unreliable trade agreements which can not guarantee any specific degree of food security with any acceptable certainty for the Less Developed Countries. The impetus to identify the several aspects which characterize the food sector and its deficits on a national or regional basis comes from the economic planners who are concerned about guaranteeing a degree of food self-sufficiency. Additionally, the economic planning is enforced by nutritionists concerned about the nutritional status of at-risk populations. These reasons call for economic and nutritional evaluation of the national

or regional food projects, food assistance programs, and food market forces, so that agricultural development may occur.

Along these considerations, national agricultural (and food-sector) development objectives can be specified, Food-Security can be viewed as the primal food objective, and specific "food targets" can be set. These issues lead to the classification of food security in terms of the ultimate national objectives which need to be achieved.

Sarris (1983) observes food security from a strictly agricultural production perspective, with all accompanying risks involved (yields, world food price fluctuations, etc.). Sarris concentrates on the formulation of a national food security strategy which is based on the optimum allocation of resources between production for the domestic sectors, the export sector, and the food import market. His objectives were to maximize the expected production level, and minimize the variance of the foreign exchange income of the developing agricultural sector; given a set of domestic consumption needs being satisfied (Sarris, 1983). His view does not concentrate on the specific social groups' needs, since it has an obvious national food security objective of achieving a certain degree of domestic production levels. Moreover, if we accept that formulating a specific optimum

national food strategy is the primal governmental objective, then an equally important "target" is an accompanying formulation of a food security strategy that ensures minimum nutritional standards for (at least) the poorest population groups.

Here is the point where food aid (and FFW, specifically) comes into play. Food aid has in many instances proved to be an effective mechanism for addressing development, income redistribution, and nutritional improvements. Food aid, overall, needs to be guided by a set of principles in order to be considered as reliable for the receivers and cost-effective for the provisioners. Food aid may decline further as an international food and income resource transfer. Concurrently, WFP, FAO, IFPRI, and several other institutions predict a further need for more food aid, not less.

On a national basis, planning will be enhanced by better knowledge of the participants' propensity to increase consumption (here, protein and calories, mainly) out of the additional income gains. These factors are essential in determining the significance of such food programs. Future food aid programs can contribute collectively in meeting the national or regional food consumption standards. Once the expected set of the consumption needs has been established, national (or regional, as always) food security strategies

can be based on the overall optimum allocation of resources between production for all sectors.

Several significant aspects of a properly conceived food policy can be derived from these research findings. This research showed that FFW contributed significantly to calorie and protein consumption advancement, by 26.07 and 20.67 percent, respectively. Given the existing controversy of calorie versus protein consumption needs, the main line of argument supports the notion that even when the minimum calorie needs are met, this does not imply that people get enough protein. This research, however, showed that FFW participants experienced significant benefits from consuming both protein and calories in significant levels. Additionally, no significantly high degree of substitution of nutrients (FFW provided nutrients) was detected. FFW foods (in nutrient equivalents) were, indeed, consumed. A slight degree of substitution was detected, however, of 5.38 percent, when the consumption estimation was derived on a per-capita and daily basis.

Moreover, FFW participants experienced significant income gains and even more significant nutritional improvement. The poorest-of-the-poor FFW participants experienced the highest nutritional gains compared to the "richer" FFW participants. Clearly, the contribution of the specific FFW project in

rural Kenya, evaluated on nutritional grounds, provides guiding evidence on targeting nutritional intervention programs to the poorest (and hardest to reach) population groups.

Seen in this respect, FFW was more essential to the poorest and needy, in terms of both nutritional and income gains. The average nutrient contribution for the poorest was found to be 34.63 percent. This nutritional value is higher (in percentage points) than the income gains alone (22.77 percent) of the poorest consumers, as they (income gains) were estimated by equating the provided (FFW) food items to their equivalent monetary (market) value. Reutlinger (1983) in Hague (The Hague Report, 1983) stressed strongly the issue of the income transfer efficiency of project food aid (i.e. FFW, in our case). His perception was that the primary function of project food aid is the transfer of income and foreign exchange. Hence, Reutlinger concludes that "...the increase in food availability in the recipient country is a function of the marginal propensity to import (food) ... by using the acquired foreign exchange" (Reutlinger in The Hague Report, p.170; 1983). Therefore, Reutlinger perceives food aid as a "bridge" of income transferring and foreign exchange gains being used to increase food imports to cover domestic consumption needs. Implicitly, his notion moves to-

wards a food import strategy more than a domestic resource reallocation in production while satisfying specific national consumption standards, as Sarris (1983) proposed. Nevertheless, a combination of the two approaches to achieve food security, in any sense (nutritional or other), seems to be a matter of each country's resource endowments.

