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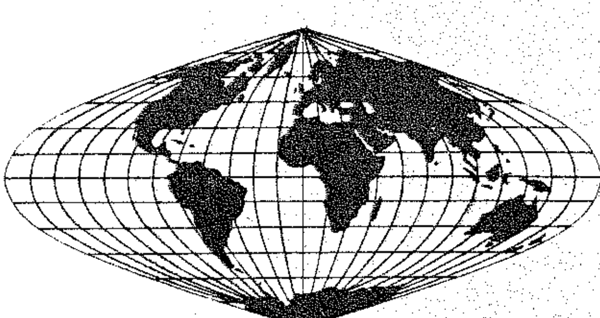
STUDY

BEHAVIORAL THRESHOLDS AS INDICATORS OF PERCEIVED DIETARY ADEQUACY OR INADEQUACY

Neville Edirisinghe and Thomas T. Poleman



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About no matter of contemporary concern has the public a greater right to be confused than the world food situation. Depending on the authority consulted, it is possible to be informed that things are getting worse for a world already teetering on the brink of mass starvation or that never before in history has the world been as well fed as it is today.

Several years ago the USDA asked me to look into the basis for such an extreme divergence of opinion and to make recommendations for better quantifying the nutrition situation in developing countries. I concluded that we should eschew the traditional approach of comparing needs against food availabilities and search instead for behavior indicative of perceived dietary adequacy or inadequacy. By so doing I hoped we might be able to sidestep the fact that nutritional needs are still not fully understood, and that food availabilities and their distribution among the population still remain to be reliably measured in most developing countries.

As to the behavior sought, my thinking was mightily influenced by the work of Merrill K. Bennett. In the course of analyzing the patterns of dietary evolution which accompanied economic development in the West, he noted that the very poor would seek to maximize the nutritional return per outlay for food by building their diet around the cheapest starchy staple foods (such as maize and potatoes). Then as incomes increased and the necessity for buying quantity alone diminished, quality considerations would begin to manifest themselves. First the cheap starchy staples would be replaced by more preferred ones (such as wheat bread), and then the importance of the starchy staples *in toto* would decline. A hundred years ago our great-grandparents consumed large amounts of bread and potatoes. Today our diets are dominated by meat, fats and oils, sugar, vegetables, and dairy products.

Would not, I reasoned, Bennett's progression of dietary change provide the framework for our search and would not the point where households begin to purchase quality instead of quantity be the behavioral threshold we sought?

In the present study Neville Edirisinghe tests the validity of the idea using household consumption data from four countries and concludes it has merit. He also concludes that the intake levels at which basic energy needs are perceived as being met is rather lower than previously thought--in the range of between 1500 and 1950 calories per person per day.

In Sri Lanka, the initial income-induced subsitutions occurred between quality rice purchased in the open market and low-quality rice received free from the state. Substitution of quality for quantity was observed beginning from the lowest reported income class; the mean per capita daily energy intake in this income class was 1940 calories. In the North-Eastern region of Brazil, calories from cassava flour, the less-preferred starchy staple, began to be substituted away for calories from preferred cereals when per capita consumption was 1530 calories.

In Indonesia, rice was the preferred source of calories and the less-preferred calories came from maize, cassava, and other roots and tubers. The most reliable threshold for Indonesia, observed in the rural sector of areas where the less-preferred staples were grown, indicated an energy consumption level of around 1700 calories at the point where quality considerations significantly replaced those of quantity. In the Central and Southern Sierra of Peru, the intake level indicative of perceived adequacy was approximately 1800 calories.

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CHAPTER I. THE SEARCH FOR THE MALNOURISHED

Identification of the malnourished has been the focus of a large body of research in the recent past. Attempts have been made to quantify the extent of malnutrition in individual countries, regions, and in the world. Implicit in the search for the malnourished is a motivation to effectively intervene to eliminate or reduce the problem. These interventions may involve national as well as international efforts. In the short run, the intervention programs usually result in some form of food aid to the needy. Interventions with long-run objectives may require assistance to weaker populations, sectors, or regions to help them effectively participate in the process of economic development.

If the problem of malnutrition is inaccurately assessed, the results may negatively affect any form of intervention. Broadly speaking, an undue overestimation of the problem may cause crisis behavior that may result in misallocation of priorities. If the problem is seriously underestimated, it may lead to a state of complacency and a real problem may be neglected. Presently there is substantial controversy over the magnitude of the world nutritional problem. Two recent studies that attempted to measure the extent of the nutritional problem in the developing world provide ample evidence of the nature of the controversy. A World Bank study concluded that the world (in 1965) had 1.2 billion malnourished people (31). An FAO study in 1977 identified a much lower figure of 400 million as nutritionally deprived (14). The reduction in numbers is by no means a reflection of successful amelioration of the nutritional problem, but reflects the vast number of problems that confront the methodology used in measuring the extent of malnutrition.

The traditional method for assessing the extent of malnutrition is to compare the food availabilities with needs. The obvious precondition for the accuracy of these assessments is precise information on the availability of food and minimum nutritional needs. Unfortunately, the current state of knowledge on the nutritional requirements of different populations, and food accounting methodologies, fall short of meeting this precondition. There is evidence that most of the studies on the nutritional problem have employed nutritional norms that are overstated and food availabilities that are understated. This resulted in undue exaggeration of the problem (27).

Malnutrition is largely a function of poverty; to quantify it in these terms requires a knowledge of the pattern of income distribution. But the accounting of incomes can be wrought with problems in economies where a large part of real-income generating activities may not be easily identified. In addition, there remains much to be understood on the linkages between nutrition, income and food preferences. When the income-calorie intake relationship is assessed, it becomes necessary to consider the nutritional implications of substitutions between "quantity" and "quality" in food consumption.

In view of the inadequacies found in the application of the traditional methodology for assessing malnutrition, an alternative approach has been recently suggested by Poleman(28). In an appraisal of the extent of world hunger, he has proposed that income-consumption behavior, if monitored properly to delineate the quantity and quality changes, may contain sufficient information to develop a better understanding of the nutritional problem (28, p. 250):

> . . . since it was not likely that the next few years would see more accurate estimates of either food availabilities or minimal nutritional needs in developing countries, we should consider abandoning altogether the approach of comparing availabilities with needs and search instead for behavior indicative of perceived dietary adequacy or inadequacy . . . . Would not the point where households began to purchase quality instead of quantity be the thresholds we sought?

The purpose of this study is to examine the legitimacy of the concept of a behavioral threshold suggested by Poleman in understanding the problem of malnutrition in developing countries. This task is undertaken in the following manner. In Chapter II the main issues in the controversy related to quantification of the nutritional problem are reviewed so that the need for an alternative approach is placed in the proper perspective. The third chapter discusses the rationale for focusing on the quantity-quality substitutions as a means to discern behavioral thresholds of dietary adequacy. A preliminary examination of the available data from individual countries is carried out to establish the basic empirical validity of the threshold concept. Chapter IV contains a discussion on the potential limitations of the threshold concept. A starchy staples consumption model is introduced and discussed in Chapter V as a way to provide a reasonable basis for making inferences on consumer perceptions of nutritional adequacy or inadequacy. Chapters VI and VII present the results of attempts to test the behavioral model using data from Indonesia and Peru. The final chapter summarizes our conclusions as to the validity of the threshold concept and its implications.

CHAPTER II. ASSESSMENT OF THE NUTRITIONAL PROBLEM: SOME BASIC ISSUES

The most widely used methodology to measure the extent of malnutrition is to compare apparent nutritional intake with recommended allowances. The malnourished are defined as those whose nutrient intake falls short of standards defined as desirable. This approach is used in global as well as individual country assessments of the nutritional problem. Often, the same methodology, refined in various ways, is used to identify poverty lines for individual country populations. The suggestion for an alternative approach to assess the problem of malnutrition has been prompted by some of the weaknesses in the traditional methodology. In this chapter, major applications of the traditional methodology are briefly reviewed and the basic issues are identified so that the need for an alternative approach can be placed in proper perspective.

The Global Assessments

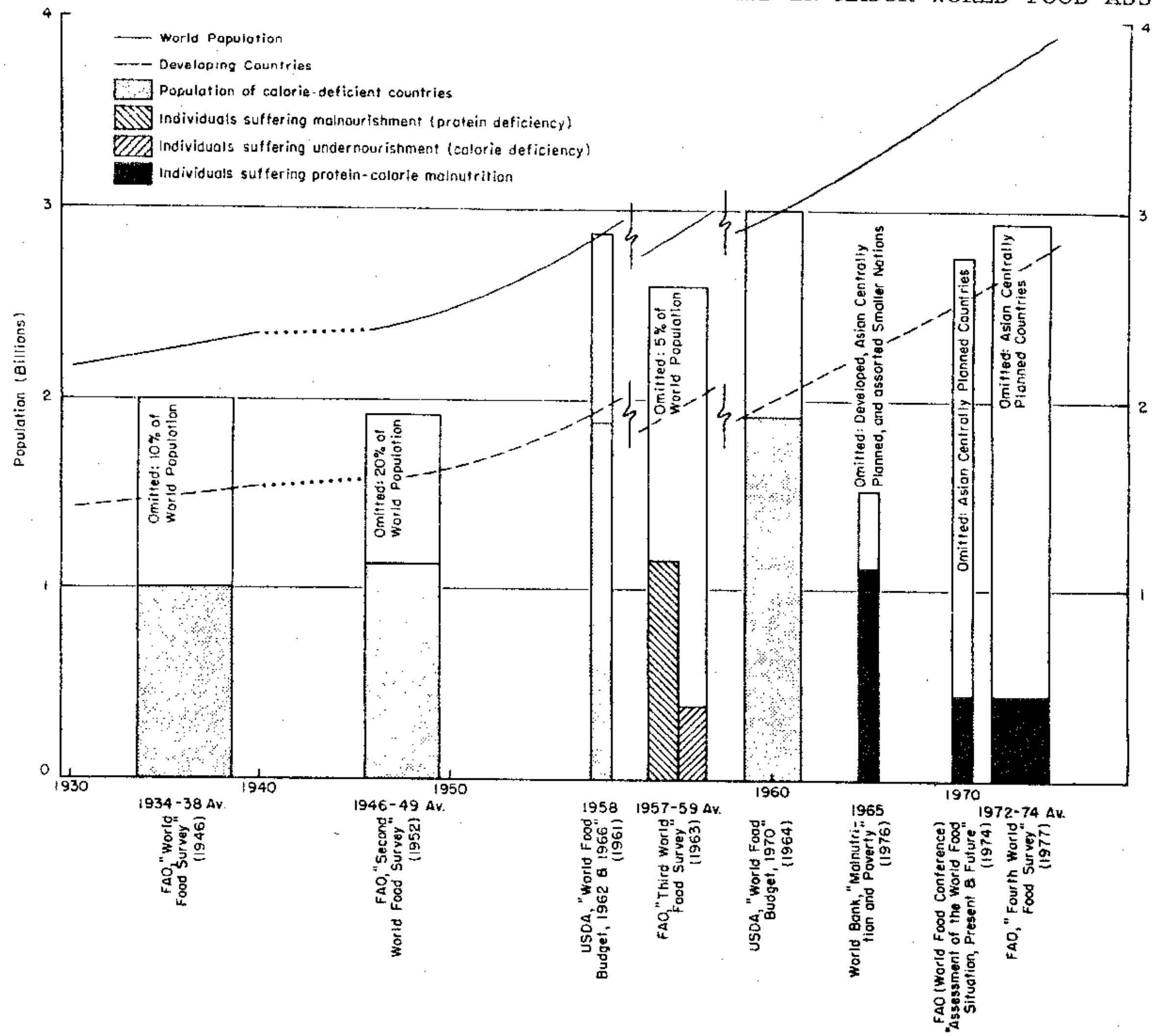
Attempts to quantify malnutrition at the global level have been mainly undertaken by three organizations: the Food and Agriculture Organization (FAO), the United States Department of Agriculture (USDA) and the World Bank. Their conclusions are graphically presented in Figure 2.1.

In the history of research related to assessment of the world nutritional problem, three broad phases can be identified.1/

The first phase was reflected in the early postwar studies. These evaluated the nutritional problem through country or regional averages of both food supplies and recommended nutritional allowances. The focus was on undernourishment--a nutritional situation generally defined to mean a shortfall in calorie intake such that a person cannot maintain bodily activity without losing weight. To calculate the calorie deficits, per capita food availabilities reported in national food balance sheets were matched against the average calorie allowances recommended by the FAO/WHO expert committees. The calorie allowances used varied between 2300 and 2600 in the case of developing countries.

1/ The history of attempts to quantify the world hunger problem, including the methodologies employed and the results obtained, are critically examined in 27 and 28.

FIGURE 2.1. PERSONS IDENTIFIED AS NUTRITIONALLY DEFICIENT IN MAJOR WORLD FOOD ASSESSMENTS



Source: T. T. Poleman, "A Reappraisal of the Extent of World Hunger," Food Policy, Vol. 6, No. 4, November 1981.

With calorie deficits so derived, the FAO's first and second World Food Surveys concluded that over 50 percent of the world population faced undernutrition during immediate prewar and postwar periods (15, 17). Similarly, the USDA's World Food Budgets (41) concluded that two-thirds of the world population faced undernutrition.

In the second phase the problem of malnourishment--the nutritional situation where a deficiency in one or more protective nutrients, such as proteins, vitamins and minerals, occurs--began to be considered as a matter of grave concern. The Third World Food Survey of the FAO in 1963 concluded that "some two-thirds of the world population suffer from undernourishment or malnourishment or both" (16, p. 51). The emphasis was on protein deficiency, but its importance as a serious nutritional problem diminished when the minimum protein allowances were adjusted downwards by about a third by the FAO/WHO expert panel in 1971 (13). Accompanying this reduction in protein allowances was a re-emphasis on energy deficits, but the problem of protein inadequacies was not completely ignored. The new emphasis was on protein-calorie malnutrition--protein was included because it can be metabolized to compensate for inadequate energy supplies, which makes it possible for an apparent protein surplus to turn into a deficit.

In the third, or current phase, the emphasis is on the distributional aspects of the nutritional problem: on the distribution of calorie needs and on the distribution of calorie supplies. FAO's Third World Food Survey (16) and the study prepared by the UN for the World Food Conference (40) recognized the need to adjust the energy requirements recommended for the average healthy persons so that variations in physical activity and other factors could be accounted for. The purpose was to minimize overestimation of the nutritional problem by establishing minimum critical needs. In the former study, calorie intake on a reference man equivalent basis, below three standard deviations from the mean, was considered as representative of undernutrition. The latter study set the critical needs at 1.5 basal metabolic rate (BMR) minus 20 percent. The rationale for the downward adjustment was evidence that some persons may have a BMR as low as 20 percent below the norm, even when the individual variations due to activity have been removed.[2/] Application of the minimum critical needs approach substantially reduced the number of people believed to be malnourished, which the two studies estimated at around 400 million (16, p. 51; 40, p. 5).

