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THE CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES

THE CASE OF MARKET INTERVENTION IN PANAMA

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EXECUTIVE SUMMARY

The objective of this study is to explain the role that agricultural price policies in Panama may have had on the levels and patterns of food consumption among the different population groups. The analysis is based on data from the National Nutrition Survey of 1980, and secondary data from the Contraloria General de la Republica, the Ministry of Agricultural Development, and other official sources. The first half of the study describes the nutritional status of urban and rural consumers, and estimates the relative impact of income and other socioeconomic variables on the consumption of rice, corn, beans, beef, milk, and poultry. The second half is devoted to the analysis of recent agricultural price policies, their impact on agricultural production, and their subsequent impact on the availability of food at the consumer level.

In 1973 the agricultural sector of Panama underwent a radical change in its institutional and political structure. The net result was a substantial increase in governmental control of agricultural resources, and a significant increase in official involvement in the input and output price systems. The principal objective of this intervention was to promote self reliance in the production of food, and to improve the nutrition of consumers, especially in the urban areas. The principal instruments used were price supports at the farm gate, governmental procurement of basic grains, and retail price ceilings. Additional policy instruments included some land reform, subsidies for credit and machinery services, and the creation of autonomous agencies engaged in the direct production of selected farm products.

After ten years of this policy environment the results of the survey indicate that there are still nutritional deficiencies to be found among the urban poor and small farmers. The present nutritional situation is such that food energy availability for approximately half the population is slightly below the levels recommended by FAO. Moreover, almost one-fifth of all households have diets with deficiencies in proteins and energy. Food consumption patterns indicate that rice is the principal individual source of calories, especially among rural households, and that beef and poultry are the main sources of protein. Corn is important only as a feedgrain for poultry.

Income is the main factor affecting food consumption in urban and rural areas. This finding is important since it was also found that most rural families derive most of their income from non-farm sources. Other variables of importance among the rural poor are education and family size. These variables were identified as being significant with respect to consumption of grains. Almost three quarters of small farm production was consumed by the small farmers themselves with the remaining 25 percent of farm production being sold for cash. Both rural and urban households show elasticities of food expenditures with respect to income of approximately 0.35.

The effect of price policies on farm production was found to be successful for those products which had also undergone substantial technological change, such as rice and poultry. The price incentive given to rice producers coupled with an increase in productivity from new varieties helped increase the availability of rice at the consumer level. In the case of poultry, the change in technology and a favorable

feedgrain import policy helped increase the supply of poultry at the same time as its real price declined. Products which did not increase their productivity, such as beef, seem to have been negatively affected by the price policy of the past decade. In the case of corn, where technical change occurred only among mechanized farmers, the results indicate that the benefits of high producer prices went to those farmers with a high proportion of market connectedness.

Market connectedness seems to be a key factor for future policy design. The results from the survey indicate that the rural poor are the demographic group with the highest nutritional risk in Panama today. However, they are the group least affected by price policies ostensibly aimed to benefit producers since their market connectedness is so low. In order for small farmers to increase their participation in the market the returns to farming need to be at least equal to the returns from non-farming activities. However, given the high domestic resource cost for grain production technologies in Panama, such a scenario is unlikely in the near future. The results thus suggest that in order to improve the nutrition of rural groups more attention should be paid to factors affecting non-farm income, especially rural labor markets and the market for human resources.

THE CONSUMPTION EFFECTS OF AGRICULTURAL POLICIES: THE CASE OF MARKET INTERVENTION IN PANAMA

I. INTRODUCTION

The purpose of this study is to attempt to explain the role which recent agricultural policies in Panama may have had in determining the levels and patterns of food consumption by different groups in the Panamanian population. The study focuses on the current food consumption situation and its economic determinants. It also attempts to trace the food consumption effects of some instruments of agricultural policy which have been pursued in the last ten years or so. The policy instruments considered are principally market interventions by the public sector through the product pricing mechanism. Specifically, the study considers farm price support and parastatal procurements as policy instruments affecting the market for rice and corn and price and export controls affecting the market for beef and milk.

The present nutritional situation in Panama is such that food energy availability is just slightly above human requirements but, for at least half the population, somewhat below the nutritional levels recommended by FAO. Moreover, approximately one-fifth of all households have diets with deficiencies in protein and caloric content. The economics of food expenditures seem to indicate that sugar is the best buy in terms of calories, but rice is the best buy in terms of calories and protein. Beans, a secondary component in the Panamanian diet, are a close second. Breads and cereals are good buys for the average family, but poultry and vegetables are not.

During the mid-1970's, official policy in Panama regarding the markets for rice, corn, beef, milk and other food commodities was oriented towards the multiple goals of food self-sufficiency, improved rural incomes, and low cost food supplies for urban dwellers. These policies have had important effects over the distribution of nutritional adequacy and incomes across different groups in the population. The policies have been only partially successful in achieving their stated goals and have led to important equity and efficiency consequences.

Recently, there has been renewed official concern with the issues of improving the nutritional situation and with enhancing the efficiency of domestic resource utilization. This report is offered as a modest contribution towards understanding the interdependencies between these two important issues in Panama.

The study is meant to deal primarily with the "consumption effects" of agricultural policies. However, these effects are so closely related to other welfare and to production effects that they must be discussed as a whole. Moreover, owing to the lack of appropriate time series, consumption effects over time can be estimated only indirectly or by inference.

It will be noted that overriding emphasis has been put on an analysis of price policies. This is so because it has been found that in a market economy these policies are the key to the behavior of production and consumption. Moreover, no matter how questionable the data base, it is generally easier analytically to relate market behavior to prices than to other phenomena of public policy such as technology transfer, capital availability and land tenure. Nevertheless, where strong evidence was found to exist concerning the effects of these other policy areas, they are, of course, considered.

Rural employment creation or maintenance is often adduced as a major objective of agricultural price support in Panama. This study does not attempt to assess the employment effect.

The report is organized as follows: First, the food consumption patterns are presented and analysed. Second, the performance of the food producing sector is reviewed in the context of the policy instruments which have been applied over the last decade. The report concludes with a qualitative assessment of probable consumption effects of policy alternatives which may be considered in the near future.

II. FOOD CONSUMPTION PATTERNS AND THEIR DETERMINANTS

This section starts with a brief review of previous analyses of nutritional adequacy in Panama and then presents the results of statistical analysis of the food consumption data developed for the 1980 Nutrition Study (Parillón, 1981, 1982). The purpose of this analysis is to present an overview of the food consumption situation for various income groups in rural and urban areas, to describe the food use patterns in the diets of various consumer groups, to estimate econometrically some of the determinants of these food consumption patterns in Panama, and to relate the findings to the original policies which initiated them.

A. Distribution of Nutritional Adequacy

Aggregate estimates of nutritional adequacy for Panama report that food energy availability is, on the average, slightly above human requirements, but that the income distribution is such that 51 percent of the population is estimated to consume less than the FAO/WHO recommendations for calories (Reutlinger and Selowsky, 1980). The data from the food consumption part of the 1980 Nutrition Study indicate that for more than half of the households in that sample, calorie intakes adjusted for age and sex composition are below the FAO reference value of 2700 calories per calorie equivalent person (Table 1). As many as 25 percent of the households have daily calorie intakes one-third lower than the reference value. There do not appear to be appreciable differences between the rural and urban distributions of nutrients among households.

Similarly, an analysis of the same data by Quevedo, in her thesis at INCAP, shows that average daily per capita calorie consumption approaches adequacy (1981). Still, the percentile distribution of calorie

consumption shows that a large number of families fall below regional recommendations for calorie consumption. Her percentile distributions show that 66.2 percent of all households in the sample have calorie consumption above 80 percent of the INCAP criterion and that the percentage of households with calorie deficiencies below this level is 33,8 percent. Percentile distributions in her analysis also show that 78 percent of all households in the sample have adequate protein consumption and that 88.9 percent have consumption above the 80 percent level of adequacy. Diets deficient in calories are more prevalent than protein deficient diets, and protein consumption is not a major problem for most households. Her analysis shows that 39.4 percent of all households in the sample have diets adequate in both calories and protein and that 20.5 percent have diets deficient in both. Of the remaining households, 38.6 percent have diets adequate in protein, but deficient in calories and only 1.5 percent have diets adequate in calories but inadequate in protein.

The average rural diet contains 29 grams of protein per thousand caloreis and the urban diet contains 32.7 grams of protein per thousand calories. These levels compare favorably with U.S. data; the average protein density ratio from the 1977-78 National Food Consumption Survey in the United States was 34.8 grams per thousand calories for the whole U.S. population (Franklin et al, 1980). Diets with these protein densities will more than satisfy protein RDA's if energy intakes are near adequacy levels, e.g., recommendations by the United States' National Academy of Science imply that a diet adequate in energy and protein would contain approximately 21 grams of protein per 1000 calories.

In summary, the nutritional problems in Panama are principally associated with an inadequate distribution of food energy across households, rather than with protein deficiencies, per se.

B. Food Consumption Patterns

The share of each principal food commodity in the household's total calorie intake and food expenditure is presented in Table 2 for all households and in Tables 3 and 4 for rural and urban households, respectively. Rice is the important staple in the Panamanian diet; it accounts for one-third of the calories, one-fourth of the protein, and one-sixth of food expenditures (Table 2). The importance of rice is greater in the diets of rural households than in urban households (Tables 3 and 4). Next in importance are fruits, vegetables, roots, tubers, plantains, bananas and oils as sources of calories and expense. Beef is an important source of protein and expense, with poultry as important in the expenditure pattern. The diets of the rural population are composed of rice, oils and fats, fruits and vegetables, including roots, tubers, plantains and bananas. The urban diets are relatively more intense in beef and poultry as complements to a rice-based diet.

The so-called basic grains, corn and beans, play a small role in the diet, yet they are of greater relative importance for rural households than for urban households. Average shares of total daily calories for rural households for corn and beans are 3.6 percent and 6.1 percent respectively, while among urban households corn represents only 1.8 percent and beans only 3.8 percent of household calorie availability. Roots, tubers, plantains, and bananas, on the other hand, represent almost 10 percent of the calories for the rural households, while for

urban families, these products account for less than 5.5 percent of the total caloric intake. Since rural households are relatively poorer than urban households, corn, beans and rice are of greater relative importance in the diets of lower income households. Other major commodities--milk, poultry and beef--represent a larger share of the diet for urban households than for rural households.