Following this line of thought, an ambiguity that Reutlinger (1983) referred to in Hague, was that "... perhaps they (FFW participants), have a higher propensity to spend on food when they (FFW-participants) receive an income transfer in food rather than money..." (The Hague Report, p. 167; 1983). Viewing the latter issue from a combined nutritional and economic strategy, the evidence calls for analysis that goes beyond simply estimating the net income transfer that FFW may provide. In other words, Reutlinger emphasized the necessity of evaluating FFW projects on the grounds of the transferred income per dollar of project cost, rather than on nutritional grounds (as for example, provided calories per dollar of cost). This research brings his conclusion into question. At the same time, Reutlinger made explicit in the Hague report that the World Bank faces a tremendous scarcity of financial resources to assist well-designed food aid projects.

Observing all these related issues, one can see that this research shows that more significant nutritional gains occurred to the benefit of the project's participants in relation to the net income transfer gains of the participant households. Likewise, in agreement with Reutlinger, it is found here that FFW participants experienced a 90 percent higher propensity to spend on nutrients. This assertion serves to clarify one of the underlying objectives behind this research. That is, the evaluation of the cost-effectiveness of different foods, which is directly related to the nutritional value per unit cost of each food.

Given the appropriate data set and the necessary time needed, further research could quite possibly be extended in that direction. For example, in order to evaluate the cost-effectiveness of a food aid project, what is needed is to design a food aid supply (i.e. FFW project) which provides all nutritional needs at the least possible cost. Reutlinger (1984) defines the cost-effectiveness of a usually consumed commodity i, as the monetary value per unit of food i to the recipient times (x) the household's marginal propensity to spend on the nutritional unit j, with respect to the cost per unit of food i. Hence, the higher the marginal propensity to spend on the targeted nutritional unit, and the lower the cost of the commodity to the donor, given the monetary

value (per unit) of the provided food (in question), the greater the cost-effectiveness of the food project will be. Unfortunately, lack of data concerning the costs per unit of each FFW provided food item, does not allow the estimation of the cost-effectiveness of this project.

Finally, it is the income elasticity of demand for nutrients that plays an equally important role in food policy. This is true, because the nutritional needs of the poorest can not be solved solely by increasing domestic food production. The problem of the poorest is one of inadequate incomes, a view which stresses the importance of direct food delivery mechanisms to the malnourished groups. Seen as such, the income elasticity of demand for protein (FFW-participants) is found to be 74.5 percent higher, than the non-participants. For calories, also, the income elasticity is 118.2 percent higher for the participant households. These income elasticities must be interpreted with caution. The risk comes from the fact that since the data used here are cross-sectional, the estimated elasticities refer to long-run responses (See for additional details, Timmer and Alderman, 1979).

To conclude discussion of policy directions, it is the real income gains of the poor that go along with increased nutrition in well-designed FFW projects, as shown in the

case here. Now, by narrowing down the income gaps, it seems to improve the nutritional status of both "rich" and "poor" consumers, at least in the long run. The improvement of the rural infrastructure will increase access to jobs, and increase significantly the nutritional status of the poor. Lowering food prices, of course, will further assist the poorest, in terms of consumption levels. Skill application may also occur through the well-designed food aid projects, since the poor develop better working skills, and employment opportunities may, hopefully, follow.

7.3 CONTRIBUTION OF THE STUDY

The concern for this study is derived from the recent economic problems which have been raised by national economic planners, and international organizations such as the United Nations and the World Food Program (WFP). The need for Food Aid project evaluations, and the economic analysis of the multi-dimensional aspects of Food Aid impacts on the recipient country's market structure represent current issues in the heated political and economic discussions about international food aid allocations.

So far, the interactions of the nutritional impacts of food aid and FFW with the economic status of the participants in the programs (FFW) have not been well analyzed.