2/ The energy cost of maintenance has been set at 1.5 X BMR by the Ad Hoc Committee on Energy and Protein Requirements, convened by FAO and the WHO. It is also noted that the figures for BMR were based on the measurement of 2200 persons in one laboratory in Boston over a period of 15 years. The authors refer to the limited representativeness of such figures (31, p. 72).

That everybody in poor countries need not be considered as suffering from nutritional deficiencies was the rationale that led recent studies to disaggregate food availabilities below the national level and identify the levels of income that did not permit sufficient food intake to meet the requirements. Reutlinger and Selowsky's study was the first attempt to quantify the global malnutrition problem by linking it to income levels and, hence, poverty (31). Ideally, an income-class specific assessment of the world nutritional problem has to be the sum of individual country income-class specific assessments. But, few, if any, developing countries have the data bases for such an exercise. Reutlinger and Selowsky adopted an indirect approach to estimate the unequal distribution of caloric consumption among income groups.

Basically, the methodology adopted to circumvent the problem of data insufficiency was to use an author-specified income elasticity coefficient in a consumption function to estimate the calorie deficits in a given region.[3/] According to this methodology, 1.2 billion of the world population were considered to be malnourished.

The Fourth World Food Survey by the FAO emphasized the distribution of calorie intake within a population as being essential for estimating undernutrition with greater accuracy (14). Since the actual distribution was not known with certainty, an approximation was attempted by indirectly fitting a Beta-distribution to the calorie intake of each country. This methodology involved the specification of a lower and upper limit of calorie intake in estimating the distribution, which could be done without difficulty. What may have caused difficulty was the need to specify income elasticities to be used in deriving the standard deviation of calorie intake which was required to estimate the distribution. The income elasticities adopted for this purpose were not reported in the study, and the accuracy of these parameters is critical.

3/ The relation between calorie consumption (C), and income (Y) was expressed in a semi-log form such that

$$C = a + b \log Y + e$$

where, a and b are coefficients to be estimated and e is the error term. From this equation, income elasticity of demand for calories is derived as:

$$\eta = b/C$$

The slope coefficient b was estimated by using region-specific calorie allowances as the value of C and specified income elasticities of 0.15 and 0.30 as η. With an estimate of b, the intercept term, a, is derived at a specified C and Y. With coefficients "estimated" in this manner, caloric consumption at different income levels was estimated and matched against regional calorie allowances to derive the calorie deficits.

The Basic Issues

The validity of the assessments of the nutritional problem has been questioned on the basis of a) the difficulties surrounding proper accounting of food availabilities, b) the definition of appropriate calorie standards and c) the estimation of the income-diet relationship.

Quantification of Food Availabilities

A common characteristic of all of the studies referred to earlier is the use of per capita food (nutrient) availabilities accounted for at the national level in food balance sheets. To the extent that there is any bias in the estimates of food supplies given in the balance sheets, there will be a degree of distortion in the final figures on the extent of malnutrition. The degree of precision in food balance sheet estimates can be affected by a large number of factors, such as the historical tradition of statistical reporting, the importance placed on generating a reliable data base, the degree of advancement in the techniques used for collection of statistics, their operational efficiency and the degree of data manipulation to appease political pressure.

Whether the problems confronting estimation of different components in the food balance sheet lead to a net overestimation or underestimation of the food available for human consumption has been examined in different countries. In general, the error appears to be in the direction of underestimation. It has been pointed out by Poleman that understatement of production is a characteristic common to most newly developed agricultural reporting systems (27, p. 7). Subsequent evaluations of the wheat acreage and production in the United States have pointed to 30 to 40 percent more production of wheat during 1866-1875 than officially reported by the United States Department of Agriculture. An appraisal of the Mexican official statistics has revealed a substantial underestimation of maize production during 1925-34, the Direccion General de Economia Rural's first decade, when production was at least 50 percent more than what was reported (27). More recent detailed studies on the food economies of Sri Lanka and Malaysia have suggested that calorie availabilities in both have been underestimated by between 10 and 15 percent (22, 30). Based on the case studies of Sri Lanka and Malaysia, Poleman observes that (27, p. 8):

> . . . as the staple in both countries is rice grown under irrigated conditions and thus relatively amenable to quantification, and as both countries have by the standards of the developing world an admirable statistical tradition, this 10 to 15 percent is probably something of a floor; elsewhere, the food actually available may be undercounted by rather more.

One conclusion regarding use of food balance sheet supply figures is clear: the nutritional problem may have been seriously exaggerated by matching understated estimates of food availability against overstated nutritional requirements. The food balance sheet ceases to be the relevant indicator of food supplies if the behavioral approach suggested by Poleman is adopted. The availability of cross-section data on household consumption and income or expenditure is crucial to test the behavioral threshold approach. Underreporting of food consumption may not be completely eliminated in cross-section surveys, but properly conducted ones may appreciably reduce this bias.

The behavioral approach, on the other hand, may well avoid the problems confronting the determination of proper calorie standards.

What are the Appropriate Calorie Standards?

Quantification of the extent of malnutrition hinges of a fundamental premise: that there exists an accurate calorie requirement standard against which observed intakes can be compared. Given the biological complexities associated with the requirements of energy and its utilization, it is not surprising to find a long-standing debate on the accuracy of the calorie/protein norms usually employed. Norms have to be a good reflection of the average conditions. How close the recommended norm is to the true average depends on the level of advancement of the nutritional science as well as on the quality of research within countries. The history of recommended nutritional allowances has been one of regular changes in response to new information. In the measurement of malnutrition, even small changes in the standards used for comparison can cause substantial changes in the final assessments because of the large numbers involved.

There can be many variables that influence energy requirements of a given individual. The four basic variables are a) physical activity, b) body size and composition, c) age, and d) climate and other environmental factors. Among individuals of the same sex, body size and age, the amount of physical activity is usually the most important factor causing variations in energy needs (13, p. 23). The interrelationships among these variables are complex and cause problems when energy requirements have to be specified. Conceptually, it should be possible to derive average requirements for groups defined according to similarity of sex, age, weight, environment and intensity of activity. The FAO methodology for specifying energy requirements first set the requirements of a "reference man" and "reference woman." The energy requirement of persons is defined as "the energy intake that is considered adequate to meet energy needs of the average healthy person in a specified category" (13, p. 10). These specified requirements of reference persons are then used to consider variations that occur due to factors such as age, weight, climate, pregnancy and lactation. Table 2.1 shows the most recent specifications of the subdivisions of the total energy output and the variations that occur under different activity levels.

TABLE 2.1. ENERGY EXPENDITURE OF THE REFERENCE MAN (65 kg.) AND REFERENCE WOMAN (55 kg.), DISTRIBUTED OVER 24 HOURS, BY ACTIVITY

(kilocalories)

	Light Activity		Moderately Active		Very Active		Exceptionally Active	
	Man	Woman	Man	Woman	Man	Woman	Man	Woman
In bed (8 hours)	500	420	500	420	500	420	500	420
At work (8 hours)	1,100	800	1,400	1,000	1,900	1,400	2,400	1,800
Nonoccupational activities (8 hours)	700-1,500	580-980	700-1,500	580-980	700-1,500	580-980	700-1,500	580-980
Range of energy expenditure (24 hours)	2,300-3,100	1,800-2,200	2,600-3,400	2,000-2,400	3,100-3,900	2,400-2,700	3,600-4,400	2,800-3,200
Mean (24 hours)	2,700	2,000	3,000	2,200	3,500	2,600	4,000	3,000
Mean (per kg. body weight)	42	36	46	40	54	47	62	55

Source: FAO, Energy and Protein Requirements, Report of a Joint FAO/WHO Ad Hoc Expert Committee (Rome, 1973), p. 28.

Adjustments of the specified average requirements of the reference persons to suit particular country populations require a large amount of information which may not be readily available in most developing countries. Time and motion studies pertaining to different types of occupations are required to account for occupational variation in energy requirements. In addition, the proportion of the population in the different occupations, and seasonal variations in different types of work are required for the proper assessment of the energy expenditure levels and the derivation of relative weights to obtain precise averages. Measuring energy needs can be a complicated and lengthy process requiring sophisticated equipment and numerous subjects. In the developing countries, this kind of research work may not be given adequate priority for economic reasons.

The use of average requirements specified by the FAO/WHO to identify malnourished groups has raised two important issues. The first is concerned with the possible overstatement of average needs themselves; the second questions the validity of using these recommendations as minimum requirements.

The theoretical possibility that average energy requirements may be specified for some homogeneous groups does not necessarily mean that the recommended nutritional intakes are accurate representations of energy requirements. The early committees on energy and protein requirements emphasized that the recommendations were provisional, tentative, and open for testing and further research (13, p.7). The specified average intake levels were more in the nature of recommended allowances designed as guidelines for dietitians and nutritional workers and such allowances consciously err on the side of caution, both to incorporate a safety margin and to ensure that the substantial variations in food needs among individuals will be covered (27, p. 9). That overestimation has been recognized by the expert committee itself is evidenced by the recent downward adjustments in the recommended intake levels. The first and the second FAO/WHO committees on calorie and protein requirements had recommended energy requirements of 3200 kilocalories and 2300 kilocalories for the "reference man" and "reference woman," respectively. These intake levels were reduced to 3000 and 2200 kilocalories for the two reference persons by the expert committee in 1971. Even after these downward adjustments, FAO opted to use still lower standards "based on the concept of minimum critical requirements" in its more recent assessments of the extent of malnutrition.

The second issue is concerned with the use of recommended average intake levels to represent minimum requirements. In a typical analysis, average per capita energy requirements are matched with apparent per capita intake of calories and those whose intakes fall below the average are considered malnourished. Sukhatme argued that it is unrealistic to believe in the existence of some universal, invariant calorie standard, even after age, sex and activity are taken into account. Proper estimation requires adjustments for individual variations (35, 36). In the model of individual calorie requirements proposed by Sukhatme and further clarified by Srinivasin (34), two sources of errors due to inter-individual and intra-individual variations in requirements are explicitly considered. To compare energy intake directly with a recommended allowance implies the assumption that there are no inter- and intra-individual variations. There can be little disagreement that inter-individual variation is not zero. With regard to intra-individual variation, Sukhatme shows sufficient evidence to prove not only that intra-individual variation is not equal to zero, but that it is positive and constitutes most of the population variation (35, p. 1976).

A summary of the reasons for the existence of intra-individual variations is provided by Srinivasan (34, p.3),

> Just as there are differences among different machines in their efficiency (i.e. the ratio of output of useable energy to energy input) different human beings differ in their functions as energy converters. However, the human body apparently has an essential homeostatic or regulatory mechanism which adjusts to varying intakes of food, without drawing on (losing weight) reserves or adding to reserves (gaining weight), while at the same time enabling the individual to perform tasks involving a given level of energy expenditures.

This is the regulatory mechanism which takes care of moderate variations in intakes without any change in weight or activity. If too low or too high levels of intake are sustained over a long period, an adaptive mechanism adjusts to the new level through changes in bodily functions or activity (34, p.3).

Sukhatme emphasized the need to account for individual variations and suggested a statistical approach to determine a minimum critical intake level as a cut-off point in counting the nutritionally deprived. For example, one could consider the minimum critical level to be two standard deviations below the mean level of intake.4/ This statistical approach to determine minimum calorie requirements did not necessarily ensure elimination of the bias due to a possible overstatement of the mean level itself. Additionally, it required a knowledge of the joint distribution of individual calorie intake and requirement and the variation.

In response to the criticisms that FAO/WHO standards may have overstated average requirements, the FAO, in 1974 introduced a new concept based on basic physiological considerations to derive a minimum critical level of calorie intake. In its report to the World

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4/ Given a population of healthy individuals and assuming a normal distribution of intakes, 95 percent of such individuals can be expected to have intakes within the interval $\mu \pm 1.96\ \sigma$, where μ is the mean intake level and σ, the standard deviation. Sukhatme suggested this standard deviation to be 375 calories (36).

Food Conference in 1974, the reasons for not using the earlier standards were clarified (40, p.47):

> In assessing the numbers at risk from energy deficiency the average requirement is not a very suitable base, for much of the population will have true requirements ranging well below the average due to differences not only in body composition, but, more important, in activity. The true variation in individual activity is not known, neither is the extent of the possible skewness in requirement distribution.

The new calorie minimum was placed at one and a half times the basal metabolic rate less 20 percent to take care of possible individual variations in the BMR. The minimum critical limits derived at 1.2(BMR) range between 1486 and 1631 calories in the case of 58 developing countries (14). These minimums are in sharp contrast to the earlier standards which ranged from 2160 to 2670 calories (14).

In summary, the history of defining appropriate calorie standards is marked by a swing from substantial overestimation in the early stages to a possible underestimation in recent years.

The Income-Diet Relationship

Income certainly is an important variable in explaining the variations in total caloric consumption. But its use for the purpose of identifying caloric adequacy is not without problems.

First, there are the usual difficulties related to accounting of incomes and their distribution. Income distribution in a country is usually estimated by sampling household incomes. It is obvious that any failure to account properly for what constitutes income will provide a distorted picture of the income distribution. The general tendency, Poleman has argued, would be to undercount incomes (27, p.22). Ideally, all flows of value added which accrue to a household's labor and property should be accounted for. A precondition to achieving this ideal accounting is the existence of a market mechanism which allows all the values added to be (socially) determined. In the developed countries, economies are highly monetized, which allows a very close approximation of true income. In the developing countries, a significant part of the production does not pass through the market place. A large proportion of the rural households produce for home consumption; only insignificant quantities are sold or exchanged. Where sales do exist, they move through informal diffuse channels. Investigators often fail to record all the home products, gifts, and exchanges in kind. Households have no incentive to record or remember everything which they produced during the reference period of the survey. Where taxation is feared, willful underreporting may occur. Compounding these problems is the effect of seasonality of crop production. If the surveys are improperly timed, signficant variations may go unrecorded. If the households are surveyed in just one period, what is recorded through recall or day-to-day record keeping (usually for short periods, such as a week) will be influenced by seasonality in production. Seasonality variations can be properly accounted for if the surveys are arranged to cover the entire year, but this is very expensive.

Further, there are problems in attaching monetary values to an intricate range of labor exchanges and services. In rural communities, labor is exchanged for many productive activities. There are many services--religious, police or medical--which are not sold in the market, but provided as obligations or exchanges. For the community these are real incomes, but there is no systematic way to evaluate them. Problems of pricing public goods by central authorities add further complications.

A more fundamental problem arises when a particular point in the income-consumption relationship has to be identified as indicative of caloric adequacy. In the recent FAO and World Bank studies referred to earlier, income elasticities of demand were somewhat arbitarily specified to be representative of caloric adequacy. The choice of 0.15 and 0.30 as the lower and upper limit of the income elasticity range used to identify the malnourished was defended by the authors of Malnutrition and Poverty with the explanation that (31, pp.18-19):

> . . . a lower elasticity than 0.15 was ruled out simply because there is much evidence from food markets and household consumption studies indicating that the income elasticities should be significantly positive; a higher elasticity than 0.30 was seen to be inconsistent with the data, inasmuch as a higher elasticity would imply that large low-income segments of the population could subsist on consumption levels too low to sustain life.