The substantial role of foods of animal origin, including fish, in the Panamanian diet is clearly shown by the survey data in Table 5. These figures also illustrate the qualitative differences in the diets of urban and rural households.

In summary, these data reveal the importance of rice, foods of animal origin (especially beef, poultry and eggs, and milk), fruits, vegetables and oils in the average Panamanian diet, and the relative insignificance of beans as well as of corn for direct consumption.

C. Costs of Diets

Regional published prices were used to impute monetary value to the 24-hour recall food consumption data obtained in the 1980 survey. This imputation was used to analyze the relationship between cost and composition of diets. The extreme values on money value of food (5th and 95th percentiles) in Table 1 are approximately the same between the urban and rural samples, but the central values are substantially higher for the urban sample. Using the median (50th percentile) levels from Table 1, urban diets cost approximately 50 percent more than rural diets for the same calorie levels. One Balboa[1/] purchases approximately 45 percent more calories in the rural areas than in the urban areas.

[1/] One Balboa (B./) = 1.0 U.S. Dollar.

The 50 percent higher food costs for urban areas are due, in part, to marketing margins, but also to quality differences. Calculating the cost of a diet adequate in energy and protein in the proportions given in Tables 3 and 4 it is estimated that $1.36 per adult equivalent person per day would be required in both the urban and rural areas when computed at regional retail prices. However, using protein content of the diet as an index of quality, it can be seen (Table 5) that urban diets are more protein dense, thus suggesting quality differences as an important factor accounting for regional differences in food costs.

D. Determinants of Food Consumption Levels and Patterns

The Directorate for Nutrition of the Ministry of Health in Panama periodically publishes an estimate of the per person food costs necessary to obtain a nutritionally adequate diet from the typical food use pattern in Panama. This cost is known as the cost of the basic food basket and was estimated at $1.06 per adult per day at the time of the 1980 nutrition survey. This value was used to stratify the data from the survey households according to income per capita and to a criterion suggested by the Economic Commission for Latin America (CEPAL, 1981). This criterion establishes three income cut-off points for defining levels of poverty; per capita incomes below the cost of a basic food basket are said to reflect extreme poverty; per capita incomes greater than the cost of one basic basket but lower than twice the monetary value of two basic baskets are said to reflect poverty; per capita incomes at levels between twice and three times the cost of the basic basket are considered low but adequate, and per capita income levels above three times the cost of the basic basket are considered as not poor.

Table 6 presents the stratification of household incomes according to this criterion and the associated average values for food costs, calorie and protein intakes, and number of calorie equivalent persons per household. The table indicates that low incomes are associated with low levels of food expenditure and food consumption. The table also highlights the great disparity between urban and rural incomes; 23 percent of the urban sample households are judged to be in extreme poverty, whereas 54 percent of the rural households are judged to be in extreme poverty according to the CEPAL criterion. Even within stratum 1 (extreme poverty), the per capita levels of food expenditure are 27 percent lower for the rural sample than for the urban sample. In addition, the number of calories per balboa spent on food vary inversely related to the income stratum, especially in the urban areas. The point here is that the households in stratum 1 and stratum 2 are relatively efficient in their calorie expenditure behavior in that, on the average, they obtain 15 to 20 percent more calories per dollar of food expenditure than the mean diet (Tables 3 and 4). The poor people in Panama make adjustments in their food preferences to lower cost foods in efforts to achieve caloric adequacy with very low incomes. This result would go counter to some statements suggesting that dietary inadequacy in Panama is associated with food purchase habits that include the use of high cost processed and imported foods.

E. Econometric Results

Total expenditures on food, calorie consumption and quantities of each of the following six commodities--rice, corn, beans, milk, poultry and beef--were regressed on a number of socio-economic variables. For urban households the explanatory variables included monthly incomes,

family size, homeownership as a measure of assets, education of the head of household, and sector of employment of the head of household.

For the rural households the regression variables included gross income (including value of agricultural production consumed by the household), family size, percentage of off-farm income, an index of market connectedness (value of agricultural products sold as a ratio of total agricultural production), land holdings, and education of the head of household. The index of market connectedness was intended to measure the direct effect that producer price policies may have on consumption patterns. The percentage of off-farm income was intended to measure the possible impact of factor market rather than product market conditions on the consumption patterns of the rural population. Table 7 presents the averages and frequencies of selected household variables used in the regression analysis for urban and rural households.

Econometric analysis of food consumption patterns for rural households on the six commodities (see the appendix for regression analyses) yielded income as a highly significant determinant of consumption of rice, milk, poultry and beef, but of lesser importance for beans and insignificant for corn. Corn and beans are the least preferred commodities; however, they are of greater relative importance to poorer households. Higher income households consume more rice, the major staple, and more milk, poultry and beef.

Table 8 presents the estimated income and expenditure elasticities for the above commodities, in rural households. As expected, beef and poultry are more elastic than rice. Any increase in disposable income, therefore, would increase consumption of protein from animal sources rather than from grains. Similarly, a technological change which would

lower beef prices would undoubtedly increase consumption of beef proportionally more than a comparable change in rice. It should be noted that the elasticities for poultry are higher than for beef. This difference is beneficial for consumers since the stock of poultry may be increased faster than the stock of cattle. If protein consumption among low income households is to be pursued, then encouraging the poultry industry over the livestock sector would bring quicker results. The expenditure elasticities are higher than the quantity elasticities, suggesting that even in the rural sector there are important quality and service components to food expenditure patterns.

For the rural households, the econometric analysis of nutritional determinants indicates that family size is a significant determinant of bean, corn and rice consumption: larger families tend to be poorer and to consume more of the less preferred commodities. In addition, education was found to be a highly significant determinant of consumption. In those households in which the family head has less than one year of education, more corn, beans and rice are consumed. This again reflects poverty as an important determinant of food consumption patterns because the lower income households have less education. The percentage of off-farm income as a regressor is significant and negative for beans and rice: households earning a greater percentage of income off the farm will consume less beans and rice. Households with high percentages of off-farm income have higher total incomes and do not consume as much of the less preferred commodities. Farm size is significant only for corn consumption. For the rural sector it is worth noting that neither farm size, mechanization, nor market connectedness are by themselves important determinants of the food consumption patterns.

For the urban households, neither homeownership nor sector of employment enter as significant determinants of the household consumption patterns. The result on sector of employment is important because it has been frequently suggested by Panamanian economists that the service orientation of the urban sector leads to conditions of poverty. If anything, this analysis suggests that the expenditure patterns of households employed in the service sector are similar to those of higher income households.

Table 9 presents the food expenditure/income elasticities for urban and rural households. These elasticities are low for populations with significant energy deficits. In the case of an open, service-oriented economy like Panama, this low estimate may suggest a different set of expenditure priorities than in the case of other developing countries in the region, which have substantially less access to consumer goods. However, these estimates are tentative and should be viewed with some care.

F. Analysis of Food Consumption in Panama

The statistical and econometric analyses indicate that income is the principal determinant of food consumption levels in both the rural and urban areas of Panama. While there are poor people in both areas, rural incomes are much lower than urban incomes, with more than half of the rural households in conditions of extreme poverty.

Given the importance of income as the determinant of both the pattern and level of food consumption, it is important in turn to analyze the sources of incomes, particularly as these may relate to agricultural policies. Rural incomes seem principally determined by conditions in the rural labor market. Table 10 presents the index of market

connectedness and the percentage of off-farm income for the four income strata as determined by the CEPAL criterion.[2/]

The index of market connectedness is not significantly different from 0.25 for all strata, yet it is clear that the higher income households in the rural area are those that are engaged in wage work rather than in agricultural production. Conditions in rural labor markets (perhaps agricultural factor markets) would seem to be a more important determinant of income than conditions in product markets. In fact, high product prices could possibly have a negative impact on real rural incomes unless they are reflected in higher real wages through the factor markets.

Wage equations were estimated for the urban and rural sectors in a related project (Parrillón et al., 1982), and it was found that wages (and therefore incomes) in both the rural and urban sector are being determined by human capital variables of schooling and experience. The principal consequences of agricultural and economic policy changes on the levels and patterns of consumption in Panama would therefore be determined by the impact of policies on wage income in both rural and urban settings.

To explore this issue further, a number of socio-economic characteristics of rural dwellers whose principal economic activity was rice and/or corn production were examined. Table 11 presents results which suggest that such producers are a minority among rural dwellers and that they tend to be poorer than other rural dwellers. Most rural households

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[2/] A study being conducted currently under UNDP auspices by Professor Jian Sahota of Vanderbilt University is questioning the CEPAL methodology and suggests that the latter markedly exaggerates the extent of poverty in Panama.

(79 percent) earn more than half of their income from non-farm sources. Hence, a policy favoring high grain prices would benefit large commercial producers (who are urban dwellers) rather than small-scale rice and corn producers.

Rice represents the major staple in the national diet, and animal products in the aggregate (poultry, fish, beef and milk) are important sources of energy and protein (40 percent of total protein). Animal products represent almost half of the food budget in the urban areas and a third of the food budget in the rural areas. Income elasticities for these products are significant and positive and somewhat high for the rural sample. Poor households in rural and urban areas will assign any additional income to these animal sources of food and perhaps to rice, but not to other basic grains (corn or beans) or to starchy foods.

Despite a nutritional problem of inadequate energy intake, any additional income will be spent on relatively more costly sources of calories. It is therefore likely that substantial income increases will be required to achieve nutritional adequacy among the poor. For example, under current relative prices, a doubling of real rural income would result in a 25 percent increase in rice consumption and perhaps a 50 percent increase in the consumption of animal products. This would represent an increase of about 250 calories per day per adult equivalent from rice and about 180 calories per adult equivalent per day from animal products. This increase in calories would be substantial, yet would be insufficient to bring the calorie levels of the 25th percentile up to the consumption levels of the 50th percentile. Accordingly, while incomes are the most important determinant of nutritional adequacy in Panama, there is ample scope for a nutrition-oriented food price policy.

III. AGRICULTURAL POLICY AS A DETERMINANT OF FOOD CONSUMPTION

The preceding section clearly indicates that income is the main determinant of an adequate diet for the average Panamanian. In particular, income can make the difference between a diet that is adequate and one that is deficient in protein content. Contrary to conventional wisdom, most rural dwellers in Panama are neither dependent on crop production for their livelihood nor on subsistence farming. These findings, as evidenced in section II, pose important policy implications for the redesign of current agricultural policy as related to nutrition. First, income is an important determinant of diet quality because the price of food is high relative to other goods in the economy. That is, if a higher intake of calories and protein is desired, income has to increase or food prices have to decrease relative to the price of other goods. Since a significant increase in real wages in both rural and urban areas is somewhat unlikely in the short run, food prices would seem to be the mechanism for improving nutrition.