Hence, the contribution of this research is to provide a set of useful information on the nutrition and economic aspects of food aid. Given the recent results of previous research in the area (Bezuneh, 1985), this study helps clarify previous ambiguities and verify some other possibilities. Specifically, the previous research in the same area showed that income augmented the consumption of food of the participant households in the FFW project (Bezuneh, 1985). This research now shows that FFW has a specific nutritional contribution which is essentially greater to the lowest income participants.

The FFW nutritional contribution has substantially improved the consumption levels of both protein and calories. Hence, a distinct result of this study is that it may help clarify the "old" controversy on the issue of protein vs. calorie contribution of food aid projects. This research detected a 26.07 percent contribution of the project in calories, and 20.67 percent contribution in protein consumption. As supporting additional evidence, it is shown here that FFW participants experience a 90 percent higher marginal propensity to spend on protein consumption compared to the non-participants.

Finally, considering all the above points it must be made clear that food security is directly related to food aid and

FFW projects. The reason is that FFW can provide substantial nutritional and income resources to subsistence farmers who adopt new techniques and inputs by participating in the project. In the case of unfortunate low harvesting seasons, FFW can provide a security payment and nutrient source needed in order to assist (and secure) farmers from a disastrous lack of irreplaceable nutrients. In this sense, the use of food is of unique importance to the lowest income farmers, who need to remain on their farms if agricultural development is to be achieved.

7.4 LIMITATIONS

Lancaster's approach, by itself, may be considered as a special case of consumer's choice, rather than a general model of consumer demand. The latter criticism of Lancaster's approach being considered as an extension of the neoclassical consumption theory does not confine the significant contribution of his "pioneering" work in the area. In this respect, it is the conceptual setting of Lancaster's approach that contributed in this research. Whereas, the importance of any modifications in Lancaster's analysis (i.e. Ladd and Suvannunt; 1976) are always essential and should be followed. What seems to be significant is the conceptual enrichment of the fundamental neoclassical consumption theory.

Scientific criticisms on the theoretical assumptions of Lancaster's approach (Hendler, p. 198) may help in improving the applicability of structural models, but do not add as much as the conceptual enrichment of the foundations of consumer choice theory.

Nevertheless, this research, as any other, has its own limitations. Not all consumption patterns or all nutrient consumption levels were estimated; the reason being either lack of available informational resources on the nutritional content of all consumed food items, or restrictions on data availability. In addition, this research may be criticized on the grounds of the mathematical linear programming models' specification (LPM). On that, the idea was to describe the actual consumption patterns of the household units, while imposing the objective of minimizing the total household food expenditures. Clearly, other more restrictive constraints could be implemented as, for example, by using National Recommended Dietary Allowances for the LP-Models' constraints in order to estimate additional nutrient marginal (shadow) prices. But, this direction may seem more appropriate for further research rather than a research limitation.

BIBLIOGRAPHY

Aseffa, Abreha. "Development Impact and Effectiveness of Food Aid: The Ethiopian Experience". Report of the World Food Programme (WFP), Seminar on Food Aid, The Hague: Government of the Netherlands, 1983.

Austin, James, and Wallerstein, Mitchel. "Reformulating U.S. Food Aid Policy for Development". World Development: 7:635-646.

Bale, Malcolm, D., and Duncan, Ronald, C. "Food Prospects in the Developing Countries: A Qualified Optimistic View". American Journal of Agricultural Economics: Vol 73:244-248, May 1983.

Balintfy, Joseph, L., Neter, John, and Wasserman, William. "An Experimental Comparison Between Fixed Weight and Linear Programming Food Price Indexes". Journal of the American Statistical Association: 65:49-60, March 1970.

Bezuneh, Mesfin, and Deaton, Brady, J. "Food Aid Disincentives and Economic Development: Some Reconsiderations in Light of the Tunisian Experience". Paper presented at the 1981 Annual Meeting of the American Agricultural Economics Association: AAEA, 1981.

Bezuneh, Mesfin. "Food Aid and Economic Development: Impact of Food For Work on Labor Allocation, Production, and Consumption Behavior of Small Family Farms in a Semi Arid Area of Kenya". Unpublished Ph.D. Dissertation: Department of Agricultural Economics, Virginia Polytechnic Institute and State University (Virginia Tech), Blacksburg, Virginia, 1985.