The choice of calorie income elasticity coefficients of 0.15 and 0.30 by Ruetlinger and Selowsky has been criticized on the basis of empirical findings. Knudsen raises the question of why the calorie response to income increase as deduced by Reutlinger and Selowsky is so low, if poverty is in fact the cause of malnutrition (23, p.105). Would not people on the edge of malnutrition spend at the margin a greater share of their expenditure on the fundamental nutrient, calories? Knudsen and Scandizzo, using cross-sectional surveys for a number of countries in South Asia, made a direct estimation of the calorie income elasticities and found them to be in the order of 0.30 and 0.60 (24).

In an evaluation of the World Bank's Malnutrition and Poverty and FAO's Fourth World Food Survey, Hall has pointed out that the calorie income elasticity coefficients employed in the two studies may be upward biased (20). This bias, on the other hand, may have affected the final estimates derived by the two studies in an opposite manner: overestimation in the case of the Reutlinger and Selowsky study and underestimation in the case of the FAO study (20). The basic objection to the use of a calorie income elasticity arises from the fact that calories are jointly consumed with many other nutrients and other characteristics. More specifically, any food contains calories even though some foods are consumed to obtain other nutrients or to satisfy taste or flavor considerations. Therefore, when a certain level of total caloric consumption is identified as signifying adequacy, one may be identifying not only "pure" caloric adequacy, but also a complete or a partial satisfaction of many other requirements. These other requirements, particularly those related to other nutrients, may also be important for the human body. But, how can these other characteristics of food be incorporated into a calorie adequacy concept? All the studies referred to earlier were restricted to caloric adequacy and did not include other measures such as "calorie-protein-taste" or "calorie-protein-calcium" adequacy.

CHAPTER III. A BEHAVIORAL APPROACH

The traditional methodology and its major limitations to accurate identification of the malnourished were discussed in the last chapter. The alternative approach suggested by Poleman is essentially behavioral. It focuses on the observed consumption changes that are induced by changes in income, and points to the possibility of identifying a threshold in the continuum of the income-consumption relationship that may indicate perceived dietary adequacy (27). In this chapter, arguments upholding the rationality of this new approach are traced.

The income-diet relationship is customarily evaluated on the basis of the percentage of income allocated to food, the proportion of food energy derived from different food groupings, and the shifts in the relative importance of specific commodities within these groupings. Typically, these relationships are evaluated to provide a basis for predicting changes in the demand for food that may be induced by changes in income. One could also search for any indicators which may be economic manifestations of nutritional needs. This approach can be justified in a preliminary way by Bennett's observations about qualitative changes in food consumption that accompanied economic development in the West (1).

Composition of the Diet and Bennett's Law

In a detailed study of the economic characteristics of food, Bennett made a pioneering observation on the relation between increasing incomes and the quality of food. He suggested that increasing incomes are associated with a relative shift in the demand for different groups of foods. In particular, he observed a declining role of starchy staples as calorie sources. Studying the case of the United States, he noted that the proportion of total calories provided jointly by grain products and potatoes had declined consistently from 42 percent in 1909-13 to 27 percent in 1949-50 (1, p. 164):

> Why has such a change occurred? Certainly in large part because people could afford to make it. Beyond any question the starchy staple fraction of the national diet has throughout the forty year period been cheaper per 1000 calories than the nonstarchy fraction. Yet the nonstarchy staple, the expensive, fraction has persistently risen, while starchy staple fraction has fallen. The phenomenon is largely a function of income. Real income per capita has risen. The proportion of it going to food has fallen. The food consumed has nevertheless become more expensive in terms of constant prices, because the relatively expensive items have come to be increasingly consumed per capita, the relatively cheap items conversely falling, while total food per capita has changed little though it has fallen slightly.

In Figure 3.1, the historical course of calorie sources in the United States is shown.

Bennett's Law generalizes the observed explicit relationship between the income level and the consumption of starchy foods--that the starchy staple ratio, which is the proportion of calories from starchy foods to the total calories consumed, declines as incomes increase. A broad indication of the operation of Bennett's Law may be observed in Table 3.1. The high proportion of calories derived from starchy staples in poor countries contrasts sharply with the relatively low proportions seen in the richer countries. The dominance of starchy staples in the diets of the poor is explained by the fact that they are the cheapest source of calories. "Far less land and labor are usually needed to produce a thousand calories of energy value in the form of starchy staples than in the form of any other foodstuff" (27, pp. 28-29).

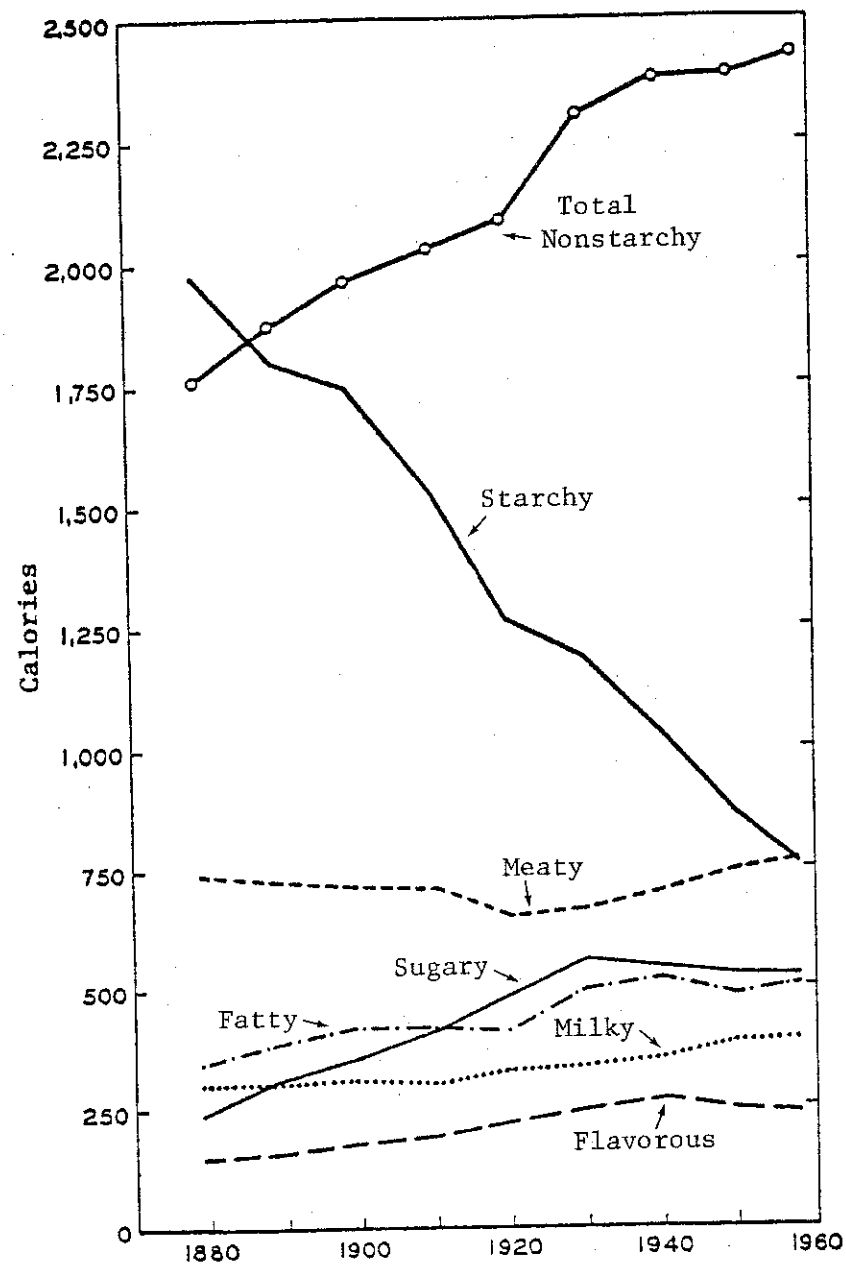
The relationship between level of incomes and the starchy staple ratio may be a useful indicator of nutritional status. It would be gratifying if one could identify some point along the continuum of adjustment in the dietary contribution of the various food groups--say, a particular starchy staple ratio--as being indicative of behavior reflecting the absence of perceived nutritional deprivation (27, p. 33).

Unfortunately, the use of the starchy staple ratio as a tool to identify the malnourished in a given period of time has its limitations. The decline in the starchy staple ratio is generally a slow process associated with secular changes in the income structure and the structure of food supplies. Within a given year, or within an even shorter period, the structure of food supplies and incomes may not undergo any significant changes. In order to use the starchy staple ratio as a measure of nutritional adequacy among population groups, one has to analyze not only time-series, but also cross-sectional data based on sufficient information on income-related food consumption variations. Such cross-sectional data are usually collected over short periods, at most for one year. If a country is at a relatively low level of economic development, empirical evidence suggests that the starchy staples usually form the dominant food group in the national diet. Demand and supply factors often operate to keep the food markets at relatively low levels of diversity and sophistication. Patterns of income distribution in most of the developing countries leave large sections of their populations with absolutely low incomes. It may not be surprising to find that starchy staples are providing most of the calories to the majority of the population, not only of the poor but also of a substantial portion of the middle income classes. It is only in the highest income classes, among the relatively few, that one may find significant changes in the importance of food groups. The case of Sri Lanka, shown in Figure 3.2 is representative of this phenomenon. It is only in the highest income class that rice and other starchy foods begin to lose their dominance, and even then their relative decline is modest.

While the rich may move from starchy foods to more preferred kinds of food, the quest for quality among the lower income classes can be identified in their choice of foods within the starchy staples group.

FIGURE 3.1. UNITED STATES: PER CAPITA DAILY ENERGY AVAILABILITIES DERIVED FROM BENNETT'S SIX MAJOR FOOD GROUPS, 1879-1959*

(calories)



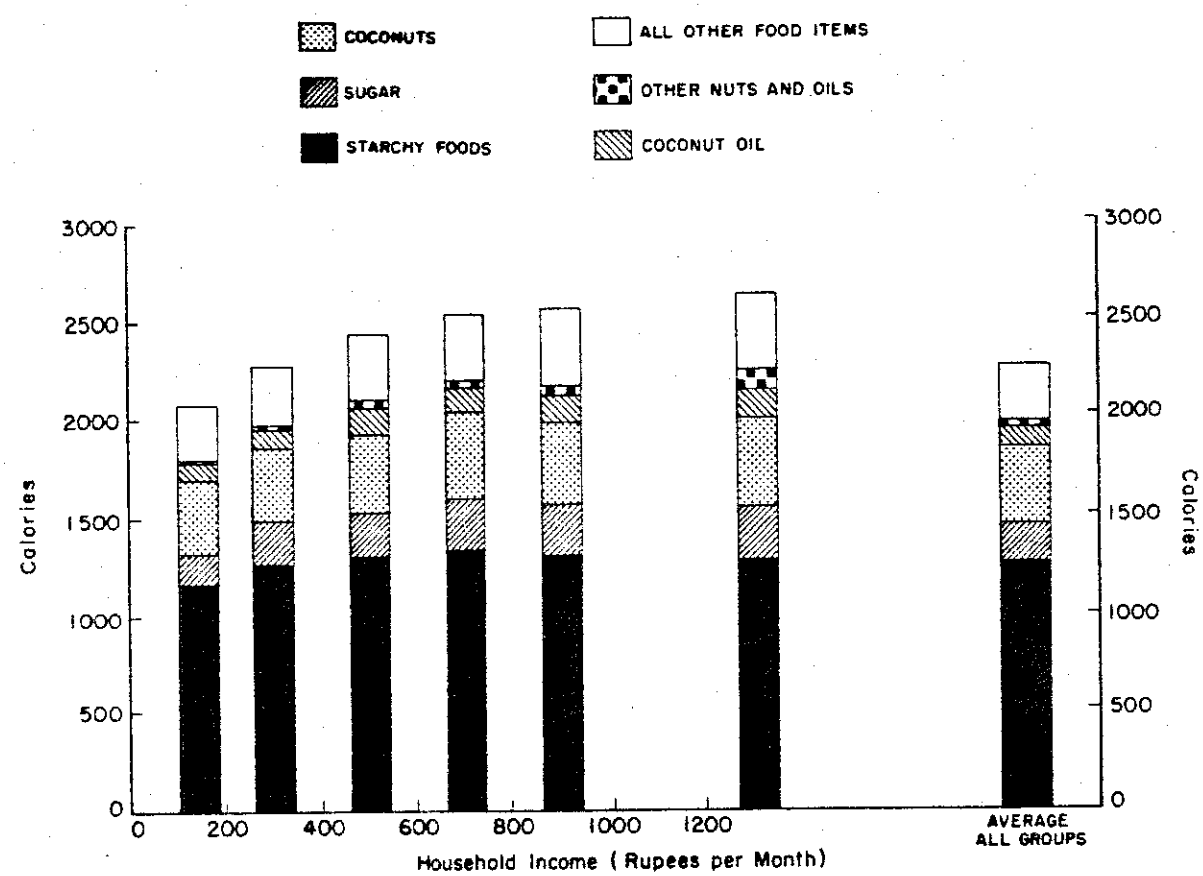
*Adapted from M. K. Bennett and R. H. Peirce, "Change in the American National Diet, 1879-1959," Food Research Institute Studies, Vol. II, No. 2, May 1961, p. 101.

TABLE 3.1. SOME NATIONAL AVERAGE STARCHY STAPLE RATIOS, 1964-66*

	Percent of Total Calories from Starchy Staples
China	78
Philippines	69
Haiti	65
Uganda	65
Sri Lanka	63
Singapore	52
Colombia	48
Argentina	41
Germany (West)	31
Switzerland	30
Canada	27

*Source: T. T. Poleman, "Quantifying the Nutrition Situation in Developing Countries," Food Research Institute Studies, Vol. XVIII, No. 1, 1981, p. 29.

FIGURE 3.2. SRI LANKA: APPARENT PER CAPITA DAILY CALORIE CONSUMPTION, BY MAJOR FOOD ITEMS AND INCOME CLASS



Source: Sri Lanka, Department of Census and Statistics, Socio-Economic Survey of Sri Lanka, 1969/70, Special Report on Food and Nutritional Levels in Sri Lanka (October 1972).

Quality Adjustments Within Food Groups

The income-consumption relationship points to shifts in the relative importance of commodities within food groups that result from changes in real incomes: the higher the real income, the greater the shift from less-preferred to more-preferred foods. In developed countries, the intragroup substitutions occur mostly among the nonstarchy staples; in the developing countries, these quality adjustments are expected among foods in the starchy staples group. A profile of these quality adjustments in the developing countries is aptly described by Poleman (27, p. 33):

> Over most of the income range in developing countries . . . the most important quality adjustments occur among the starchy staples. In virtually all LDCs there are well understood preference hierarchies among these foods. In West Africa, for instance, rice, wheat, and yams will be substituted for maize, millet and cassava when the consumer has sufficient access to a choice and the income to express it. Rice, of course, is dominant in tropical Asia, and consumers there recognize what to the unsophisticated palate is a bewildering hierarchy of quality differentiations. Wheat and rice are substituted for maize in Mexico as incomes rise and the populations become more urbanized . . . . This behavior is consistent with what we know of the evolution of Western diets. One of the first changes evident in nineteenth century Europe was the replacement of rye bread and potatoes by wheat products . . . and a shift away from maize meal marked the onset of the transformation of the American diet . . . .