Second, the relatively high proportion of rural dwellers farming on a part-time basis, or rather, working for wages, indicates that upward changes in the price of food at the farm gate will result in an increase in food production by small farmers only if the returns to labor under the new price level equal or exceed the wage rate from off-farm sources.

This section outlines the consequences of agricultural policies under the above constraints, relating them to the supply of food. The section starts with a brief summary of past policies, emphasizing the economic or doctrinal reasons behind each policy change, followed by a brief review of policies aimed at increasing producer and consumer welfare

through input subsidies and price support at the farm gate, and ceiling prices at the retail level. The section concludes with an analysis of the policy effects on past production and a discussion of the apparent consequences on nutrition.

A. Background

Official concern with the levels of food consumption, farm production and rural employment began in the 1950's. Until then, the Panamanian agricultural economy consisted of three very distinct subsectors: the foreign-owned banana enclaves, the cattle ranches, and slash-and-burn subsistence farming. The low density of the population and the open nature of the dollar-based economy that depended essentially on the Canal and the secondary activities generated by its presence led successive governments to ignore the rural areas as well as the consumption levels of the small urban labor force. The strength of the service sector meant that, in 1950, agriculture, including the banana plantations, already accounted for less than 30 percent of Panama's gross domestic product, although it still employed 55 percent of the labor force.

Partly as a result of the world economic recession of the early 1950's, nascent private interest in investing in commercial crop production coincided with the emergency of official concern. Hence, a new public institution, the Instituto de Fomento Económico (IFE), was created for supplying farm credit, marketing, and the storage of basic grains, i.e., rice, corn and beans. Price supports were introduced but IFE was not given sufficient funding for either construction of appropriate storage facilities or crop purchases.

Following the revolution of 1968 certain important provisions of the Agrarian Code of 1962 began to be implemented in order to provide land for several thousand landless rural families who had no stable employment. A Ministry of Agriculture was created for the first time in 1968 (later changed to Ministry of Agricultural Development--MIDA) and substantial credit and technical assistance resources were channeled to the agrarian reform collectives created largely on expropriated lands. The reform phase was at its peak in 1970-72. Thereafter, land takeovers and creation of new settlements (asentamientos) gradually declined (Shearer, 1976).

Concern with rural equity continued to be part of official policy, but a new concern began to be expressed in 1973 over the static domestic food production at a time of rapidly rising domestic demand and world prices of food staples. Important institutional changes were made in the administration of the agricultural sector, and government investments in both support to private producers (credit and technical assistance) and public capital formation increased spectacularly. Of great potential importance was the creation in 1975 of a semi-autonomous agricultural marketing agency, the Instituto de Mercadeo Agropercuario (IMA), whose charter gave it the responsibility to intervene in the markets for key commodities in accordance with prevailing official policy regarding farm and consumer prices. While IMA's storage facilities and working capital for handling domestic produce--as well as the number of trained professional staff--remained relatively modest through the early 1980's, the Institute was effective in part because it was able to monopolize or regulate on behalf of the government the importation of staple food and feed stuffs, most importantly corn and sorghum, as well as onions and dry beans.

Subsequently, as grain world prices descended while prices of fuel and of chemical farm inputs began to climb, official policy began to be concerned with the economic efficiency of production. Unfortunately, by that time several agricultural sub-sectors, particularly the public enterprises and the asentamientos, had been locked into inefficient structures, and returns were declining at prevailing prices even though in some cases (notably corn) real prices were being maintained above the international level.

At least until the mid-1970's it was the government's enunciated policy to continue to let the urban-metropolitan sector subsidize the rural cropping sector for an unspecified "transitional" period. This subsidy, however, was mostly undertaken through large public investment programs in economic and social infrastructure and services in the rural areas: rural water supply and health services, rural education, roads, some storage facilities, agrarian resettlement, subsidized farm credit, and finally, enormous investments in public agro-industrial enterprises such as sugar complexes and the Bayano basin state farming corporation. However, net public expenditures in the agricultural sector declined substantially even in nominal terms since 1976 (IDB, 1981).

The current policy situation is one of transition. The government recognizes that the cost, both monetary and social, of running some of the parastatal institutions may be too high. Moreover, there is no evidence yet to indicate that continued official intervention in agricultural markets would further increase social welfare. The two main objectives of present agricultural policy are: to provide the urban and rural sectors with an adequate and inexpensive supply of food, and to increase the income and welfare of farm producers. The problem is,

however, that such objectives are being pursued within a conflictive pricing framework. The existence of a system of support prices assumes the existence of farm producers who are price responsive, with a highly elastic supply curve. However, the presence of a parallel system of retail price controls assumes a supply curve which is highly inelastic, with the net result that output of some items, especially the cyclical ones (i.e., beef) has stagnated.

As a consequence, policies ostensibly oriented toward rural welfare and/or greater domestic food self-sufficiency have been in large measure offset by policies designed to protect consumers against retail food price fluctuation and to avoid upward pressures on workers' cost of living. These have taken the form of price ceilings on a wide range of foods, combined with export quotas for sugar (in the mid-70's) and beef (until 1981). In the case of the three basic grains, regulation of the market is made possible largely by the government's direct control over a substantial share of the market supply.

B. The Effect of Producer Oriented Policies

Two types of price policies, aimed at producers, have been in operation during the past decade: input subsidies and price supports. Subsidized inputs generally include production credit, official machinery services, and certified seeds. Fertilizer and pesticide prices have not been subsidized. The expected effect of an input subsidy is to produce a rightward shift in the supply curve by altering the rate of exchange among production inputs, that is, a new production function is created by favoring some inputs over others. The net result of the supply shift is a significantly reduced equilibrium price with an expected increase in the quantity of food produced. The basic assumptions here are:

-- a price elastic supply curve;

-- a fairly inelastic demand schedule; and

-- increased use of the subsidized input will result in a rightward shift in the supply curve.

The intended effect of a price support, on the other hand, is to produce an upward movement along the supply curve, e.g., an increase in the area sown. Price supports, however, have a cost attached to them: the difference between the equilibrium price and the support price, multiplied by total production. In fact, it can be asserted that price supports generally imply a net social cost which increases in direct proportion with the price elasticity of supply. Furthermore: (1) the larger the difference between the free market price and the support price, the greater the loss in social welfare, and (2) the more inelastic the demand curve for the supported product, the greater the social loss.

The long-term equilibrium effects outlined above seem to apply to Panama. For example, subsidized farm credit can significantly alter the production function. Priced well below the market rate, annual production credit rose steadily but insufficiently during the past decade. As a consequence, the Agricultural Development Bank (BDA) was forced to use non-price rationing measures such as specific credit lines and higher transaction costs. A large proportion of the available credit, therefore, went to asentamientos and to large individual producers, leaving the part-time farmers, as defined in the second section of this study, without operating capital (Bernal, Herrera, and Joly).

Most of the short-term credit went for the purchase of inputs, especially labor, fertilizers, seed, and pesticides; the type of inputs

which indeed shift the supply curve to the right. Since most of the loanable funds were assigned to specific credit lines, the effect of subsidized credit was to increase the yields of the preferred crops: rice, potatoes, onions and vegetables. Corn and sorghum, two other favored crops, incorporated the effects only among some subgroups, namely mechanized farmers. At the national level corn is at an economic disadvantage in areas where rice is more profitable, while sorghum is a relatively new crop. Both suffered heavy losses due to drought during three of the last ten years, increasing substantially the risk of utilizing capital intensive inputs.

1. Yields

Table 12 presents the yields for rice and corn for the periods 1960-1970 and 1970-1980. The first decade depicts the yields prior to the institutional and infrastructural reforms brought about by the revolutionary government. The second decade shows the yields under government intervention. For the sixties, rice and corn yields show a slowly increasing trend; some of the fluctuations are associated with climatic problems such as flood and droughts (Phillips, 1971).

Rice yields rose steadily during the seventies, reflecting increased availability and adoption of higher yielding varieties as well as the withdrawal of marginal land from rice cultivation. Average yields reportedly increased by 20 percent and at a compound annual rate of 2.3 percent (Table 12C). Average yields under mechanization had increased to 2.7 MT per hectare by the end of the decade, compared to 1.5 MT/Ma. for the non-mechanized small farm. The proportion of marketed production, however, remained constant, around a little more than two-thirds of the total harvest (IDB, 1981). As the domestic rice crop

reached record levels, imports declined from an average of 22,000 MT in 1971, or 15 percent of total disappearance, to none in 1982.

Overall rice yields during the seventies were undoubtedly affected by the substantial gains in productivity in Chiriqui. With the exception of the drought year of 1977, yields in Chiriqui were maintained at levels of more than twice the average of the other provinces. Furthermore, rice productivity in the province increased at an average rate of 3.6 percent per year, to the point that by 1980 Chiriqui was producing 46 percent of total national production. In addition to large areas of good soils, Chiriqui, the breadbasket of Panama, has the best infrastructure for credit, inputs, and post-harvest services and the most entrepreneurial population.

Compared to rice, corn yields at the national level show a somewhat erratic productivity pattern. First of all, none of the provinces is really dominant over the others in terms of total production. Los Santos accounts for the highest proportion of total production (24.2 percent), followed by Veraguas, Chiriqui and Herrera with 17.7, 14.7, 13.3 percent, respectively. Second, none of the provinces shows a marked change in productivity over time. In fact, in all of them 1980 yields were not significantly different from 1970.

The marked difference in the rates of productivity growth between corn and rice has to do more with the importance of rice in the average diet and with natural factors than with policy differences. Rice is a food staple, while corn is a feedgrain; moreover, the response to fertilizer and pesticides of the new CICA varieties produces levels of profitability for rice far higher than for corn. As a consequence, corn tends

to be grown only in those rainfed areas where the average precipitation is lower than the requirements for rice.