Chavas, Jean-Paul, and Keplinger, Keith. "Impact of Domestic Food Programs on Nutrient Intake of Low-Income Persons in the U.S.". Southern Journal of Agricultural Economics: SJAE, July 1983:155-162.

Christensen, Cheryl, and Witucki, Larry. "Food Problems and Emerging Policy Responses in Sub-Saharan Africa". American Journal of Agricultural Economics: AJAE, Vol. 64:889-896, Dec. 1982.

Dams, T., et al. "Food and Population: Priorities in Decision Making". Report of a Meeting of the International Conference of Agricultural Economists: Nairobi, August 1976: Hants, England, Saxon House, 1978.

Deaton, Brady, J. "Public Law 480: The Critical Choices". American Journal of Agricultural Economics: AJAE, 62:988-992, 1980.

De-Janvry, Alain. "Dilemmas and Options in Formulation of Agricultural Policies for Africa". Food Policy, Economic Development Institute (EDI): The World Bank, (Draft), pp:185-196, 1985.

Falcon, Walter, P. "Recent Food Policy Lessons from Developing Countries". American Journal of Agricultural Economics: AJAE, Vol. 66:180-185, May 1984.

FAO. "Food Composition Tables for Use in Africa". Rome: FAO/USDA, 1968.

FAO. "Yearbook of International Population, Trade Statistics". Rome: Various Issues, 1976, 1978, 1980.

Food and Nutrition Board. "Recommended Dietary Allowances.". National Research Council: Institute of Medicine, National Academy of Sciences, Ninth Edition: 1980, Washington D.C., 1980.

Foster, Phillips. "Agricultural Prices and Rural Malnutrition.". United States Agency for International Development: Occasional Paper No.7, February 1978.

George, P., S., and King, G., A. "Consumer Demand for Food Commodities in the United States with Projections to 1980.". Giannini Foundation Monograph, No. 26: University of California Berkeley, March 1971.

Grigsby, S.,E., and Simpson, R., L. "Evaluation of P.L. 480, Title I Trade Agreements: The Case of Colombia.". International Economics Division: Economic Research Service (ERS), USDA, (Draft), 1984.

Hall, Lana, L. "Evaluating the Effects of P.L. 480 Wheat Imports on Brazil's Grain Sector.". American Journal of Agricultural Economics: AJAE, 62:19-28, 1980.

Hathaway, D., E. "International Food Security : Issues and Alternatives.". International Food Policy Issues: Statistics and Cooperatives Service (SCS): USDA, January 1978.

Hendler, Reuven. "Lancaster's New Approach To Consumer Theory and Its Limitations.". American Economic Review: AER, 65:195-199, March 1975.

Hopkins, Raymond, F., and Puchala, Donald, J. "The Global Political Economy of Food.". The University of Wisconsin Press, 1978.

Horton, Susan. "The Determinants of Nutrient Intake: Results from Western India.". Journal of Development Economics: JDE, 19:147-162, North-Holland, 1985.

I.F.P.R.I. "Food Needs of Developing Countries: Projections of Production and Consumption to 1990.". International Food Policy Research Institute: I.F.P.R.I., Research Report 3. , Dec. 1977.

I.F.P.R.I. "Food Security: An Insurance Approach.". International Food Policy Research Institute: I.F.P.R.I., Research Report 4., Sept. 1978.

Isenman, P., J., and Singer, H. "Food Aid: Disincentive Effects and Their Policy Implications.". Economic Development and Cultural Change: EDCC, 25:205-237, 1977.

Johnston, Gale, D., and Schuh, Edward, G. "The Role of Markets in the World Food Economy.". Westview Special Studies in Agriculture Science and Policy: Westview Press, Boulder, Colorado, 1983.

Joy, Leonard. "The Segments of the World Population at Nutritional Risk.". American Journal of Agricultural Economics: AJAE, Vol. 61:977-981, Dec. 1979.

Konandreas, Panos. "Assessing the Components of Prospective Food Aid Requirements.". Food Policy: Feb. 1986, pp:19-26.

Ladd, George, W., and Suvannunt, Veraphol. "A Model of Consumer Goods Characteristics.". American Journal of Agricultural Economics: AJAE, Vol. 58:504-510, August 1976.