And, as for the nutritional implications of the quality adjustments within food groups, the suggestion has been made that (27, p. 34):

> If one were to seek a behavioral threshold suggestive of perceived nutritional adequacy, then, a prima facie case can best be made for the income level at which substitution among the starchy staples sets in.

A Preliminary Search

In a preliminary search, consumption data from four countries--Sri Lanka, Brazil, Peru, and Indonesia--were checked for evidence of such substitutions within the starchy staples food group. Incorporating the latest methodologies, the four surveys collected much valuable information--with differing degrees of completeness--which can be used to analyze the food consumption behavior of different segments of the population. In the following sections, the results of a broad evaluation of the consumption patterns in each country vis-a-vis the expected threshold behavior are presented. In subsequent chapters the cases of Indonesia and Peru will be analyzed in detail.

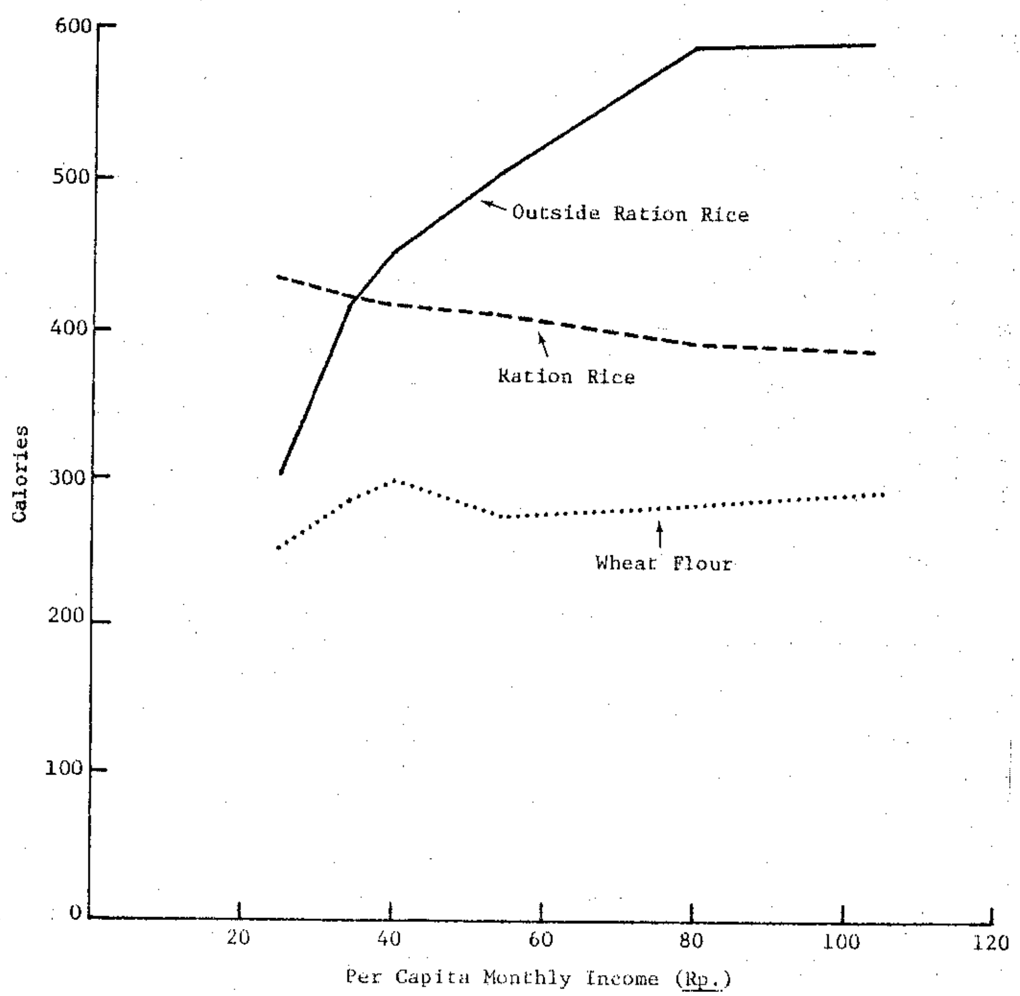
Sri Lanka

The 1969/70 socio-economic survey of Sri Lanka was designed to collect representative data on the living conditions of the population, with special reference to the consumption and expenditure patterns. It was an island-wide survey conducted in three rounds spread over a year with a sample of 9,694 households. Data from this survey have been extensively used for many different studies. Two of the most prominent were conducted by the International Food Policy Research Institute (18) and the World Bank (42). Details on the survey methodology and food consumption and nutrition related statistics are reported in the Socio-economic Survey of Sri Lanka 1969/70, Special Report on Food and Nutritional Levels of Sri Lanka (32).

The survey found apparent daily per capita utilization of approximately 2260 calories, a figure consistent with the national food balance sheet for the same period (11). This average level of apparent caloric consumption compares favorably with the recommended level of 2200 calories, a figure derived by adjusting the FAO/WHO recommendations (32). Cereals figure predominantly in the national diet, providing nearly 57 percent of the total calories, with rice providing 44 percent. The role of other starchy staples, except wheat flour, is minimal. All other locally grown cereals, roots and tubers contributed no more than 3 percent of caloric supply. The relative importance of the starchy staples food group at different income levels has been presented in Figure 3.2. Consumption levels of the major starchy staples among low-income classes are plotted in Figure 3.3.

During this survey period, as well as during the previous two decades, Sri Lankan consumers received a substantial portion of their rice through a government sponsored rationing scheme. Until 1978, rationed rice was made available to almost everyone either free or at highly subsidized prices. During the period of the survey, the ration scheme distributed two pounds of free rice weekly to almost every individual. Any additional rice requirements could be purchased in the open market at competitive prices. These open market purchases were appreciably affected by the real income increases associated with the subsidized, rationed rice (18). All wheat flour is imported into Sri Lanka. Once considered an inferior food, its role in the diet has increased substantially due to government price policies (11). In terms of income-induced substitutions within the starchy staples group, Figure 3.3 indicates a process of substitutions between rationed rice and purchased rice. The consumption of rationed rice declined as incomes increased. This decline in per capita consumption of calories from rationed rice begins at the lowest income classification reported in the survey report. The total per capita calorie consumption from cereals and all other noncereal food groups in this income class (Rs. 20 per capita per month) is 1940 calories. This is an important phenomenon because of the universal entitlement to rationed rice. Where one commodity dominates the diet, as rice does in Sri Lanka, the income-induced substitutions may be expected to occur within different qualities of the predominant commodity, rather than between different commodities.

FIGURE 3.3. SRI LANKA: APPARENT PER CAPITA DAILY CONSUMPTION OF CALORIES FROM MAJOR STARCHY STAPLES AMONG LOW-INCOME CLASSES, 1969/70*



*Source: Derived from Sri Lanka, Department of Census and Statistics, Socio-Economic Survey of Sri Lanka, 1969/70, Special Report on Food and Nutritional Levels in Sri Lanka (October 1972).

In such cases, one needs detailed information on the different qualities and grades which can be numerous. Consumption surveys usually confine their data to broadly defined foods, and the Sri Lanka survey is no exception. Nevertheless, the Sri Lanka case need not be dismissed on this count. It is generally known that the quality of the rice distributed under the rationing scheme was considered inferior (45). And large investments were made to upgrade the quality of rationed rice (33). The consumption of ration rice also involves certain opportunity costs because of a long waiting time at the distribution centers, and because the rice required reprocessing at home. The competitive nature of the outside-ration rice market meant that a better quality product was offered for sale. Given the possibility that the Sri Lankan consumer in 1969/70 may have considered the two types of rice as two different commodities, what does the negative relationship between income and ration rice indicate? Why has a free ration been substituted away for a better staple? May not one argue that the incomplete utilization of a low quality free ration means that basic calorie adequacy was not a serious problem even among the lowest income consumers?

Brazil

Insights into the Brazilian food consumption patterns have been made possible by an extremely comprehensive nationwide household study--the Estudo Nacional da Despesa Familiar (ENDEF) (4). It was conducted over the course of a year, from August 1974 to August 1975, and covered 55,000 families in seven principal regions. This survey employed methodologies to obtain as unambiguously as possible a picture of the expenditure/income distribution, food consumption and nutritional status of the Brazilian population. Expenditure information was collected on a vast number of different commodities purchased within the week of the survey and the previous month, quarter and year. Food consumption was recorded by regular visits to the households to avoid problems of recall. Anthropometric data were collected, as well as a wide range of socioeconomic information useful in the interpretation of such data.

Published data from ENDEF contain consumption, expenditure and other information aggregated by region and by nine expenditure classes. Table 3.2 is based on published data. It shows the apparent average daily calorie consumption levels and the caloric contribution of the major food groups.

At the national level, the starchy staples (in which cereals predominate) account for 47 percent of the total calories. Within the cereals group, rice is predominant and wheat products are the next most important food type. The importance of maize and wheat bread changes drastically between the urban and rural areas. Roots and tubers, of which cassava flour is the most important commodity, are much more important in rural than in urban areas. Apparently, the higher consumption of cassava flour in the rural sector contributes heavily to make the average total calorie consumption level substantially higher than the urban total.

TABLE 3.2. BRAZIL: APPARENT PER CAPITA DAILY CALORIE INTAKE FROM DIFFERENT FOOD TYPES, BY SECTOR*

Food	Urban	Rural	National
Cereals	757	752	755
Rice	414	399	400
Maize	50	168	92
Wheat Bread	182	50	144
Other	111	135	119
Roots	182	370	236
Cassava Flour	137	309	185
Other	45	61	51
Sugar	286	278	280
Legumes	190	338	245
Vegetables	19	15	20
Fruits	40	26	38
Meat and Fish	192	158	182
Dairy Products	105	102	116
Oils and Fats	246	183	231
Beverages	18	12	17
TOTAL	2,039	2,239	2,123

*Source: Derived from Brazil, Fundacao Instituto Brasileiro de Geografia e Estatistica, Estudo Nacional da Despesa Familiar: Consumo Alimentar Antropometria: Dados Preliminares (4 vols., Rio de Janeiro: IBGE, 1977).

The relationship between income and starchy staple consumption is pictured in Figure 3.4, and it provides an indication of how larger incomes have been utilized to acquire more of the preferred staples. The substitutions are unambiguous: consumption of cassava flour decreases continuously and more rice and wheat products are consumed as incomes increase. This movement away from cassava flour begins at the lowest reported income aggregation where the average annual expenditure is only 1200 cruzeiros per capita. The reported nutrient consumption at this level of expenditure is around 1660 calories per capita per day.

Regional disparities in living standards in Brazil have caused increasing concern.1/ The North-East, which contained 32 percent of the population in 1974, is usually singled out as the region most lagging behind in development. In such indicators of welfare level as mean calorie intake, adult literacy, and medical care, the performance of the North-East has been well below the national average (38). Poor natural endowments found in the region are considered to be the major cause of its problems. Table 3.3 provides an indication of the differences that exist between the North-East and the South-East, a relatively wealthier region. The average calorie intake in the South-East is substantially higher than in the North-East. The role of cassava flour is noteworthy with regard to differences seen in calorie sources. In the rural and urban sectors of the South-East, this source of calories contributes not more than two percent to the total calorie intake. In the North-East, cassava flour is the dominant calorie source. These calories make nearly 29 percent of the rural and 17 percent of the urban average calorie consumption.

The relative importance of starchy staples as calorie sources at different income levels in the North-East is depicted in Figure 3.5. The substititions are not too different from what was observed at the national level. As one moves from the poorest to the next income level, rice and wheat flour replace cassava flour. The lowest income level indicated in Figure 3.5 is 1000 cruzeiros. The apparent daily per capita calorie consumption reported at this level of income is 1530 calories (4).

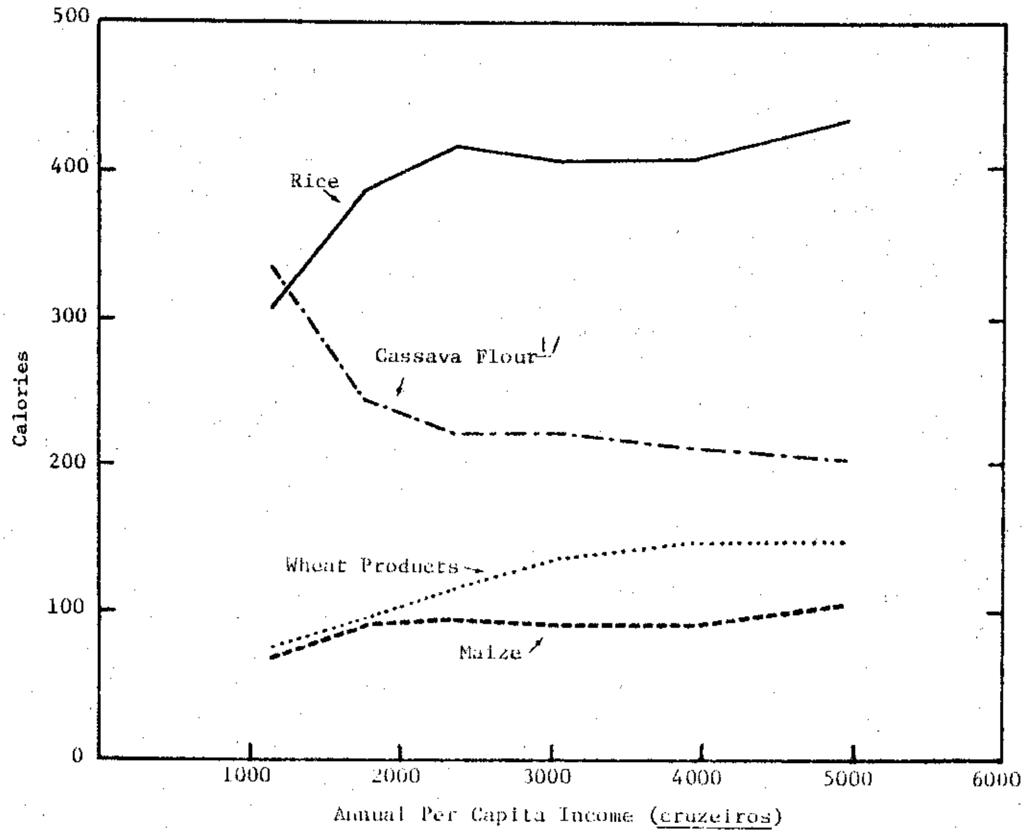
Peru

The case of Peru is analyzed with data from the Encuesta Nacional de Consumo de Alimentos (ENCA)--a household food consumption and budget survey carried out between August 1971 and August 1972. The ENCA sample consisted of 8000 families drawn so as to give proportional representation to the nine geographic regions in the country. We were able to analyze a portion of the survey in detail, as raw data were made available by Ferroni, who used them for his study of the urban bias in Peruvian food policy (12). The subsample we examined was from the Central and Southern Sierra of Peru and consisted of 1958 observations. Details of this survey will be discussed in Chapter VII. The ENCA methodology appears to be superior to that of the other consumption surveys.