One important qualification needs to be stated, however. Overall figures for corn and sorghum do not reflect the trend observed among mechanized farms (Table 13). Based on official data, corn yields among mechanized farms have increased about 10% per year, unlike the area planted, which has decreased more than 25% between 1977 and 1981. In contrast, the area allotted to mechanized sorghum has more than doubled, while yields have remained more or less constant for the same period. The important point is that total area for feedgrains has increased by more than 40% during a five-year period, and that this increase has occurred among the mechanized farms, indicating a significant bias in the net effect of agricultural policies aimed at the feedgrain producing sector. Non-mechanized and subsistence corn growers have evidently not been affected by official feedgrain policies.

The effect of input subsidies in the livestock sector may be considered nil[3/] because the time horizon for technological change for cattle is much longer than for annual crops. Moreover, during the last two decades little serious research on new livestock systems was undertaken, although in 1980 CIAT and IDIAP initiated a cooperative research effort in the central provinces (CIAT, 1982). Lack of an appropriate technology has prevented any measurable changes in productivity from taking place.

The poultry industry, on the other hand, underwent a radical change. Helped by a favorable feedgrain imports policy, the oligopolistic and

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[3/] Figures on yields for beef and poultry are practically non-existent. The discussion here is based on personal communication with CIAT personnel. See SERE (1981) and CIAT (1983), pp. 13-14.

well-capitalized poultry industry quickly adopted U.S.-developed capital intensive technologies. As a consequence, production and productivity increased at an astonishing rate, producing a real decline in consumer prices (RECA, 1982), in part owing to official controls on poultry and egg prices.

2. Prices

Observed producer and consumer prices are not necessarily equal to the equilibrium prices under free market conditions. However, the prices reported in secondary sources serve as price leaders for non-governmental procurements, especially since IMA, the official marketing agency, buys between 10 and 25 percent of total grain production (MIDA, 1982).

Real support prices for rice increased between 1970 and 1976 and began to decline slowly during the second part of the decade (Table 14). Similar patterns can be observed for corn (Table 15). Real prices for beef and poultry, on the other hand, show a slow and steady decline during the entire 1970-1980 period (Table 16). The effect of these prices on total production, as will be evident later, seems to be modestly positive in the case of rice, statistically insignificant in the case of corn and poultry, and negative in the case of beef.

The effect of the policy environment on rice and corn may be examined in terms of area or in terms of total production. If input subsidies were effective one would expect an increase in total production without an increase in area planted. On the other hand, if product prices--especially support prices--were relatively more effective, the area planted would show substantial gains over a short period of time. The commercial mechanized rice farmers and asentamientos with good

bottom land in Chiriqui and the Central Provinces initially responded promptly to the high support prices of 1973 to 1976. Overall rice area planted, according to official estimates, increased by 11 percent per year from 1972 through 1976, to a record 122,400 hectares. However, as the real price of rice declined, total area declined to less than 98,000 hectares by 1980, down 22 percent from the levels planted in 1970. The real producer price in 1981 was lower than in 1970.

Tables 17 and 18 show the different price response of rice and corn. The evidence indicates that total production of rice is sensitive to prices, while corn production is not (Table 17). The regression for rice, moreover, indicates that real producer prices have significantly greater impact on total production than nominal prices. Although production increases without an increase in area, there is a small, positive relationship between area planted and real prices, reflecting the effect of migration into new areas in the provinces of Darien and Bocas del Toro.

In the case of corn, changes in production seem to be totally unexplained by prices. However, area planted which includes new settlements in Darien and Bocas del Toro, seems to be highly responsive to producer price.

Corn area responded positively through 1977 to a 1974 price increase; the 1976-77 average area was 30 percent, or almost 20,000 hectares, greater than in 1970-71. However, in 1978-80 corn area declined to an average of about 74,000 hectares, slightly below the level at the beginning of the decade; real producer prices had been declining to their pre-1974 level (Table 16).

Consistent with the nutrition survey findings, marketed production of corn rose from 28 to 40 percent of total production from 1971-73 to 1976-78 (Table 15). Since the bulk of the marketed corn goes into poultry feed, market demand was obviously reflecting the expansion that took place in the production and consumption of chickens and eggs during the 1970's and the government's control of imports of feed grains.

The continued decline in the area planted to corn was associated with an upsurge in sorghum plantings during the five years 1977-81. Corn farmers in the central provinces started planting sorghum around 1974. In 1981 sorghum area peaked at about 18,000 hectares; it declined to about 15,000 hectares in 1982. It has been predicted, however, that until a more adequate sorghum variety is found, sorghum area will decline rapidly (See García, 1982).

Sorghum production had been negligible through 1974-75 because there had not been any tangible private or public effort to introduce appropriate seed and production technology, and because livestock feeders, especially poultry firms, tended to consider sorghum far inferior to corn. However, by 1981-82, sorghum area (all mechanized) exceeded the mechanized corn area by 40 percent (18,000 vs. 10,000 has). The BDA lent three-fourths as much money for sorghum growing as for corn, and the crop insurance institute was insuring the same area for both crops.

It seems, therefore, that despite the strong emphasis placed by the government of Panama on high and stable support prices for rice, corn, and sorghum, prices have had little impact on total production or productivity when compared to the effect of input subsidies. The evidence seems to suggest that technological change induced by policies such as

subsidized credit and machinery services have helped increase the yields of rice and mechanized corn. The net result has been an increase in total production from commercial farmers. If the figures for corn, however, include subsistence farmers or farmers with a low resource base, then productivity figures for corn drop significantly. However, in the case of rice, size-neutral technologies, such as new varieties, have been adopted across the board. In addition, the regression results shown previously indicate that if a price policy is to be pursued, it should be based on real prices and not on nominal prices.

3. The Case of Beef and Milk

As mentioned previously, beef production is a cyclical activity in which the effect of a given policy is not felt for several years. Similarly, the effect of an ill-designed policy may be diffused at first but become more visible after several years. In the case of beef production in Panama, the cyclical effect is particularly difficult to read since the size of the total herd is estimated only every ten years, about every two livestock cycles. Hence, forewarning can only be attained through an examination of the changes in the proportion of cows in total numbers slaughtered.

In the structure of the price discovery system for farm products in Panama, output prices are a consequence of negotiations between producers and the government. The latter seems to have ignored past attempts by livestock farmers to negotiate a new price. Therefore, prices have been kept low and with them, the adverse political consequences in the metropolitan area.

Milk and beef are important in the Panamanian diet. They are joint products on a large number of ranches, and are generally believed to be

more promising for the Panamanian export economy than basic grains (BNP, 1982).

Trends of slaughter of beef animals are a function of trends in herd size. Census data indicate a 65 percent increase in cattle numbers between 1960 and 1970, following a similar increase in the previous decade. The total increase during those twenty years closely paralleled the increase in grazing land registered by the censuses, suggesting that beef production increases occurred almost entirely at the extensive margin. However, cattle numbers increased less than seven percent between 1970 and 1980, a compound annual growth rate of less than 0.7 percent. (Shearer, 1978; Reca, 1982).

Numbers of cattle slaughtered increased at an annual compound rate of 5.3 percent from 1967-69 to 1975-77 (measured in three-year moving averages), with cyclical variations ranging from 3.1 percent to 7.4 percent. In 1978, slaughter suddenly began to decline: the annual rate of decline from 1975-77 to 1978-80 was 3.8 percent for a total drop of 11 percent (Table 16). Average live weight of slaughtered animals was practically the same throughout, according to the official data (Reca, 1982).

Beef export figures as reported in Panama are incomplete. According to a recent analysis of available data (Reca, 1982), overseas exports increased from an average of 1,900 MT in 1970-72 to 3,000 MT in 1976, after which they dropped to an average of merely 750 MT in 1978-80. Exports to the United States--the principal market--have always been less than 10 percent of total domestic slaughter and for the three years ending in 1980 they were less than three percent of annual domestic slaughter. In some years extraordinary efforts have had to be made to

maintain a minimum nominal level of exports to the United States in order to protect Panama's standing in the U.S. import quota system.

Beef prices in Panama have been regulated at all levels in the marketing chain. They have been adjusted in an ad hoc fashion from time to time, with little reference to the international market. This has meant that, while Panamanian producers have not had the benefit of the sharp rises in world beef prices in the early seventies, the price decline in the mid-1970's was much more moderate in Panama than abroad; the obverse, of course, is true for consumers. All four adjustments in the official producer price for beef on the hoof between 1973 and 1980 have been upward in nominal terms--from 21.5 cents to 39.5 cents per pound, or an overall increase of 84 percent (Reca, 1982.) However, the average real producer price in 1979-80 was about 15 percent less than the 1972-73 average (Table 19).

As late as 1979-80, all cuts except rib steaks were subject to price control. At that time, the price of filet--a luxury cut--was nominally set at $2.50 per lb, i.e., about one-half the free market U.S. price, while beef ribs were priced at 60 cents, about 40 percent below the prevailing U.S. retail price. In other words, assuming that filet was available at the official price, high income consumers in Panama were being "protected" to the same extent as low-income consumers.

Beef availability, as reported by government figures, (Table 19) shows the decline in the total herd with a lag of about four years, a normal lag for livestock cycles. Peak availability was obtained in 1976, when per capita availability reached 54.1 lbs., declining to 40.5 pounds in 1979. At the same time, per capita disappearance of poultry meat went up from 11.2 to almost 15 pounds during the same ten year

period. Moreover, the apparent consumption of eggs rose almost 60 percent from 1970-71 to 1979-80, to 7.7 kg. per capita (DEC, 1982).

The Panamanian milk market has been characterized by a somewhat artificial distinction between producer prices for milk for fluid use and for processing; the differential has in general not been based on any effective quality standards or control. The monopsonistic canning company has effectively promoted the establishment of seasonal price differentials to bring forth more production during the dry season. Until the late 1970's, official milk pricing seems to have responded almost entirely to short-term concern about consumer prices for fluid milk. Maximum prices to producers had been virtually unchanged from April 1970 to July 1973 and March 1974, respectively, for Grade A and industrial milk.

In September 1976, the official prices at the farm gate for Grade A and industrial quality, respectively, were 23 cents and 16.5 cents per liter, a nominal increase of 15 percent and 65 percent over previous levels. Official data for average prices received, however, indicate that the real price of Grade A milk declined 39 percent, and of industrial milk, 13 percent. With consumer prices subject to ceilings based on producer prices, it should not be surprising to find that there was a steady increase in per capita consumption of pasteurized, canned and powdered milk during the decade, from 21 kg. of fluid milk equivalent per capita in 1970-71 to 30 kg. in 1978-79, an annual rate of increase of 4.7 percent (DEC, 1982).