Lancaster, Kelvin. "A New Approach To Consumer Theory.". Journal of Political Economy: JPE, 74:132-157, 1966.

Lancaster, Kelvin. "Consumer Demand: A New Approach.". Columbia University Press: New York, 1971.

Lane, Sylvia. "The Contribution of Food Aid to Nutrition.". American Journal of Agricultural Economics: AJAE, 62:981-987, Dec. 1980.

Latham, Mitchel. "Human Nutrition in Tropical Africa.". Rome: FAO, 1985.

Mann, J., S. "The Impact of Public Law 480 Imports on Prices and Domestic Supply of Cereals in India.". American Journal of Agricultural Economics: AJAE, 49:131-146, 1967.

Maxwell, S., J., and Singer, H., W. "Food Aid to Developing Countries: A Survey.". World Development: 7:225-247, 1979.

Mellor, John, W. "Food Aid Policies and Income Distribution in Low Income Countries.". Ecocomic Development & Cultural Change: EDCC, 27:1-26, 1978.

Mellor, John, W. "Food Aid and Nutrition.". American Journal of Agricultural Economics: AJAE, 62:979-983, Dec. 1980.

Mellor, John, W. "The Contribution of Food Aid to Equitable Growth.". in Report of the World Food Program (WFP): Government of the Netherlands, The Hague, 1983.

Mellor, John, W. "Food Prospects for the Developing Countries.". American Economic Association: AEA, Papers and Proceedings, AJAE 73:239-243, May 1983.

Mosquera, T., U. "The Right to Food: A Critical Review.". Report of the World Food Program (WFP): Government of the Netherlands, The Hague, 1983.

Nelson, G., O. "Improving the Effectiveness of Food Aid: A Report of the Seminar.". Food Aid and Development Council: ADC, N.Y., 1981.

Phlips, Louis. "Applied Consumption Analysis.". Revised and Enlarged Edition: North-Holland Publishing Company, 1983.

Pitt, Mark, M. "Food Preferences and Nutrition in Rural Bangladesh.". The Review of Economics and Statistics: RES, 65:105-114, Feb. 1983.

Pinstrup-Andersen, Per, and Caicedo, Elizabeth. "The Potential Impact of Changes in Income Distribution on Food Demand and Human Nutrition.". American Journal of Agricultural Economics: AJAE, August 1978:402-415.

Prato, Anthony, A. "A Proposal for Reducing the Nutrient Deficiencies with Economical Diets.". Canadian Journal of Agricultural Economics: CJAE, 21:15-22, 1973.

Prato, A., A., and Bagali, J., N. "Nutrition and Nonnutrition Components of Demand for Food Items.". American Journal of Agricultural Economics: AJAE, Vol. 58:563-567, August 1976.

Reutlinger, Shlomo., and Selowsky, Marcelo. "Malnutrition and Poverty: Magnitude and Policy Options.". World Bank: Staff Occasional Papers (23), World Bank, Johns-Hopkins University Press, 1976.

Reutlinger, Shlomo. "Food Insecurity: Magnitude and Remedies.". World Development: 6:797-811, 1978.

Reutlinger, Shlomo. "Project Food Aid and Equitable Growth: Income Transfer Efficiency First.". World Food Program (WFP): Seminar on Food Aid, Government of the Netherlands, The Hague, 1983.

Reutlinger, Shlomo, and Katona-Apte, Judit. "The Nutritional Impact of Food Aid: Criteria for Selecting CostEffective Foods.". Food Policy Issues: Economic Development Institute (EDI), The World Bank, (Draft), pp. 185-196, 1985.

Reutlinger, Shlomo. "Food Security and Poverty in LDC.". Finance & Development: Vol 22, No.4, pp.7-11, Dec. 1985.

Rogers, K., D., Srivastara, V., K., and Heady, E., O. "Modified Price, Production and Income Impacts of Food Aid Under Market Differentiated Distribution.". American Journal of Agricultural Economics: AJAE, 54:201-208, 1972.

Ruttan, Vernon, W., and Fox, Glenn. "A Guide to LDC Food Balance Projections.". Department of Agricultural and Applied Economics and Hubert H. Humphrey Institute of Public Affairs: University of Minnesota, St. Paul, in the European Review of Agricultural Economics, Vol.10-4, pp.2-356, 1983.