1/ Analyses of these disparities are found in 38 and 43.

FIGURE 3.4. BRAZIL: APPARENT PER CAPITA DAILY CONSUMPTION OF MAJOR STARCHY STAPLES AMONG LOW-INCOME CLASSES, 1974-75

(calories)



1/ Plus other roots and tubers (5 percent of total).

Source: Derived from Brazil, Fundacao Instituto Brasileiro de Geografia e Estatistica, Estudo Nacional da Despesa Familiar: Consumo Alimentar Antropometria: Dados Preliminares (4 vols., Rio de Janeiro: IBGE, 1977).

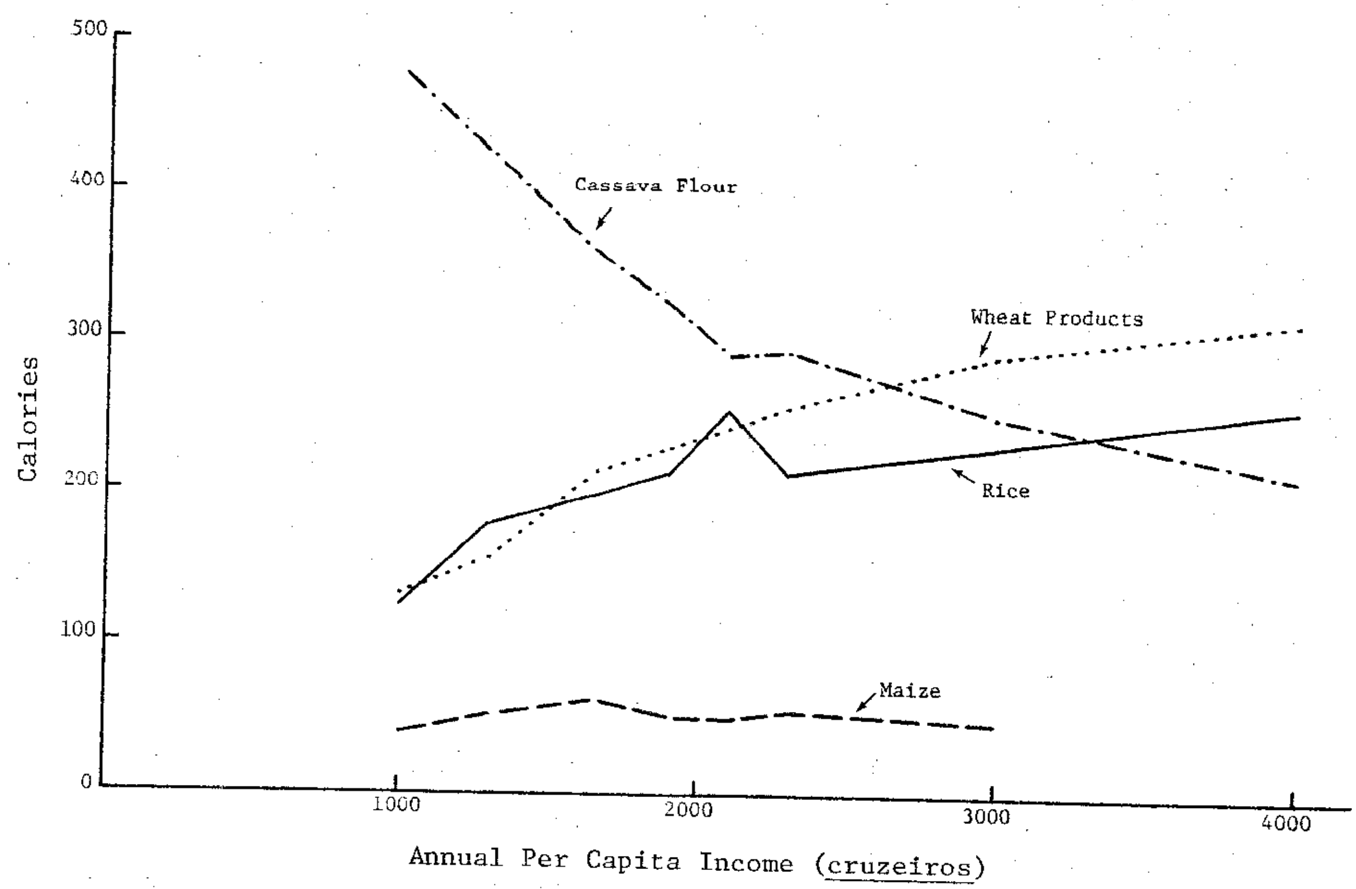
TABLE 3.3. BRAZIL: APPARENT PER CAPITA DAILY CALORIE INTAKE FROM DIFFERENT FOOD TYPES, SOUTHEAST AND NORTHEAST REGIONS, 1974-75

(calories)

Food	Southeast			Northeast		
	Total	Rural	Urban	Total	Rural	Urban
Cereals	895	1,037	832	513	471	569
Rice	478	530	455	239	256	217
Maize	68	152	31	107	149	51
Wheat Bread	158	57	202	137	53	249
Other	191	298	144	30	13	52
Roots	95	154	68	497	617	336
Cassava Flour	31	51	22	456	574	297
Other	64	103	46	41	43	39
Sugar	309	334	298	209	195	228
Legumes	200	258	174	2]4	405	216
Vegetables	26	22	28	10	8	12
Fruits	42	29	48	35	26	46
Meat and Fish	196	171	207	177	161	198
Dairy Products	150	146	152	75	71	81
Oils and Fats	320	312	323	70	45	103
Beverages	25	20	27	10	7	14
TOTAL	2,256	2,482	2,156	1,920	2,007	1,804

Source: C. Williamson-Gray, "Food Consumption Parameters for Brazil and Their Application to Food Policy" (International Food Policy Research Institute Research Report 32), September 1982, p. 19.

FIGURE 3.5. NORTHEAST BRAZIL: PER CAPITA DAILY CONSUMPTION OF CALORIES FROM MAJOR STARCHY STAPLES AMONG LOW-INCOME CLASSES, 1974-75



Source: Derived from Brazil, Fundacao Instituto Brasileiro de Geografia e Estatistica, Estudo Nacional da Despesa Familiar: Consumo Alimentar Antropometrica: Dados Preliminares (4 vols., Rio de Janeiro: IBGE, 1977).

The Sierra food consumption data were particularly useful because of the existence of a relatively large number of major staples in the diet, with a fairly clear indication of the preference hierarchy. We made a preliminary examination of the substitutions among the staples along the income spectrum.

What happens to per capita consumption of starchy staples as incomes change is illustrated in Figure 3.6. Potatoes, wheat bread and rice are consumed in larger quantities as incomes increase. The consumption of barley and maize also increases from the lowest income class to the next, but thereafter decreases. These foods appear as inferior above annual per capita income of around 2250 soles. Substitution away from barley and maize occurs, in spite of the fact that these foods are relatively cheap calorie sources, as will be discussed in Chapter VII.

Indonesia

The data set available for our study is the fifth of the Indonesian National Social Economic Surveys, commonly known as SUSENAS (21). This survey was conducted in three subrounds during the year 1976 and contains nearly 18,000 observations in each round. As this was the only survey at our disposal which contained observations from an entire national sample with detailed documentation, it was used to examine the impact of national, regional, and seasonal variations on consumption behavior. The case of Indonesia is analyzed in detail in Chapter VI.

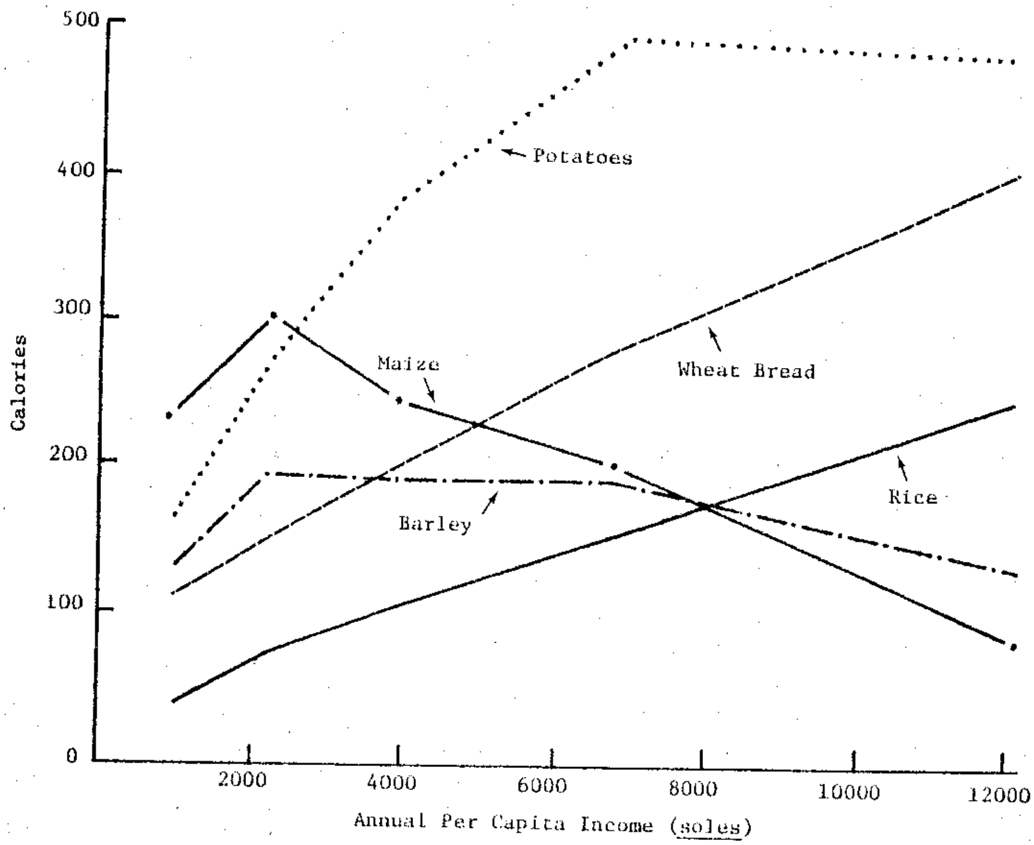
The Indonesian starchy staple consumption patterns lend themselves to an examination of the threshold behavior. This is shown by the summary of consumption behavior plotted in Figure 3.7.

Rice, as would be expected, is the most important staple: its consumption increases substantially as one moves up the income ladder. Cassava and maize are the next most important staples. For the poorest consumers, they together provide more calories than rice. In fact, the lowest income groups appear to increase the consumption of calories from cassava and maize as well as from rice in response to increased income. As soon as the per capita income level reaches around Rp. 1500, the importance of cassava and maize as calorie sources begins to diminish in favor of the more preferred rice. This same pattern of starchy staple consumption was evident in the case of Peru. Both observations were possible because the availability of raw data facilitated more detailed analysis of the diets of the poorer consumers. As will be discussed in Chapter VI, the average Indonesian consumer tends to move away from cheaper sources of calories at much lower levels of caloric consumption than previous studies predicted.

Conclusions

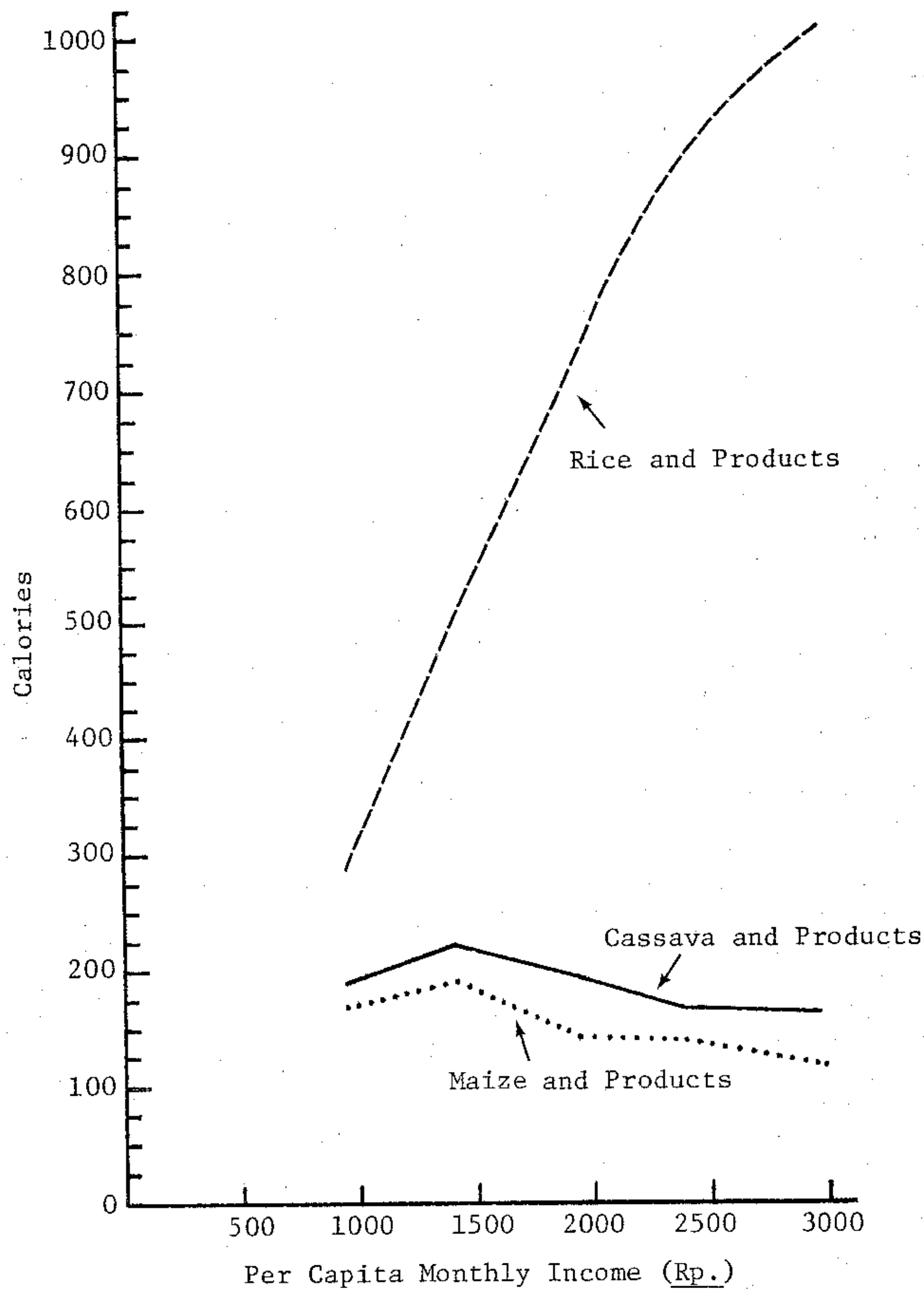
Preliminary analysis of the evidence from Sri Lanka, Brazil, Peru, and Indonesia suggests that the notion of behavioral thresholds as indicators of perceived dietary adequacy or inadequacy has merit and that the initial substitutions, as postulated, are to be found among the starchy staple food group.