The diagnosis of the behavior of the beef market appears to be rather simple and straightforward: a decline in real producer and retail prices and stagnant productivity during the course of the decade

has led simultaneously to a sharp increase in domestic demand and a tangible decline of supply and a virtual halt in beef exports.

The behavior of the milk market cannot be completely explained on the basis of data available at this time. Real producer prices dropped considerably and continuously during the decade, from what had already been considered rather artificially depressed levels ten years earlier. Yet, milk production, which had been declining through 1976, suddenly spurted towards the end of the decade--at least according to the official estimates. As real consumer prices also declined, per capita consumption rose considerably. At the same time, imports continued to represent about 60% of the national supply.

One clue to the apparently paradoxical increase in domestic milk production may lie in the regional pattern. Los Santos is the most important source of milk of the Central provinces (Herrera, Los Santos and Veraguas) which together supply about 70 percent of the dairy plant's raw material. Of the 5,000 double purpose herds in the country, 3,000 are found in the three central provinces; these are small to medium sized herds of cebu or cebu-milk breed crosses. Productivity per cow and per hectare has been traditionally very low. But credit and technical assistance from official and private sources appear to be producing improvements in dairy technology in this area in terms of feeding, breeding and sanitation. In particular, the processing company has been applying differential prices and technical advice in an apparently successful attempt to bring forth more market milk during the dry season (CEPAL, 1981). One might surmise that the marginal profitability of these technical innovations has been adequate even at declining real prices per liter of milk sold. In addition, studies by Heckadon (1981)

have shown that milk sales have become increasingly important for these poor ranchers as a source of constant cash flow throughout the year.

C. Domestic Resource Costs

Domestic Resource Costs (DRC) measure the monetary value of domestic resources used to produce foreign exchange earnings or savings for a given tradable commodity. A measure of comparative advantage for a particular commodity is obtained by comparing its domestic resource cost to the real exchange rate.

Domestic resource cost calculations for rice and corn were made using cost of production data from Chiriqui province in Panama. The calculations for both crops considered a traditional low technology input mix and a high technology input mix. Information regarding the traded and nontraded proportions of the specific inputs included in the cost of production data was not available for the calculations. Therefore, each input was designated to be either wholly traded or nontraded. Also, there was no exact information available regarding land rents as domestic resources. A value of the return to land use was determined by multiplying the yield per hectare and the relevant producer price and then subtracting the total production cost per hectare from that value. The DRC computations are then sensitive to whether or not this value for land rent is included as a domestic resource (Table 20).

Given the structure of incentives facing producers of rice and corn and the current levels of inputs used in their production, the DRC calculations which include a value for land rent show that a comparative disadvantage exists in the production of rice and corn. They also show that the greater the level of technological input used in production, the greater the disadvantage will be. However, exclusion of land values

from the calculations show that a comparative advantage would exist in the production of both rice and corn. If we consider the value of land to be only 50 percent of the value determined above and apply that to the DRC calculation, then a comparative disadvantage would persist for both rice and corn though they would move to a more competitively neutral position.

D. Consumer Oriented Policies

Price control at the consumer level is perhaps the only consumer policy which directly affects the agricultural sector. The retail prices for farm products in the urban areas are controlled by the Office of Price Regulation (ORP), a watchdog agency independent of the Ministry of Agricultural Development (MIDA). Although both agencies coordinate their efforts most of the time, frictions do occur since each ostensibly represents opposing interests, those of producers vs. those of merchants and consumers. Price controls by ORP are not limited to farm products, but to housing, medicines, and other prime necessities, some forms of entertainment and transportation. Table 21 shows consumer priced indices for main commodity groups from 1977 to 1981. Contrary to the assertion of many farmers, it appear that food prices have not lagged behind those of other expenditures groups. If food prices are too high relative to other goods, it is not because of unfair price controls but because of low productivity in the farm sector. Even livestock, which is stagnant due to a cost-price squeeze, has not been at an obvious disadvantage relative to other food products, as shown in the meat price column. This suggests that the dismal rate of growth observed in the stock of cattle in the last agricultural census may be linked more to low productivity than to a low rate of growth in consumer prices.

The above assertion is internally consistent only if the current official control on beef exports continues. In a recent study of the livestock sector, Reca (1982) concludes that in order to increase beef production, it is necessary to deregulate the export market for beef. His assessment of a deregulation scenario, however, indicates that higher beef exports would cause a 4 percent decrease in domestic beef consumption based on a price elasticity of demand for beef of 0.4; the computations derived from this survey (Table 9) suggest a much lower elasticity coefficient. His principal conclusion, as regards the future of the livestock sector, is to open up the export market, which offers a price incentive to producers. This conclusion does not contradict the issue of technical change and the gains in productivity, but poses a dilemma with respect to nutrition, namely, should exports continue to be discouraged in order to increase domestic per capita availability?[4/] Vegetable sources of protein, such as beans, show only modest potential for growth due to the small size of the area most suited for production: the district of Caisán, in the province of Chiriqui, and the low preference shown by consumers for beans and bean products as a significant proportion of the diet. Hence, animal sources of protein would seem to be more favorable domestic alternative. In order to increase the domestic supply it becomes obvious that a balance should be sought between the incentives to increase production (i.e., producer price) and the incentives to increase productivity (i.e., input subsidies for appropriate technologies).

[4/] In 1981 the export ceiling was raised to the equivalent of 30,000 head of cattle, which was nearly attained in 1982; however, exports dropped sharply again in 1983 as problems were encountered with U.S. sanitary regulations.

Given the current state of affairs with regards to livestock research in Panama, as well as the long term prospects of technologies currently available (such as new pasture varieties) it seems that opening up the export market would be the most feasible alternative in the short run.

At present export price levels (1984), Panama's ceiling prices for beef are in effect acting as floor prices. No great increases in export prices are expected in the foreseeable future; hence, this is a good time to try to introduce a completely free market for beef (which has not existed since World War II), while at the same time assuring continued dynamic growth of poultry supplies at reasonable prices. These, in turn, can be assured if domestic and import prices for feedgrains are reduced.

IV. CONCLUSIONS

Three areas related to consumption and its interaction with agricultural policy need to be addressed. The first one relates current nutritional status to agricultural price policy. The second area relates current policy goals and current policy instruments and discusses some of the inconsistencies that were found. The third area covers the problem of income generation in rural areas and its implications for groups at nutritional risk. Finally, the more important findings of this study and their implication for long term agricultural policy are discussed.

According to the food consumption survey, the biggest nutritional problem in Panama is the inadequate intake of food energy among low-income households in both rural and urban areas. Protein consumption is not a problem. Based on the econometric analysis of the survey, income is the main determinant of nutrition, accounting for a big nutritional difference between the groups at nutritional risk (e.g., the 5th percentile of the population) and the nutritional average. This difference becomes acute in rural areas, where monetary income and hence consumption of purchased foods is lower than in the urban areas.

Since the populational group for which adequate nutrition may be a problem is well defined and highly localized, broad-based agricultural policies directed to improve the nutritional status of Panamanians need to be reexamined. Price policies which are currently unfavorable for producers, as in the case of beef, have produced an unintended reduction in the availability of beef for the entire population. The econometric results show that the income elasticity of food expenditures for beef is

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relatively low. Hence, a higher beef price, accompanied by continued dynamic growth of poultry supplies at reasonable prices and a subsidy program specifically directed to the group at nutritional risk will produce adequate protein consumption and a stable supply of beef for domestic consumption and export.

Another conclusion from the econometric analysis is the need for fine tuning of price policies for basic grains. For the past ten years the price system for producers has favored grains over livestock, perhaps on the assumption that grains consumption was not a problem, and an increase in the per capita consumption of beef was desirable. The food consumption survey, however, shows that current nutritional needs call for opposite policies: calories should now be favored over protein and, therefore, beef prices should be allowed to rise relative to rice and other sources of energy.

The results also show that the groups at risk in the rural areas are not benefitting from the favorable grain price policies. Small farmers, it was found, are mostly part-time subsistence farmers who sell nothing or only a small proportion of their product. High support price policies do not benefit this group. Instead they provide windfall profits for the most efficient commercial farmer, thus increasing the gap between rich and poor in the rural areas. This is especially true in the case of rice, where the price paid to to producers was intended, and is, to be substantially higher than the clearing price in the absence of government intervention.

In terms of reconciling the goals of the Panamanian government with the price policy instruments utilized to date, there are several important findings. First, market intervention in the form of high support

prices and purchase of part of the harvest by state agencies seemed to call forth greater output only when accompanied by technological change. For rice, high support prices and IMA's purchases perhaps helped increase the quantity supplied. These policies, however, went into effect at the same time as farmers began to use widely certified seeds of the IRRI and CICA varieties. In this case price policy was complementary to technical change, by accelerating increases in yields and area. In the case of corn, sorghum, and beans the complementary technical change was only applicable to the mechanized farms, which represent a small percent of the total number of grain producing farms. Moreover, the input intensive technology used in the mechanized production of corn and sorghum only helped augment the already high cost of producing feedgrains in Panama, where the comparative advantages lie in grass-fed cattle production.

Second, price controls at the consumer level have had negative effects when not accompanied by technological change. Retail price controls were applied equally to beef and poultry. There has not been any tangible technological change in beef production in Panama, while the poultry industry has, for the last ten years, experienced impressive gains in productivity. As a net result, total poultry prices in terms of beef declined 15 percent during the same period. In contrast, beef production declined steadily in view of the disincentives brought about by price and export controls and the absence of new production technologies.

Another lesson learned from market intervention through price policy instruments is that, because incomes of very small farmers are derived primarily from non-farm sources, it may be more important to intervene in the market for rural labor than in the product price system.

Rural labor markets in Panama have not been properly studied. A detailed study of rural labor markets should closely examine those parameters impinging on nutritional quality, such as reservation wages, income and substitution elasticities for work and leisure, and the variables influencing the labor supply curve. Morover, the study should explicitly address the potential for growth in employment and real wages, the requirements for human capital accumulation, and the basic needs in terms of quality of life in the rural areas.