Sarris, Alexander, H., and Taylor, Lance. "Cereal Stocks, Food Aid and Food Security for the Poor.". World Development: Vol.4:967-976, 1976.

Sarris, Alexander, H. "Food Security and Agricultural Production Strategies Under Risk in Egypt.". Journal of Development Economics: JDE, 19:85-111, 1985, North-Holland.

Schneider, Hartmut. "Food Aid for Development.". Report on the OECD: Development Centre Expert Meeting on "Scope and Conditions for Improved Use of Food Aid for Development", Paris, March 1978, OECD.

Schneider, Hartmut. "Meeting Food Needs in a Context of Change.". Development Centre of the Organization for Economic Cooperation and Development: OECD, Paris, 1984.

Schuh, Edward, G. "Improving the Development Effectiveness of Food Aid.". U.S. Agency for International Development: USIAD, 1979.

Schuh, Edward, G. "Food Aid and Human Capital Formation.". Food Aid and Development: Agricultural Development Council, N.Y. 1981.

Schuh, Edward, G. "Increasing the Effectiveness of Food Aid: Offsetting the Opportunity Cost of Schooling.". Report of the World Food Program (WFP): Government of the Netherlands, The Hague, 1983.

Schuh, Edward, G. "The World Food Situation: Changing Trends in World Food Production and Trade.". American Economic Association: AEA, Papers and proceedings, American Journal of Agricultural Economics (AJAE), Vol.73:235-238, May 1983.

Schuh, Edward, G. "Strategic Issues in International Agriculture.". The World Bank: Washington D.C., 1985 (Draft).

Schultz, T., W. "Value of U.S. Farm Surpluses to Underdeveloped Countries.". Journal of Farm Economics: JFE, 62:1019-1030, 1960.

Seevers, G. "An Evaluation of the Disincentives Effects Caused by P.L. 480 Shipments.". American Journal of Agricultural Economics: AJAE, 50:630-642, 1968.

Selowsky, Marcelo. "Target Group-Oriented Food Programs: Cost Effectiveness Comparisons.". American Journal of Agricultural Economics: AJAE, Vol. 61:988-994, Dec. 1979.

Sen, S., R. "Whither Aid.". American Journal of Agricultural Economics: AJAE, 53:768-776, 1971.

Sexauer, B. "Critical Choices in World Food Aid and Nutrition: Discussion.". American Journal of Agricultural Economics: AJAE, 62:993-994.

Sinha, R. "The World food Problem: Consensus and Conflicts.". World Development: 5:371-382, 1977.

Stevens, Christopher. "Food Aid and Nutrition: The Case of Botswana.". Food Policy: Feb. 1978:18-28.

Stevens, Christopher. "Food Aid and the Development World.". Overseas Development Institute: London, 1979.

Tanco, R., A. "The First of All Imperatives: Banish Hunger in Our Time.". Symposioum in Richmond, VA: in Agriculture in 21st Century by Rosenblum, W., J., 1983, University of Virginia.

Timmer, Peter, C., and Alderman, Harold. "Estimating Consumption Parameters for Food Policy Analysis.". American Journal of Agricultural Economics: AJAE, 61:982-987, Dec. 1979.

Timmer, Peter, C. "Food Prices and Food Policy Analysis in LDCs.". Food Policy: Vol.5:188-199, August 1980.

Valdes, Alberto. "Food Security for Developing Countries.". A Westview Special Study: Westview Press, Boulder CO., 1981.

Varian, Hal, R. "Microeconomic Analysis.". Norton Publishing Company: Second Edition, 1984.

Waterfield, Charles. "Disaggregating Food Consumption Parameters.". Food Policy: November 1985:337-351.

Weckstein, R., S. "Food Security: Storage vs. Exchange.". World Development: Vol.5:613-621.

World Bank. "World Development Report.". New York: Oxford University Press, 1978, 1984.

World Bank. "Food Security in Food Deficit Countries.". Staff Working Paper No.393, June 1980.

World Food Program. "Brief on WFP in Kenya.". Nairobi, Kenya, 1980.

Yetley, Mervin, J., and Tun, Sovan. "A New Method To Assess Effects of Food Supply Shocks on Consumption in Developing Countries.". USDA: ERS, Technical Bulletin No.1697, Washington D.C., January 1985.

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