FIGURE 3.6. PERU: MAJOR STARCHY STAPLES CONSUMPTION AMONG LOWER INCOME CLASSES IN CENTRAL AND SOUTHERN SIERRA, 1971-72*



*Source: Peru, "Encuesta Nacional de Consumo de Alimentos (ENCA), 1971-72" (raw data).

FIGURE 3.7. INDONESIA: PER CAPITA DAILY CONSUMPTION OF CALORIES FROM MAJOR STARCHY STAPLES AMONG LOW-INCOME CLASSES, 1976*



*Source: Indonesia,"National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

CHAPTER IV. SOME LIMITATIONS

The proposal to use behavioral thresholds as indicators of perceived dietary adequacy is based on a conceptually consistent set of reasoning derived from certain biological and economic relationships. But its empirical testing depends almost exclusively on cross-section data on food consumption and expenditure which may give rise to some limitations. Unless these data are available in a sufficiently disaggregated form, it is possible that threshold behavior could be confused with the differences in consumption patterns which occur between cities and the countryside, one region and another, and from one season to the next.

Regional Variations

Consider first the possible impact which regional differences in food habits might have. Since the behavioral approach is commodity specific, it requires a close examination of the nature of the substitutions that occur among foods in the starchy staples food group. The composition of the starchy staples food group may vary substantially from one region to another; so would the preference hierarchies associated with these foods. Production and supply of food in a given location may be largely determined by ecological factors and food preferences may be largely influenced by these supply factors. In countries where substantial regional variations exist, analysis of threshold behavior on aggregated data may be difficult to interpret.

This potential problem was already encountered when analyzing Brazilian data in Chapter III. In the North-Eastern region of Brazil, which contains some of the poorest areas, cassava flour and legumes are heavily consumer, whereas in the South-East their role is less important (Table 3.3). Similarly, in a cross-section of Indian dietary patterns, one is bound to encounter marked regional variations. Rice is the dominant staple in states such as Bihar, Kerala, West Bengal, Maharashtra, and Andhra Pradesh. Millet and wheat are the secondary sources of calories in these regions. In Gujarat, Himachal Pradesh, Mysore, Jammu, and Kashmir, millet is dominant. Wheat is more important than millet or rice in areas such as Madhya Pradesh, Punjab and Haryana (19).

Indonesia provides another example of regional diversity. In Central and Eastern Java, rice is the dominant crop, but maize and cassava also play an important role. In the Province of Aceh over 95 percent of the farm land is devoted to rice. "In striking contrast to most other provinces such as Java, other food crops such as maize, pulses and cassava and other roots and tubers are hardly grown" (3). In the province of Maluku, a completely different pattern exists. In this province, wild sago is the staple (5).

Of course, one may come across countries where food consumption patterns across regions are more homogeneous than the cases referred to above. Sri Lanka is one such case where regional disparities may be relatively small. The behavioral approach differs from the traditional methods because it focuses on consumption of specific foods rather than total calories. Since the particular kinds of food of interest to the threshold concept can vary from region to region, the thresholds will only be meaningful if derived from properly disaggregated data. Such thresholds from different regional disaggregations may be compared for consistency with regard to the basic hypothesis. The availability of cross-section data may provide limitations to such disaggregations.

Seasonal Variations

Another important factor that can affect food consumption patterns is the seasonality in food supplies. Food markets in most developing countries are characterized by seasonal changes in food supplies. High dependence on weather patterns for crop production and lack of sufficient marketing development to ensure supply consistency through storage and transporation are two major reasons why seasonality prevails over food markets. Seasonality affects food supplies and relative prices, and through these factors it exerts influence over the process of substitution among foods. Its effect on substitution is of direct relevance to the application of the threshold concept.

The effects of seasonality on apparent food consumption in urban Ghana provide useful insights into their implications on the threshold approach.1/ Figure 4.1 shows the sizeable seasonal changes which occur in the diets of urban Ghanaians. Arrivals of both maize and processed manioc, the two main suppliers of calories in Accra, varied greatly over the year, as did those of plantains, the third ranking source. Fluctuations in the supply of plantains have been caused by marketing bottlenecks rather than by seasonality in production.

The apparent variations in maize and processed manioc are a combined reflection of seasonal supply conditions and consumer preferences. Maize arrivals in the city are highest during harvesting periods in maize growing areas--in October-January and in the midsummer. Price fluctuations are reflective of this decidedly seasonal character of maize supplies (Figure 4.1, bottom section). Prices are relatively low during high supply months but rise sharly during lean periods. Maize prices appear to have a direct impact on the consumption of manioc products, of which gari is the dominant form. As the price of maize rose in the spring--to the point where it became rather more expensive in terms of calories than gari--imports of the dry manioc products increased greatly. During

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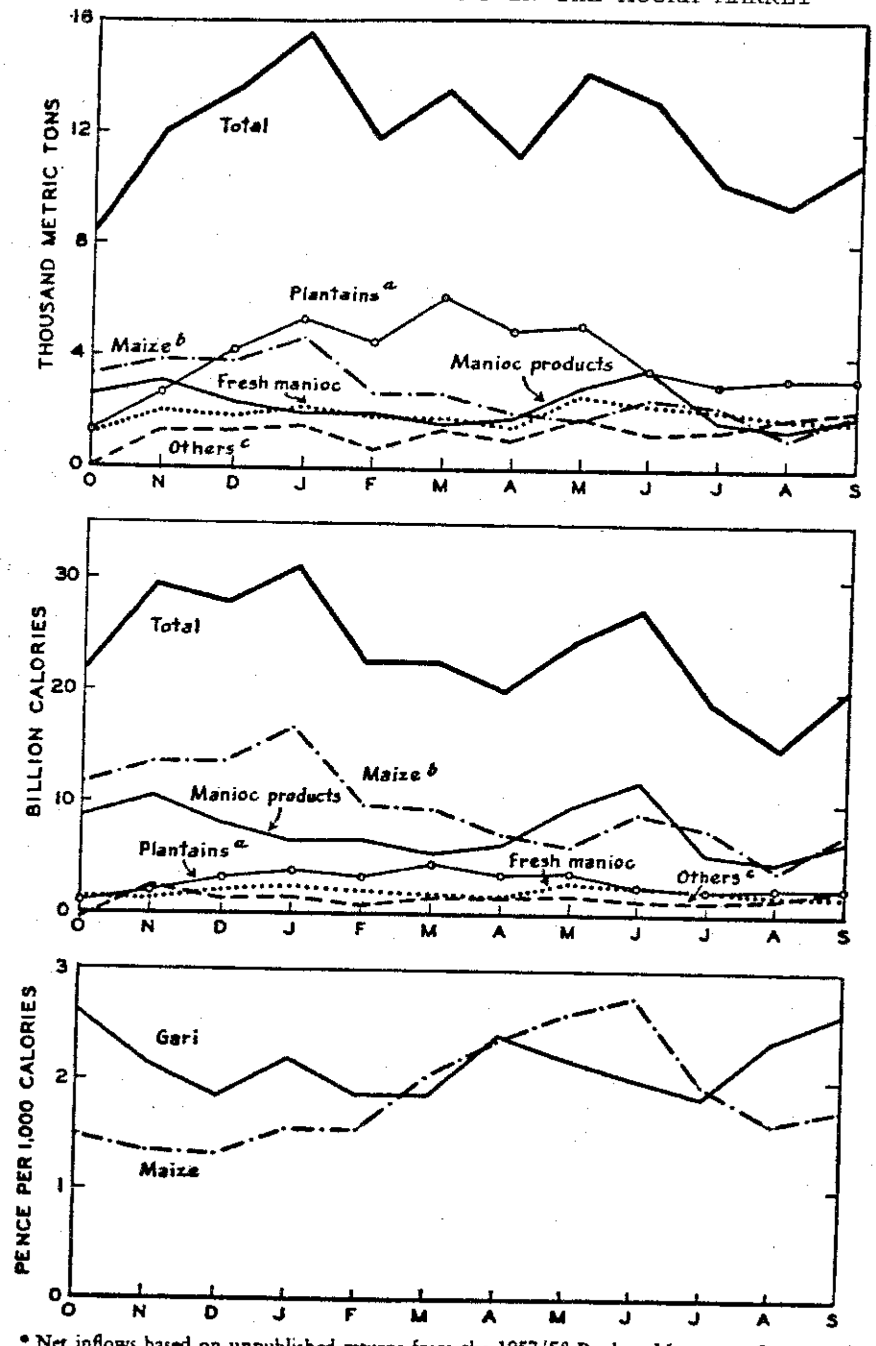
1/ This section on the effects of seasonality on threshold behavior is based on an analysis of the food economy of urban Ghana by T. T. Poleman (29). The descriptions are heavily drawn from this study.

FIGURE 4.1. GHANA: PRODUCE MOVEMENT CENSUS, 1957/58: NET MONTHLY INFLOW OF STAPLE FOODS INTO ACCRA; AND AVERAGE MONTHLY WHOLESALE PRICE OF MAIZE AND GARI IN THE ACCRA MARKET*



* Net inflows based on unpublished returns from the 1957/58 Produce Movement Census; price data from Ghana, Dept. Agr., *Monthly Report—Foodstuffs Supply Position* (various issues); caloric values calculated using conversion factors given in FAO, *Food Composition Tables—Minerals and Vitamins—For International Use* (Nutr. Studies 11, 1954), pp. 10–12, 18.

[a] Includes bananas.

[b] Includes sorghum.

[c] Rice, millets, yams, cocoyams, "other cereals," and "other roots and tubers."

Source: T. T. Poleman, "The Food Economies of Urban Middle Africa: The Case of Ghana," Food Research Institute Studies, Vol. II, No. 2, May 1961, p. 171.

April-July, these products seem to have temporarily supplanted maize as the chief source of calories. This supply behavior of manioc products is particularly important because manioc is available for harvesting throughout the year. This behavior is an indication of the less-preferred position of the dried manioc products in the diets. Evidence to this effect has been obtained also from household expenditure-consumption relationships (29, p. 158). If manioc products, in fact, are considered inferior, then higher prices for these foods (rather than for maize) challenge the basic economic rationale of the threshold concept according to which higher prices for the staple must be an indication of better quality. One may also argue that the Ghanaian urban consumer is indifferent as to quality of the two foods and that decisions on their consumption may be exclusively dependent on relative prices.

This case of Ghana may be exceptional, but it provides an important reminder of the pitfalls that application of the threshold concept may encounter. These limitations may be many and real, but the limitations of the traditional approaches to hunger measurement are too important to be ignored. As the proponent of the behavioral approach puts it (27, p. 45):

> . . . identification of thresholds from country to country will not be easy and will demand that the analysts know a good deal about the area in question . . . . But . . . it is the approach most likely to yield results in the foreseeable future. Additional and better budget surveys are more reasonably to be expected in the next few years than are accurate estimates of food availabilities and minimal nutritional needs.

CHAPTER V. A STARCHY STAPLES CONSUMPTION MODEL

In Chapter III, changes in the food consumption-income relationship that were brought about over a long period of time were discussed. That economic enhancement brings about dietary adjustment was the salient feature observed. The principal characteristic of this adjustment was the tendency to increase consumption of food products that carry relatively larger costs of production. The essence of what has been observed over a long historical process can also be observed in a cross-section of a society at a given point in time, since most societies have households with sufficient variations in income and consumption. The purpose of this chapter is to discuss a model of consumption behavior which incorporates the threshold concept in a utility maximization framework. The major objective of this discussion of expected income-induced consumption change is to establish a decision criterion to identify income thresholds where substitution of quality for quantity is significant. These thresholds, if they exist, are expected to lead to a better understanding of consumer perceptions of nutritional adequacy or inadequacy.

A Behavioral Model of Starchy Staples Consumption

In less-developed and traditional societies, starchy staples provide the bulk of the calories. It is within this food group that the substitution of quality for quantity considerations may first be observed in response to increased income. Our task is to identify the level of income at which this takes place, and evaluate its nutritional implications.

We assume that all consumers make rational consumption decisions to maximize their total utility, subject to budget constraints. It is further assumed that these consumers possess a reasonable knowledge of the characteristics of the commodities and have a consistent structure of preferences. The process of conceiving the preference structure is assumed to be independent of price or cost considerations. Prices become relevant in the choice of a utility-maximizing bundle of commodities under a budget constraint. When the budget constraint is relaxed by an increase in real income, it facilitates changes in the consumption bundle and a movement toward a new equilibrium. When real incomes increase, consumers react by increasing the consumption of some commodities, decreasing others, and acquiring new ones which were previously beyond their reach.

To monitor income-induced consumption changes, the starchy staple food group is divided into two groups--the preferred and the less-preferred. The preferred is defined as the set of starchy staples for which the income elasticity of demand continues to be positive within most of the income range of a given society. The less-preferred are those starchy foods for which the income elasticities will become negative at relatively low levels of income. Where mere survival is the prime objective in food consumption, it is assumed that the choice of food is dictated by basic energy requirements. In order to appease hunger, the largest possible quantity of calories is purchased and the rational choice is to consume the cheapest calories. On the assumption that calories from less-preferred starchy staples are relatively cheaper, it may be reasonable to expect less-preferred staples to loom large in the diets of the poor. Quantity considerations will continue to dominate budget allocations as long as elimination of hunger remains the sole concern of food consumption. When income is sufficiently large, it will allow substitution of quality considerations for quantity considerations.