The characteristics of the rural labor market, as revealed in the survey findings in Section II of this study, indicate that a hike in the price of food at the producer level would not necessarily increase income from farming for small producers, since market connectedness is very low. If an increase in market connectedness is sought through the price system, the results suggest that the required price increase would have to be high enough to make the returns from farming equal or greater than the wage rate. In a separate study, Hazell, Bassoco and Arcia (1982) present a model of a small commercial farm in Chiriqui in which the returns to labor for rice grown with modern techniques is approximately $7.0 per day, or approximately 40 percent more than the prevailing wage rate at the time of the study. This additional finding confirms the previous assertion that unless technical change and increased productivity is sought in the farm sector, increased market connectedness among the rural poor will be highly unlikely. In addition, if consumer prices are raised as part of the incentive package for food production, part-time farmers would be negatively affected given their condition as wage laborers.

The last point to be discussed in this area is self-sufficiency in food production. The current policy of self-sufficiency should not be confused with food security, where a steady food source is the key policy element. The domestic resource costs for Panama indicate that production technologies relying on imported inputs, such as mechanized corn, will leave a negative effect on the balance of payments and the cost of food. Hence, efforts should be made to identify production alternatives, including alternative crops.

As regards the relationship between the results of this study and the long term goals of agricultural policy, first, there should be consistency between nutrition policy and economic growth. As exemplified here, a well conceived employment policy in rural areas may do more for the nutritional status of the rural poor than intervening in the price of food. Second, food security, or the stable supply of food at equilibrium prices, should be sought through technical change complemented by the policy environment and not vice versa. Rice and poultry seem to be good examples of success in this area. Finally, long term nutrition policy should be directed at the cause of the malaise and not the symptoms. A careful analysis and intervention in the rural labor market would positively affect the capacity of poor people to generate additional income and improve their nutrition. Increasing the productivity of rural labor would be likely to do more for the group at nutritional risk than intervention in the product market.

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Table 1. Percentile Distribution of Energy Intake and Household Food Costs by Region and Urban Rural Categories

	Urban						Rural					
	n	5th	25th	50th	75th	95th	n	5th	25th	50th	75th	95th
							CEP[a]/day					
Isthmus[b]	123	1263	1816	2199	3027	4408	119	1025	1798	2381	3089	4634
Central[c]	46	1138	2055	2594	2911	5847	180	1190	1875	2514	3168	4310
Chiriqui	26	1129	1952	2638	3054	5917	75	737	1640	2068	2791	4393
Bocas del Toro	4	-	-	-	-	-	18	531	2001	2752	3135	6138
Darien	-	-	-	-	-	-	23	943	1609	2221	3662	5628
							Household Food Costs ($/day)					
Isthmus	131	1.4	3.5	5.4	7.6	12.5	127	1.2	2.5	3.8	6.2	11.8
Central	54	2.1	3.3	5.5	7.1	11.0	182	1.1	2.1	3.2	4.6	7.9
Chiriqui	26	1.5	3.7	5.6	7.7	17.0	75	.6	2.1	3.1	4.5	8.4
Bocas del Toro	4	4.6	5.0	6.5	7.1	7.3	18	1.4	4.4	6.9	8.4	21.1
Darien	-	-	-	-	-	-	23	.4	1.4	3.4	4.8	9.6

[a]Calorie-equivalent person.

[b]Encompasses the provinces of Panama and Colon.

[c]Groups together the provinces of Cocle, Herrera, Los Santos and Veraguas.

Table 2. Calorie, Protein, and Expenditure Shares for Principal Food Commodities

Commodity	All Households (n=728)		
	Average percent of daily calories	Average percent of daily protein	Average percent of daily food expenditures
Corn	2.8	2.0	2.1
Cereals	.5	.5	.4
Breads	7.8	8.1	5.2
Beans	5.3	11.2	4.9
Rice	33.4	23.6	16.4
Fish	1.9	8.6	5.2
Milk	4.1	6.9	6.8
Poultry-eggs	4.1	9.9	10.3
Beef	6.3	15.5	13.9
Pork	1.0	1.8	2.1
Oils	12.0	0	6.3
Vegetable Products[a/]	11.9	6.5	12.8
Sugars	5.4	0	2.2
Others	3.5	5.4	11.4
TOTALS	100.0	100.0	100.0

Source: Household consumption data collected for the Nutrition Evaluation project in 1980: The share each principal food commodity contributes to households total caloric intake, protein intake and expenditures on food.

a/ Include vegetables and fruits, roots and tubers, and bananas and plantains.

Table 3. Calorie, Protein, and Expenditure Shares for Principal Food Commodities

ommodity	Rural Households (n=418)		
	Average percent of daily calories	Average percent of daily protein	Average percent of daily food expenditures
orn	3.6	2.7	2.8
ereals	.3	.4	.4
reads	5.6	5.9	4.3
eans	6.1	13.2	5.7
ice	36.0	26.9	20.0
ish	2.1	10.5	6.2
ilk	3.0	5.3	5.5
oultry-eggs	3.2	8.0	9.0
eef	4.8	12.4	10.6
ork	1.0	1.8	2.2
ils	11.3	0	6.7
egetables and Fruits	4.7	3.7	7.0
oots and Tubers	4.9	1.8	3.8
lantains and Bananas	4.9	2.5	3.3
ugars	5.3	0	2.5
thers	3.2	4.9	10.0
OTALS	100.0	100.0	100.0

Source: Household consumption data collected for the Nutrition Evaluation project n 1980: The share each principal food commodity contributes to households total caloric ntake, protein intake and expenditures on food.

Table 4. Calorie, Protein, and Expenditure Shares for Principal Food Commodities

	Urban Households (n=192)		
ommodity	Average percent of daily calories	Average percent of daily protein	Average percent of daily food e:.pendi tures
orn	1.8	1.3	1.0
ereals	.7	.7	.7
reads	11.4	11.9	6.9
eans	3.8	7.7	3.4
ice	28.3	17.9	9.6
ish	1.0	4.7	3.2
ilk	6.3	10.1	9.4
oultry-eggs	5.2	12.2	11.7
eef	9.6	22.4	21.0
ork	1.0	1.6	1.8
ils	13.0	0	5.8
egetables and Fruits	1.9	1.6	5.8
oots and Tubers	3.3	1.4	3.1
lantains and Bananas	2.1	0.6	1.2
ugars	6.2	0	2.0
thers	4.4	5.9	13.6
OTALS	100.0	100.0	100.0

Source: Household consumption data collected for the Nutrition Evaluation project n 1980: The share each principal food commodity contributes to households total caloric ntake, protein intake and expenditures on food.

Table 5. Proportion of Daily Calories and Protein Intake and of Total Food Expenditure from Animal Sources

	Calories	Protein Percent	Food Expenditures
All Households	17.4	42.7	38.3
Urban Households	23.1	51.0	47.1
Rural Households	14.1	36.2	33.5

Table 6. Means and Standard Deviations of Variables from Analysis of Income Food Strata for Urban and Rural Households

	Urban Households (n=166) Income Food Strata[a]							
	1		2		3		4	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Total family calories (daily)	11,269	5,108	13,889	6,413	11,386	7,242	9,463	5,024
Total family protein (daily)	351	171.5	430	182	368	245.5	317	181
Total family food expenditures (daily)	5.28	2.63	7.06	4.07	6.64	4.99	5.76	2.85
Calorie equivalent persons	5.23	2.1	5.2	2.1	4.4	2.3	3.8	1.8
Number in Sample	38		32		23		73	
Percent of Sample (%)	23		19		14		44	
Per Capita Food Expenditures (Balboas)	0.99		1.36		1.51		1.52	
Calories/Balboa	2,134		1,967		1,715		1,643	
	Rural Households (n=381) Income Food Strata							
	1		2		3		4	
Total family calories (daily)	12,042	6,754	11,295	5,546	10,404	5,451	9,436	5,756
Total family protein (daily)	334	202	326	154	345	204	312	228
Total family food expenditures (daily)	3.96	2.76	4.29	2.55	5.27	4.10	4.54	3.28
Calorie equivalent persons	5.4	2.2	4.7	2.1	3.9	2.1	3.5	2.2
Number in Sample	200		81		34		62	
Percent of Sample (%)	54		21		9		16	
Per Capita Food Expenditures (Balboas)	0.73		0.91		1.35		1.30	
Calories/Balboa	3,041		2,633		1,974		1,078	

a) Strata 1 Gross per capita income < 1 basic food basket
Strata 2 1 basic basket ≤ gross per capita income ≤ 2 basic baskets.
Strata 3 2 basic basket ≤ gross per capita income ≤ 3 basic baskets.
Strata 4 Gross per capita income ≥ 3 basic food baskets.

Table 7. Averages and Frequencies of Selected Household Variables[a] Used in Regression Analysis for Urban and Rural Households

	Urban households (n=192)
Monthly gross income ($)	472 (med=300) (n=387)
Family size	4.8
Home ownership (%)	40% own 60% do not own
Employment sector (%)	48% services 52% others
Education head of household (yrs.)	12% less than one year 43% one to six years 45% more than six years
	Rural households (n=418)
Monthly gross income ($)	293 (med=143) (n=387)
Family size	5.3
Monthly agricultural sales ($)	44.5 (n=319)
Monthly agricultural income ($)	97.3 (n=319)
percentage off-farm income	.55
Market connectedness = $\frac{\text{Ag sales (\$)}}{\text{Ag income (\$)}}$	.24
Land size (hectares)	6.8 (med=0.5)
Mechanization of agricultural production (%)	7% mechanized 93% unmechanized
Education head of household (yrs.)	33% less than one year 57% one to six years 10% more than six years

[a]Variable definitions in Appendix A.

Table 8. Estimates of First Stage Engel Functions for Per Capita Food Expenditure Regressed on Per Capita Income for Urban and Rural Districts 1980 Panama National Data

	Urban		Rural	
	Estimate	t	Estimate	t
Intercept	- .42	-1.47	- .22	-1.17
Log (income per capita)	.28	4.16	.23	4.54
n	17		47	
model F	17.3		20.68	
r square	.51		.31	
elasticity of food expenditures with respect to income	.368		.356	

Table 9. Estimates of Income Elasticities of Selected Commodities for Rural Households Based on Two-Stage Estimation

First Stage: Regression of food expenditures on income and
Second Stage: Regression of logarithm of total family grams per commodity on logarithm of total food expenditure and family size, market connectedness, land size, mechanization, percent off-farm income, education of head of household

	N	Income Elasticity
Corn	151	0.00
Beans	188	0.04
Rice	373	0.12
Milk	255	0.21
Poultry	76	0.36
Beef	170	0.23

Table 10. Market Connectedness and Non-Farm Income for Rural Households (N=381).