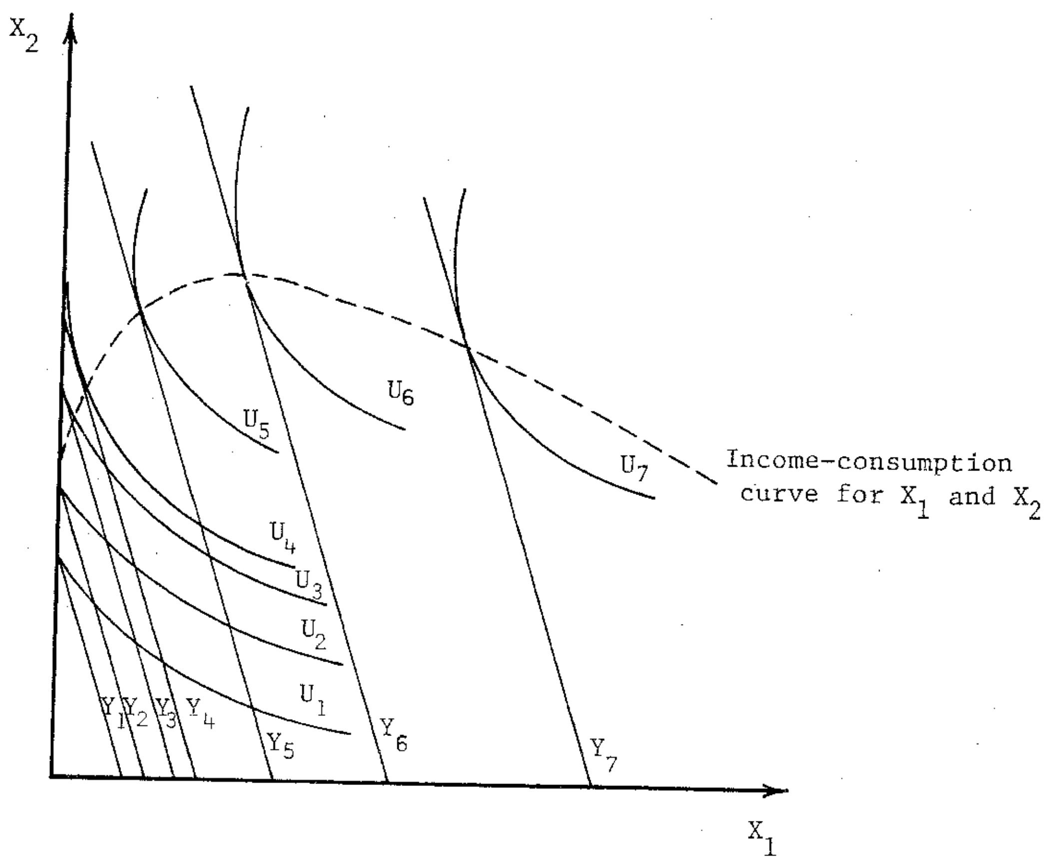
A simple two-dimensional view of the expected consumption behavior is represented in Figure 5.1. Consumption level of the calories from less-preferred starchy staples (X_2) and preferred staples (X_1) are represented on the vertical and horizontal axes respectively. The indifference curves ($U_1, \ldots, U_n$), represent the combinations of quantities of the two forms of calories that keep utility constant. The budget lines ($Y_1, \ldots, Y_n$), represent different income levels under constant prices. The optimal combination of the two commodities under a given budget constraint is represented by the point of tangency between the utility indifference curve and the budget line.

Following the rationale behind the quantity-quality differentiation in calorie consumption, income levels Y_1 and Y_2 have been drawn to represent extreme poverty where the only consideration in food consumption is acquiring the largest possible quantity of calories. Accordingly, only the cheaper of the two forms of calories is consumed at these income levels. In most societies, this is an uncommon situation; even among the diets of the poorest, some of the generally preferred starchy staples are usually consumed. Consumption patterns beyond Y_2 represent this expectation. At Y_3, Y_4 and Y_5 substitution of the preferred calories is indicated. Increasing incomes allow attainment of higher levels of utility by increasing the consumption of both forms of calories. According to this picture, successively fewer calories from the cheaper sources are consumed as incomes continue to increase beyond Y_6. The income level represented by Y_6, therefore, provides a significant threshold indicative of a movement away from the basic quantity considerations. Beyond this point, the importance of the lower-cost starchy staples as sources of calories begins to diminish in favor of those costlier staples which are preferred. This threshold may be regarded as indicative of perceived caloric adequacy to meet basic energy requirements.

Estimation of the Consumption Model

In this study, the behavioral threshold will be discerned by estimating the relation between consumption of calories from less-preferred starchy staples and income. The threshold income level will be defined as the one beyond which the income elasticity of demand for calories from less-preferred staples turns out to be negative.

FIGURE 5.1. INDIFFERENCE CURVES DEPICTING THE HYPOTHESIZED "QUANTITY-QUALITY" SUBSTITUTIONS UNDER GIVEN BUDGET CONSTRAINTS



X_1 - calories from preferred starchy staples

X_2 - calories from less-preferred starchy staples

Given the focus of the current analysis and the nature of the information in the data sets available for analysis, demand functions will be specified to take the following general form:

$$Q_i = f(Y_i P_i P_j D) \tag{5.1}$$

where

Q_i = per capita quantity of commodity i consumed or its calorie equivalent,

Y_i = per capita income or expenditure,

P_i = price of commodity i or price of calories from commodity i,

P_j = price of other commodities or their calorie prices that may significantly influence the consumption of commodity i,

D = dummy variables to represent factors that may significantly influence consumer preferences.

Considering the hypothesized calorie consumption-income relationship, a log-log quadratic functional form will be used to represent the Engellian relationship.

The Engellian relationship expressed as a log-log quadratic function takes the form:

$$\ln Q = A + b \ln Y + C (\ln Y)*(\ln Y) \tag{5.2}$$

where

lnQ = log of total quantity of calories consumed,

lnY = log of per capita monthly income/expenditure.

When an estimated function results in a positive b coefficient and a negative c coefficient, the log-log quadratic function allows the value of the dependent variable to increase first, reach a maximum, and then decrease, with successive increasing values of the independent variable (Y). This relationship is graphically shown in Figure 5.2. According to this function, the maximum (minimum) calorie value of the dependent variable will occur when:

$$\ln Y = b/2c \quad \text{or} \quad Y = e^{b/2c} \tag{5.3}$$

The marginal propensity to consume (mpc), and the income elasticity (η), would be:

$$mpc = Q(b-2c\ln Y)/Y \tag{5.4}$$

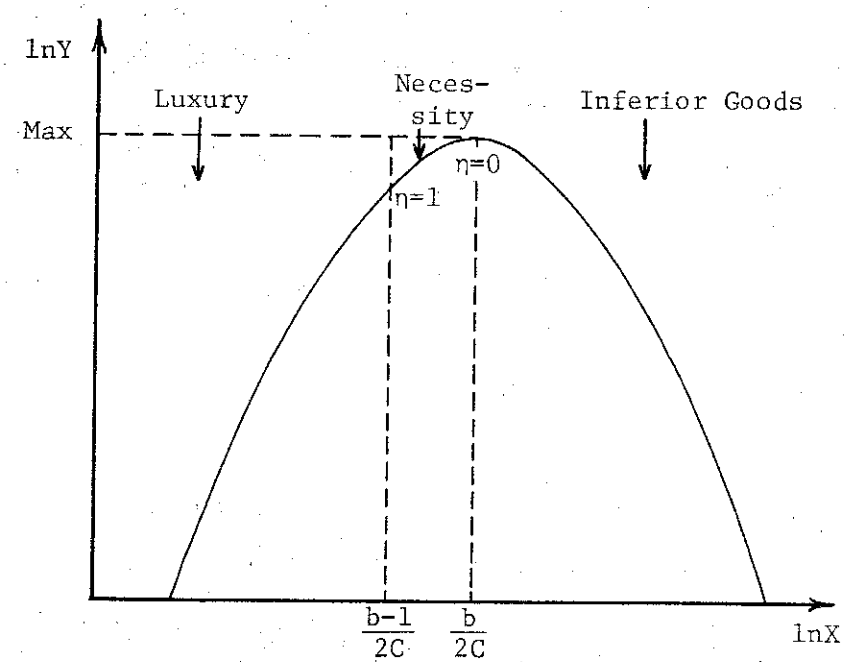
$$\eta = b-2c\ln Y \tag{5.5}$$

As depicted in Figure 5.2, the income elasticity can have a positive and negative range.

In the next two chapters this behavioral model will be tested on data from Indonesia and Peru.

FIGURE 5.2. AN ENGEL'S CURVE IN LOG-LOG QUADRATIC FORM

Functional form: $\ln Y = a + b \ln X - C(\ln X)^2$



lnY = log of quantity consumed

lnX = log of income/expenditure

η = income/expenditure elasticity of demand

CHAPTER VI. THE CASE OF INDONESIA

Indonesia is the world's largest island complex and the archipelago nation has the fifth largest population in the world. Its vastness, the geographic location, and the unique effect the scattered islands have on the socioeconomic organization make the food economy of Indonesia truly complex. The agricultural economies of each island have been shaped by factors such as the degree of fertility of soils and the benefits of the monsoons (26). They are also influenced by man-made factors such as the degree to which government investments have influenced regional development and crop production. For example, there is a very close positive correlation between the geographic distribution of young volcanic materials, soil fertility, and population density, which is exemplified by the case of Java.1/ As for crops within regions, rice has been the most encouraged. Its production and yields have benefited from massive investments in infrastructure, inputs and credit programs such as BIMAS--the national rice intensification program. Maize and cassava, on the other hand, have received only minimal attention (9).

Using the national annual food availabilities reported in the food balance sheets for the years 1974 to 1977, the apparent per capita average nutrient consumption is as presented in Table 6.1. These averages suggest relatively satisfactory levels of nutrient availabilities compared with the recommended allowances for the average Indonesian. The daily per capita average allowances derived after adjusting the 1973 FAO/WHO recommendations to suit the Indonesian situation are 1900 calories and 39.2 grams of protein; these figures increase to 2100 calories and 45.9 grams of protein when a "loss factor" of 10 percent and a "protein score" are included (9). The satisfactory levels of average nutrient availabilities do not necessarily guarantee the absence of distributional problems. This has been demonstrated by comparisons of income-class specific nutrient consumption with the recommended allowances (9). Table 6.2 reveals the all-important role of starchy staples--cereals, roots and tubers--as sources of calories and protein. The dominance of vegetal sources of calories and protein is consistent with the historical relationship between income and food consumption discussed earlier.

SUSENAS V

Since 1963, the Indonesian government has been conducting periodic national sample surveys to collect information on the social and economic

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1/ In 1973, Java had a population of 86 million people--nearly two thirds of the Indonesian population (21, p. 1).

TABLE 6.1. INDONESIA: PER CAPITA DAILY NUTRIENT CONSUMPTION, 1974-77*

Year	Calories		Protein		Fats	
	Total	Percent of Vegetal Source	Total	Percent of Vegetal Source	Total	Percent of Vegetal Source
	(Kcals)		(grams)		(grams)	
1974	2248	97.8	45.8	89.3	35.0	92.9
1975	2150	98.0	45.3	88.2	33.2	93.6
1976	2231	98.0	43.7	89.7	39.6	93.2
1977	2314	98.0	44.5	90.0	42.6	93.3

*Source: John A. Dixon and Rudolf S. Sinaga, "Food Consumption Patterns in Indonesia" (Paper presented at The Third Asian Congress of Nutrition, Jakarta, October 6-10, 1980), p. 4.

TABLE 6.2. INDONESIA: DISTRIBUTION OF CALORIES AND PROTEIN BY FOOD GROUPS, 1974-1977*

(percent)

Food Group	Calories, Percent of Total	Protein, Percent of Total
Cereals[a/]	66.5	67.4
Starchy foods[b/]	11.5	4.5
Sugar	5.0	0.1
Pulses, Nuts and Oilseeds[c/]	7.3	14.8
Fruits	1.9	1.1
Vegetables	0.4	1.3
Meat	0.8	2.7
Eggs	0.1	0.4
Milk	0.2	0.5
Fish	0.8	7.0
Oils and Fats[d/]	5.5	0.0

a/ Cereals include rice, maize and wheat.

b/ Starchy foods (roots and tubers) include sweet potatoes, cassava, and sago.

c/ Pulses, Nuts and Oilseeds include groundnuts, soybeans, and coconuts/copra.

d/ Oils and Fats include groundnut oil, copra oil, palm oil, and animal fats.

*Source: John A. Dixon and Rudolf S. Sinaga, "Food Consumption Patterns in Indonesia" (Paper presented at The Third Asian Congress of Nutrition, Jakarta, October 6-10, 1980), p. 6.

status of the population. Six such surveys--called the SUSENAS, the Indonesian National Economic Survey--have been conducted to date.[2/] SUSENAS V, which was conducted in 1976, provides the data base for our analysis.[3/] This survey was conducted in three rounds: round one from January to April, round two from May to August, and round three from September to December. Each round surveyed about 18,000 households, which makes a total sample of nearly 54,000 households. The household was defined as a person or group of persons who live together and usually share their meals. The design for the survey was based on stratified sampling with villages as the first level and households as the second. The selection of the households was done geographically and with a probability proportional to size. About one in twenty of all villages was selected for the survey.[4/]

The data tapes made available for our analysis contained information collected on the questionnaire schedules covering expenditure and consumption. Nearly 100 food items were covered in the questionnaire, but information was recorded in varying degrees of detail. Detailed data on purchases, home production and gifts, which specified both the quantities consumed and their monetary values, were made available for 40 major food items. This group contained the commodities relevant to our analysis. Quantities and values were available for a further 16 miscellaneous food items. For the third category of 42 items--fruits, vegetables, nuts, legumes and prepared foods--only expenditure values were reported. The lack of quantity information on these commodities greatly hampered the nutritional evaluation of household food consumption.

The large number of observations available in the SUSENAS V data made it possible to create a substantial number of income classes. The mean values of the variables in each expenditure class formed the data set used for the analysis in this study.[5/] The expenditure classes were created with a view to giving sufficient representation to the lower range in the expenditure spectrum. The 20 expenditure classes so created and their relative weights in relation to the total population are shown in Table 6.3. The weights used in Table 6.3 were obtained from the published results of SUSENAS V data (21). In the original survey there was a bias in favor of urban Java and urban off-Java; these regions were sampled in greater proportion than the regional population weights (reported in the 1971 population census) would have allowed. This bias was adjusted for using the population share estimates in the published results (37).

2/ A useful description of the SUSENAS surveys and their relevance to consumption studies is found in 6.

3/ Published data from SUSENAS V have been subjected to extensive analyses particularly on aspects of food consumption. See 8, 37, and 39.

4/ A detailed description of survey characteristics can be found in 37 and 39.

5/ It would have been better if the raw observations were used directly in the analysis, but such an exercise would have been extremely expensive.

TABLE 6.3. INDONESIA: PERCENTAGE DISTRIBUTION OF POPULATION BY MONTHLY PER CAPITA EXPENDITURE CLASSES, 1976*

Expenditure Class (Rp. per capita/month)	Population Share (percent)	Cumulative Share (percent)
0-499	.09	
500-749	.32	.39
750-999	.74	1.13
1000-1249	1.71	2.84
1250-1499	2.71	5.55
1500-1749	4.15	9.70
1750-1999	5.48	15.18
2000-2249	5.25	20.43
2250-2749	6.16	32.63
2750-2999	6.29	38.92
3000-3249	5.28	44.20
3250-3499	5.00	49.20
3500-3749	4.78	53.98
3750-3999	4.44	58.42
4000-4999	13.64	72.06
5000-5999	8.81	80.07
6000-7999	9.43	90.30
8000-9999	4.25	94.55
10,000-14,999	3.76	98.31
15,000+	1.66	100.00

*Sources: Indonesia,"National Socio-Economic Survey,1976 - SUSENAS V" (raw data).