Income Food Stratum	N	%	Market Connectedness[a]	% of Income From Off-Farm Sources
1	204	54	0.26	36
2	81	21	0.27	66
3	34	9	0.19	72
4	62	16	0.31	75

[a]Market connectedness is the ratio of the value of farm sales to the value of total farm production for each household.

Table 11. Averages of Food Consumption Variables and Other Selected Household Variables for Rice and Corn Producers[a]

	Rice producers (n=24)	Corn producers (n=28)	Rice and corn producers (n=34)	Producers of less than two hectares corn or rice (n=332)
Total daily family food expenditures	3.27	4.30	2.87	4.40
Monthly gross income	145	250	150	324
Family size	5.8	5.3	5.3	5.2
Market connectedness	.24	.35	.32	.23
% income from off-farm	.198	.25	.20	.64
Calories per capita	2,165	2,377	1,912	2,146

[a]Producer must have planted two or more hectares of either rice or corn or both.

Table 12a. Rice Yields by Province, 1960 - 1970 (qq/ha.)

Year	Total	Bocas Del Toro	Chiriqui	Veraguas	Herrera	Los Santos	Cocle	Panama	Colon	Darien
1960	16.1	14.0	17.2	16.8	24.9	19.9	14.8	14.0	8.1	15.3
1961	17.4	8.0	20.1	18.2	19.5	18.8	14.8	16.7	16.9	23.6
1962	19.7	19.1	23.1	12.7	23.4	19.4	22.9	18.9	15.9	22.1
1963	17.3	12.4	24.5	17.7	20.0	13.8	15.9	13.0	16.3	22.1
1964	17.9	16.0	18.1	19.2	20.0	20.9	12.9	13.8	19.3	20.9
1965	16.9	14.0	23.1	17.4	16.4	15.7	14.3	13.0	11.1	27.2
1966	15.9	12.3	20.5	14.6	21.0	18.5	10.7	12.8	11.2	21.5
1967	17.1	13.7	20.4	17.3	17.2	17.7	17.6	15.3	10.3	24.4
1968	18.8	13.4	20.6	15.7	25.2	19.2	17.1	18.8	17.3	21.9
1969	18.0	13.4	24.0	19.0	22.5	20.6	14.4	13.2	12.6	21.9

SOURCE: DEC.

Table 12b. Corn Yields by Province, 1960 - 1970, (qq/ha.)

Year	Total	Bocas Del Toro	Chiriqui	Veraguas	Herrera	Los Santos	Cocle	Panama	Colon	Darien
1960	16.1	14.0	17.2	16.8	24.9	19.9	14.8	14.0	8.1	15.3
1961	17.4	8.0	20.1	18.2	19.5	18.8	14.8	16.7	19.9	23.6
1962	19.7	19.1	23.1	12.7	23.4	19.4	22.9	18.9	15.9	22.1
1963	17.3	12.4	24.5	17.7	20.0	13.8	15.9	13.0	16.3	22.1
1964	17.9	16.0	18.1	19.2	20.0	20.9	12.9	13.8	19.3	20.9
1965	16.9	14.0	23.1	17.4	16.4	15.7	14.3	13.0	11.1	27.2
1966	15.9	12.3	20.5	14.6	21.0	18.5	10.7	12.8	11.2	21.5
1967	17.1	13.7	20.4	17.3	17.2	17.7	17.6	15.3	10.3	24.4
1968	18.8	13.4	20.6	15.7	25.2	19.2	17.1	18.8	17.3	21.9
1969	18.0	13.4	24.0	19.0	22.5	20.6	14.4	13.2	12.6	21.9

SOURCE: DEC.

Table 12c. Rice Yields by Province, 1970-1980, (qq/ha.)

Year	Total	Bocas Del Toro	Cocle	Colon	Chiriqui	Darien	Herrera	Los Santos	Panama	Veraguas
1970	28.9	13.6	27.7	15.3	43.6	32.1	25.8	23.7	17	24.6
1971	31.1	7.7	33.8	13.2	46.4	15.8	20.6	24.9	19.3	22.1
1972	31.1	7.3	37	15.8	46.2	15.8	23.3	20.5	17.9	20.3
1973	26.2	7.3	21.3	12.9	46.9	15.8	15.4	16.3	10.7	17.6
1974	33.9	7.3	38.5	16.2	48.1	15.8	26.9	25.4	22.2	21.1
1975	35	7.3	38.1	21	50.4	15.8	28.2	20.3	28	21.5
1976	35.3	7.3	40.5	19.8	50.7	15.8	24.7	25.4	27.7	22.7
1977	26	64	22.9	21	38.9	35.4	19.6	15.7	14.4	20.1
1978	37.3	40.2	33.4	25.3	54.7	37.5	30.9	31.1	32.8	27.6
1979	36.1	25.3	27.5	23.3	58.2	26.8	29	29.7	28.2	23.3
1980	35.9	29.4	29.1	21.1	59.2	33.1	252	28.5	29.2	23.4

Up to 1976, yields for Darien and Bocas del Toro are based on Census figures.

SOURCE: DEC.

Table 12d. Corn Yields by Province, 1970-1980, (qq/ha.)

Year	Total	Bocas Del Toro	Cocle	Colon	Chiriqui	Darien	Herrera	Los Santos	Panama	Veraguas
1970	18.8	13.7	14.3	12.1	22.1	14.4	23.4	21	14.1	17.7
1971	19.2	7.4	21.5	12.8	21.4	19.7	22.1	22.4	15.3	15.1
1972	18.9	6.3	23.8	12.4	19.6	19.8	23	19.6	16.1	16.3
1973	14.9	6.3	10.7	10.1	19.3	19.8	16.1	15	10.3	14.3
1974	17.9	6.3	16	8.6	18.2	19.8	21.7	20.6	16.9	15.8
1975	17.3	6.5	15.7	10	17.6	19.8	21.3	20.3	14.9	15.6
1976	19.3	6.5	17.6	14.1	17.8	19.8	23.7	23.3	18.5	17.4
1977	17	17.3	11.8	17.4	21	28.8	17.3	19.2	11.4	14.3
1978	21.2	5	14	23.2	20.6	30	23.6	25.2	19.3	17.5
1979	20.7	15.7	12.4	20.7	17.5	27.1	25.1	29.6	16.9	17.7
1980	20.1	15.6	13.7	14.4	20.1	27.8	23.7	25.6	18.2	16.2

Up to 1976, yields for Darien and Bocas del Toro are based on Census figures.

SOURCE: DEC.

Table 13. Area, Production and Yields for Mechanized Corn and Sorghum

	Corn			Sorghum			Total Area
Year	Area 000 Has.	Production 000 qq	Yields qq/Has.	Area 000 Has.	Production 000 qq	Yields qq/Has.	(Corn & Sorghum)
1977	11317	369607	32.66	7911	385590	48.74	19228
1978	3229	303267	22.92	9030	376762	41.72	22259
1979	12744	504981	39.63	8741	45035	51.94	21485
1980	9016	424121	47.04	18141	889480	49.03	271557
1981	8649	433504	50.12	18903	791103	41.85	27552

SOURCE: MIDA, Dirección Nacional de Production Agricola.

Table 14. Real Rice Prices for 1970-1981 Period,
(1975=100 under Food Price Index)
($/qq)

Year	Support Price	Price FOB Bangkok	CIF Price	Retail Price
1970	7.76	8.46	15.91	n.a.
1971	7.68	7.5	10.32	n.a.
1972	7.45	8.3	9.37	n.a.
1973	8.03	18.92	25.17	19
1974	10.52	25.92	37.35	24
1975	10.0	16.5	21.63	20
1976	10.08	11.1	12.63	20.4
1977	9.59	11.3	11.58	21
1978	8.67	14.48	14.48	21
1979	7.96	11.7	14.87	17
1980	8.51	n.a.	n.a.	15
1981	7.1	n.a.	n.a.	24.9

SOURCE: DEC, Panama.

Table 15. Corn Prices for 1970-81 Period
($/qq)

Year	Support Price	Average Price Received by Producers	Real Price (1975=100)
1970	4.25	4.40	
1971	4.25	4.78	
1972	4.50	4.75	
1973	6.0	5.02	6.65
1974	8.5	6.66	7.52
1975	8.5	8.05	8.05
1976	8.5	8.12	7.89
1977	8.5	8.13	7.38
1978	8.5	9.13	7.42
1979	9.00	9.43	7.43
1980	10.80	10.43	
1981	11.25	9.6	

SOURCE: DEC, Contraloría General de la República.
INDEX: Indice de Precios recibidos por el productor agropecuario.

Table 16. Production and Consumer Prices of Beef and Poultry 1970-80

Year	Slaughter (000 heads)	Beef Price (1975 $/lb)	Broiler Production (000 MT)	Broiler Price (1975 $/lb)
1970	173.2	.64		.85
1971	188.6	.67		.85
1972	201.8	.63		.79
1973	194.7	.69		.79
1974	206.6	.64		.72
1975	222.3	.6		.71
1976	240.6	.58	8930	.69
1977	239.8	.52	9600	.69
1978	216.4	.63	11850	.64
1979	195.7	.74	19480	.59
1980	214	.65	21500	.66
1981	238.0	.61	20000	.61

SOURCE: RECA (1982).

Table 17. Regression of Logarithms of Total Production on Logarithm of Prices at the Farmgate for Rice and Corn

Crop	Intercept	Producer Price (1975B/qq)	Nominal Producer Price	r	R^2
Rice	6.6413	.736		3.55	.283
	(8.31)	(1.89)		5.31	.371
Rice	7.4812		.3241	5.31	.371
	(25.72)		(2.30)		.371
Corn	6.9525		.392	.54	.056
	(18.79)		(0.73)		
Corn	6.655	0.294		.4	.0429
	(7.46)	(0.64)			

Values in parentheses are t-values.

Table 18. Regression of Logarithm of Area Sown on Logarithm of Real and Nomimal Producer Prices for Rice and Corn

Crop	Intercept	Producer (1975 $/qq)	Nominal Producer Price ($/qq)	F	R^2
Rice	6.218 (12.04)	.3503 (1.47)		2.16	.19
Rice	6.6245 (28.13)		.1606 (1.43)	2.05	.2
Corn	3.0026 (1.61)	1.7434 (1.83)		3.34	.27
Corn	6.1449 (34.62)		.2148 (2.41)	5.8	.42

Numbers in parentheses are t-values.

Table 19. Availability and Prices for Beef and Poultry

Year	Beef Availability (lb/person/year)	Beef Consumer Price (1975 $/lb)	Poultry Availability (lb/person/year)	Beef Consumer Price (1975 $/lb)
1970	4.51	.74	11.22	.85
1971	49.06	.67	13.2	.85
1972	49.28	.63	12.32	.79
1973	47.08	.69	11.88	.79
1974	45.1	.64	12.96	.72
1975	51.0	.60	11.66	.71
1976	53.68	.58	14.52	.69
1977	54.12	.52	12.98	.69
1978	45.98	.63	14.52	.64
1979	40.48	.74	14.96	.59
1980		.65		.66
1981		.61		.61

SOURCE: DEC and RECA, 1982.

Table 20. Domestic Resource Costs[a]

	Low Yield Technology	High Yield Technology
Rice		
100% of land value[b]	1.33	7.77
50% of land value	1.13	4.37
0% of land value	0.94	0.97
Corn		
100% of land value	1.23	2.44
50% of land value	1.02	1.37
0% of land value	0.81	0.30

[a]Domestic resource cost (DRC) is the value of domestic resources (in balboas) committed to the production of output from one hectare divided by the value added in world prices (U.S. dollars). This result is then divided by the real exchange rate; the result is a unitless number. A value less than one indicate a comparative advantage; a value greater thn one indicates a comparative disadvantage.

[b]Land value is an estimate of land rent as a domestic resource committed to the production of output from one hectare and is calculated in the following manner: (Producer Price x Yield) - total cost of production for one hectare.

Table 21. Consumer Price Index by Commodity Group for Panama City, 1977-81 (1975=100)

Year	Food	Meats	Housing	Clothing	Others	Total
1977	104.4	98.6	113.7	108.5	109.7	108.7
1978	110.9	112	121.2	112	110.7	113.3
1979	122.2	133.1	125	118.2	121.8	122.3
1980	137.6	143	135.4	130.5	145.6	139.2
1981	150.2	149	141.9	137.5	156.7	149.4

Source: DEC

APPENDIX

The food consumption data collected for the Nutrition Evaluation Project was obtained from a 24-hour recall of the foods consumed by the household as a unit. Because information was asked of only one respondent, who might not be aware of foods consumed outside of the home by other individuals, the data provided by the instrument reflect consumption in the home, and may underestimate actual consumption. Information was also obtained, however, on the number of persons (by sex and age groups) sharing each meal, in order to allow for more precise estimates of intake as compared to needs. Actual intakes of calories, protein and other nutrients were estimated by household and by calorie equivalent person (CEP), which is used to adjust for the different caloric (energy) requirements of various sex and age groups.

The measure of income selected for analysis is expressed in this equation:

TOTAL INCOME = INCOME FROM SALARY + INCOME FROM AGRICULTURAL PRODUCTION (1)

The measure of income from salary is the sum of money received during the previous month from 13 sources (salary, sale of products, sale of services, profits, commissions, dividends, pension, gambling, rental income, securities, family, and donations and noncash gifts) and is the most reliable measurement of income for the households without agricultural production. The measure of income from the agricultural production of the land was derived from a dataset assembled by agronomists at the

Ministerio de Desarrollo Agropecuario in Panama. The dataset contained measurements of total monthly production (as a function of current market prices of crops sown), total monthly inputs to production, a monthly income value attributed to sales, and a monthly income value consumed by the household itself. Thus, the precise measure of income derived from the agricultural production is:

$$INCOME_{AG} = INCOME_{SALES} + INCOME_{CON} - INPUTS \qquad (2)$$

where:

$INCOME_{AG}$ = agricultural income

$INCOME_{SALES}$ = income from products sold in the market

$INCOME_{CON}$ = income from the products that are consumed by the household

INPUTS = inputs to production (i.e. fertilizer, seed, machinery, etc.)

Because most of the agricultural households had little or no input, costs of production were negligible; the derived income from agriculture did not subtract the inputs as in equation (2). Thus, we can rewrite equation (1) as:

$$TOTAL\ INCOME = INCOME_{SALARY} + INCOME_{SALES} + INCOME_{CON}$$

where income for most households in the urban setting is strictly due to salary.

For the analysis of consumption, there are 610 households with food and income data, 192 households in urban areas, and 418 in rural areas.

The data collected for the Nutrition Evaluation Project in 1980 was used to determine (1) the share each principal food

commodity contributes to the household's total calorie intake and expenditures on food, (2) the relationships between household consumption of principal foods and the household's incomes and other household characteristics such as sector in which employed, household assets, education level for head of household, type of household, i.e. extended versus nuclear family (for urban households) and degree of market connectedness, size of land holdings, land tenure, technology used, and importance of off-farm work (for rural households).

The analysis for rural households has included variables for family size, land size, education, off-farm work, market connectedness, and technology. Family size is the number of persons per household. Land size is the number of hectares owned by each household. The education of the head of each household in years is divided into three classes, less than one year, one to six years, and more than six years. Off-farm work measures the percentage of total income earned from work off own farm. The variable for technological use classifies households as mechanized or unmechanized relative to the system of agricultural production used. Market connectedness is the ratio of the value of agricultural sales to agricultural income.

Methodological Issues

The technique of the two-stage budgeting has been applied to obtain estimates of income elasticities for the major food groups in the Panamanian diet, i.e. corn, beans, rice, milk, poultry and beef. The two-stage budgeting procedure assumes that the typical consumer maximizes his utility function in two stages. In the

first stage income is allocated among different expenditure groups, for example, food, housing, transportation, etc. In the second stage, the group expenditures are then allocated among various commodities, for example, food expenditures can be allocated among rice,corn, beef, etc. Formally, the consumer is assumed to maximize a utility function $U = U[u^I(x_I),.., u^S(x_X)]$ subject to the budget constraint. In the first stage income M is allocated over the S categories of expenditures ($R = I,..., S$) in the following way:

$$M_R = M_R(P_I,..., P_S, M) \quad (3)$$

where M_R is the expenditure on group R and $P_I...P_S$ are group price indices. In the second stage, the group expenditure M_R is allocated among the individual commodities that constitute the group in the following way:

$$q_r = q_r\ (P_{R1}, P_{R2},..., P_{Rn_R}, M_R) \quad (4)$$

where, n_R is the number of subgroup commodities in group R.

Equation (4) can be rewritten as:

$$q_r = q_r\ [P_{R1}, P_{R2},..., P_{Rn_R}; M_R\ (P_I,..., P_S, M)] \quad (5)$$

Since the price variability that exists in the data is minor, prices have been assumed constant across all households, as is customary for single, cross-sectional data such as these. The problem of estimation of the demand parameters, therefore, collapses to a problem of estimating the income-expenditure parameters of the Engel function. No price parameters were estimated with these data.

This two-step budgeting procedure avoids estimation problems related to multi-collinearity, which might arise from the joint dependence of household behaviors on market conditions. Specifically, the posited model in equations (4) and (5) includes shifter variables which may be determinants of, or determined jointly with, household income. For example, land size may be a determinant of income, off-farm labor supply and market connectedness, which in turn could affect the percentage of income earned from sources other than farm production. For these reasons, the estimation first regressed total food expenditure on income, M_R on M, equation (3), and then estimates equation (5), q_r on Mr, for each commodity. The regression of M_R on M, equation (3), is presented in Table 8. The regressions of individual quantities by commodity group for the rural area are presented in Table A. The regressions of individual quantities for the urban area were statistically insignificant. The overall estimates of the income elasticities for selected commodities in the rural are are presented in Table 9. The estimates of the income elasticities are calculated by multiplying the elasticity of food expenditures with respect to income from the first stage estimate for the rural households, by the elasticities for the individual commodities from the second stage estimates, that is:

$$\frac{dQi}{dM}\frac{M}{Qi} = \frac{dMr}{dM}\frac{M}{Mr} \cdot \frac{dQi}{dMr}\frac{Mr}{Qi} \qquad (6)$$

Table A . Second Stage Estimation:
Regression of Logarithm of Total Family Grams of Each Commodity on Longarithm of Total Family Food Expendituresand Other Selected Variables For Rural Households

Commodity	Intercept	Log of total family food expenditures	Family size	Market connectedness	Mechanization	% Off-farm income	Land size	Education, head of household (yrs.)			F	R^2
Corn	5.345	-0.0678	0.0706	-0.180	0.35718	-0.43066	0.0112	>6	-0.355	(-1.14)	3.82	.177
	(15.62)	(-0.42)	(1.76)	(-0.50)	(0.90)	(-1.59)	(1.94)	<1	.6424	(2.81)		
								1-6	0	--		
Beans	5.4569	0.1158	0.06656	-0.19477	-0.06539	-0.30066	0.0008	>6	-0.0436	(-0.28)	4.61	.1707
	(39.12)	(1.54)	(3.62)	(-1.14)	(-0.43)	(-2.65)	(0.36)	<1	0.31668	(3.31)		
								1-6	0	--		
Rice	6.0815	0.32614	0.10536	0.0514	0.1779	-0.21308	.00011	>6	-0.249	(-2.55)	26.97	.372
	(64.86)	(6.80)	(8.95)	(0.45)	(1.54)	(-2.81)	(0.06)	<1	0.139	(2.19)		
								1-6	0	--		
Milk	4.465	0.578	0.00925	0.13309	0.1259	0.09037	0.0063	>6	0.29015	(1.32)	3.19	.0938
	(14.90)	(4.10)	(0.31)	(0.43)	(0.46)	(0.42)	(1.22)	<1	0.0418	(0.23)		
								1-6	0	--		
Poultry	4.844	1.0202	-0.0258	-0.0452	0.11272	-0.1825	0.0036	>6	-0.300	(-1.52)	7.05	.457
	(16.60)	(7.11)	(-0.86)	(-0.16)	(0.30)	(-0.93)	(0.46)	<1	0.2228	(1.27)		
								1-6	0	--		
Beef	5.2686	0.6336	-0.0279	-0.1478	0.289	-0.155	-0.0026	>6	-0.0564	(-0.31)	4.14	.1704
	(20.97)	(5.20)	(-0.91)	(-0.54)	(1.26)	(-0.79)	(-0.49)	<1	0.0658	(0.40)		
								1-6	0	--		

Note: t-statistics in parentheses.