Indonesia, Central Bureau of Statistics, Indonesia Untuk Sosial Ekonomic Nasional Tahap Ke-Lima (January-December 1976).

The known quantities of food reported by each household were converted to their calorie equivalents using calorie conversion factors.[6] Due to absence of quantity data on some foods, total per capita apparent consumption of calories had to be imputed using an indirect approach. It was assumed that the cost of calories from the bundle of foods on which quantity data were not available would be about twice that of the cost of calories from the foods whose quantities were known. Considering the type of foods involved--vegetables, nuts, fruits and prepared foods--this assumption is probably not too unrealistic. In general, these foods have higher unit prices than the starchy staples which formed the bulk of foods whose quantities were reported. This procedure for imputing the "unknown" calories has been adopted in earlier research on Indonesia (39). One of the shortcomings of this procedure is the use of a constant factor of two to multiply the known cost across all commodiites and households. The cost of this quantities-unknown bundle may in fact vary nonlinearly relative to the cost of the quantity-known bundle. The major reason for such nonlinearity would be the quality substitutions which occur when levels of expenditure increase. The final figures on per capita calorie consumption should therefore be treated cautiously.

The average calorie consumption from starchy staples is shown in Table 6.4 for each of the survey rounds. The predominance of rice over all other starchy foods is clearly evident.

A broad indication of the income-induced variations that occur in the consumption of calories from major starchy staples was already observed in Figure 3.7 of Chapter III. Consumption of cassava, other roots and tubers, and maize declines, while that of rice increases. Wheat flour consumption is not shown in Figure 3.7, as only negligible quantities were consumed. Wheat flour, though not a strong contributor to total calories, appears to be a preferred food; its consumption tended to increase with expenditure throughout the income range. Some wheat flour consumption may occur through the eating of prepared foods. Considering the observed starchy staple consumption patterns, the preferred staples and the less-preferred staples in the Indonesian diet may be identified rather easily: rice, no doubt, is the preferred staple; cassava, maize, yams and other tubers are the less-preferred ones.

Estimation of the Consumption Model

Total rice, or preferred, calories were defined as the sum of calories from normal rice, glutinous rice and rice products. The total expenditure on all types of rice consumed was divided by total rice calories to impute the rice calorie price. Similarly, the sum of calories consumed from maize grain, fresh maize (on the cob), dried maize, maize flour, fresh cassava, dried cassava (gaplek), cassava flour, sweet potatoes, tales and sago flour was treated as the total quantity of calories from the less-preferred staples. A composite price of calories from less-preferred staples was imputed by dividing the total expenditures for these staples by the sum of their calories. All the transformations of data were carried out at the household level.

6/ The calorie conversion factors used in this study are found in 10.

TABLE 6.4. INDONESIA: APPARENT PER CAPITA CONSUMPTION OF CALORIES FROM STARCHY STAPLES AND IMPLICIT PRICES, 1976*

	Calories Per Day[a/]	Implicit Price of 1000 Calories (Rp.)
Round 1 (January-April)		
Rice	1234	24.74
Maize	114	15.47
Cassava	162	11.10
Roots and Tubers	63	14.06
Round 2 (May-August)		
Rice	1235	23.68
Maize	82	15.36
Cassava	156	11.44
Roots and Tubers	56	14.85
Round 3 (September-October)		
Rice	1137	26.29
Maize	76	14.71
Cassava	110	13.85
Roots and Tubers	33	18.24

a/ Rice calories from ordinary rice, glutinous rice and rice products. Maize calories from all maize grains and maize flour. Cassava calories from fresh cassava, dried cassava (gaplek) and cassava flour. Roots and tubers calories from sweet potatoes, tales and sago flour.

*Source: Indonesia, "National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

Implicit in the plot of observations shown in Figure 6.1 is the suggestion that there are certain structural differences in the pattern of demand for the less-preferred starchy staples between several elements of the population. The upper expenditure classes in the rural sector show a tendency to increase consumption of less-preferred staples as expenditure levels increase. Increased consumption of fresh cassava seems to be responsible for most of this trend. This picture is consistent with the published aggregate results of SUSENAS V data. According to published results, average per capita consumption of fresh cassava, which is around 0.5 kilogram at the expenditure level of Rp. 4000, more than doubles when expenditure levels are beyond Rp. 10,000 (21, p. 77). It is interesting to note that dried cassava consumption also registered an unexpected increase at the highest levels of expenditures (21, p. 77).

Two questions arise from this picture of less-preferred staples consumption. The first is whether fresh cassava should be included in the less-preferred staples bundle. Earlier research using aggregated data from the same survey indicated that the income elasticity of demand for fresh cassava was positive up to Rp. 4000-5000 expenditure levels in certain regions and sectors (8, 39). With a relatively large amount of data available for the lowest segments of the expenditure range, we attempted to estimate the relation between fresh cassava consumption and expenditure in the range up to Rp. 2000. The results, presented in Table 6.5, failed to show a clear relationship. These results, as well as the general observation that cassava is less preferred relative to rice in Indonesia, provided sufficient justification to keep it in the less-preferred staples bundle.

The second question relates to the range of expenditures that should be considered in the analysis of thresholds. The occurrence of certain unusual consumption variations at higher expenditure levels was already noted. Since our consumption model pertains essentially to the lower range of expenditures, it is necessary to separate the effects of those consumption variations which occur at relatively higher levels of expenditure. Put another way, one must identify the range of expenditures within which the consumption model would be best operative. Instead of arbitrarily defining this expenditure range, we adopted a scheme whereby the consumption model was tested successively for different expenditure ranges. The relevant expenditure range was treated as the one which resulted in most significant estimates of the expenditure parameters.

The equation for estimating the demand for calories from less-preferred starchy staples took the following general form:

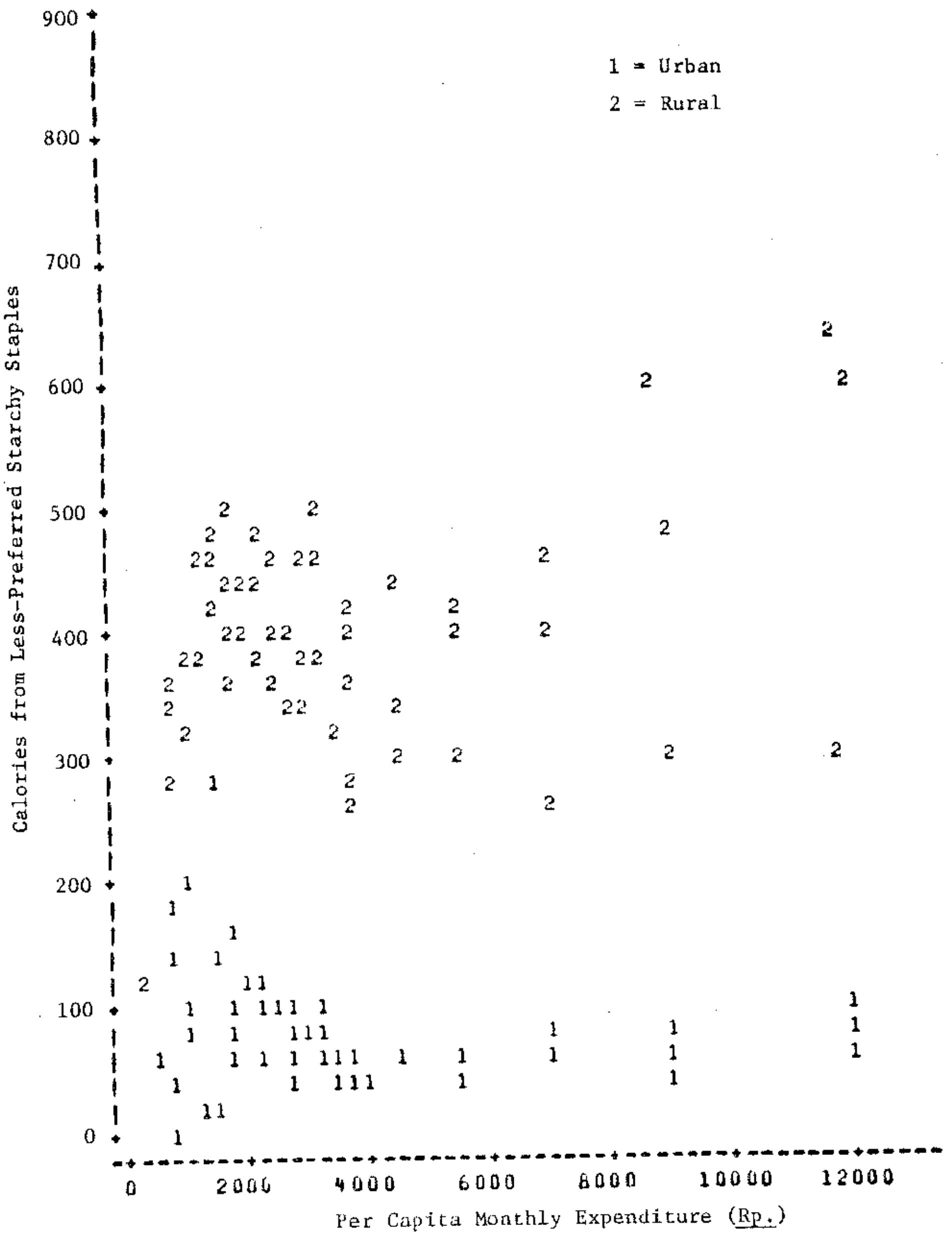
$$\begin{aligned} lnlps \;=\; & A + g_i D_i + b_{10} lnexp + b_{20} lnexpsq + b_{30} lnlpspr \\ & + b_{40} lnrcclpr + c_{ij} D_j + e_i \qquad (6.1) \end{aligned}$$

where

lnlps = log of per capita quantity of calories from less-preferred starchy staples,

A = intercept term for the base group,

FIGURE 6.1. INDONESIA: PLOT OF APPARENT CONSUMPTION OF CALORIES FROM LESS-PREFERRED STARCHY STAPLES AGAINST EXPENDITURE, 1976*



Source: Indonesia,"National Socio-Economic Survey - SUSENAS V" (raw data).

TABLE 6.5. INDONESIA: DEMAND FOR CALORIES FROM FRESH CASSAVA AMONG EXPENDITURE GROUPS UP TO RP. 2000

	Estimate	"t" Ratio
Intercept	11.37	4.2
Intercept*D[a/]	5.17	0.28
Expenditure	-0.50	1.53
Own Price	0.33	1.27
Rice Calorie Price	1.02	1.44
Expenditure*D[a/]	-0.84	0.35
		R^2=0.05

NOTE: All variables in natural logs.

a/ Dummy: urban observations

Source: Indonesia,"National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

g_i = difference between A and the intercept term of the ith nonbase group of observations,

D_i = dummy variable taking the value of 1 for all observations in the ith nonbase group and a value of zero for all other observations,

b_{10}-b_{40} = slope coefficients of the explanatory variables,

lnexp = log of per capita expenditure,

lnexpsq = log of per capita expenditure squared,

lnlpspr = log of the composite price of the calories from less-preferred starchy staples,

lnrcclpr = log of the composite price of rice calories,

c_{ij} = difference between the base-group slope coefficients and the slope coefficients pertaining to the groups of observations defined by the dummy variables,

D_j = dummy variables taking the observed value of the explanatory variables within the defined groups and zero for all other observations.

The data used for most of the estimation work was made up of the means of the 20 expenditure groups separately derived for the urban and rural sectors of 25 provinces. The use of cell means in estimating a function using least squares procedures creates certain statistical problems if the frequency in each cell is not uniform. The assumption of homoscedastic error variances, crucial if ordinary least squares procedures are to produce unbiased estimates of the parameters, is violated when the number of observations in the cells differ from one another. We corrected for the problem of unequal error variances by weighting each cell mean by the square root of the number of observations (25). All statistical work was carried out using the Statistical Analysis System (SAS) procedures.

Results: All Indonesia

The results of estimating the demand function for calories from less-preferred starchy staples are presented in Table 6.6. The demand coefficients estimated for the entire expenditure range are presented in the first column of the table. Reported in the second column are the results in relation to our consumption model. The coefficients of the expenditure terms were most significant when expenditure classes greater than Rp. 3000 were separated using dummy variables to represent observations in that range. The data used in these regressions included both urban and rural sector observations from all provinces in Indonesia.

First, consider the results when no expenditure dummies were specified. According to the estimated expenditure slopes for all groups,

TABLE 6.6. INDONESIA: DEMAND FOR CALORIES FROM LESS-PREFERRED STARCHY STAPLES, 1976

	All Groups	All Groups, with Dummy Variables
Intercept	16.54 (4.8)	-47.08 (-2.9)
Intercept*D[a]		73.38 (3.9)
Expenditure	-3.94 (-4.8)	14.29 (3.4)
Expenditure Squared	0.23 (4.8)	-0.98 (3.3)
Expenditure*D[a]		-29.03 (-3.9)
Expenditure Squared*D[a]		1.38 (4.3)
Own Price	-2.14 (-35.0)	-1.20 (-8.4)
Rice Calorie Price	-0.60 (-3.0)	0.63 (1.78)
Own Price*D[a]		-1.12 (-7.0)
Rice Calorie Price*D[a]	-1.81 (-4.3)	
	R^2=0.44	R^2=0.47

NOTE: All variables are in natural logs. "t" ratios are in parentheses.

a/ Dummy: per capita monthly expenditures greater than Rp. 3000

Source: Indonesia,"National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

calories from cassava, maize, roots and tubers are considered as inferior by all households having per capita monthly expenditures of less than Rp. 5000.7/ This range contains over 70 percent of the total population. Beyond this range, these calories appear to be treated as normal--their consumption is successively increased as expenditure levels increase. This result is not consistent with the hypothesized behavior.

Specification of the function in the overall regression is such that it appears to have caused a distortion in the consumption patterns of the lower expenditure groups. When this misspecification is avoided by allowing for possible changes in the intercept and slope coefficients pertaining to higher expenditure levels, the results are different and may provide a better representation of reality.

Basically, what the results from the dummy variable model reveal is the possibility that the hypothesized less-preferred starchy staples consumption model is representative of the consumption behavior among low-income households in Indonesia. The Engel relationship estimated from a log-log quadratic function has reasonable statistical support in that both expenditure coefficients are significant at the five percent level. Furthermore, the signs of the expenditure coefficients are as expected in the model. According to these coefficients, the maximum level of consumption of calories from less-preferred starchy staples among low-income consumers occurs when per capita monthly expenditure is around Rp. 1500.8/

In the expenditure range greater than Rp. 3000, defined by the dummy variables, the calorie consumption-expenditure relationship undergoes changes that are statistically significant. Not only are the expenditure slopes of the two groups different, their signs also undergo changes when moving from the base group to the upper group. Beyond an expenditure level of Rp. 3000, consumption of calories from less-preferred staples continues to decline as expenditure levels increase to around Rp. 5000, beyond which these calories once again become normal. These results confirm the bimodal pattern of consumption observed in Figure 6.1.

Since in the range of expenditures of less than Rp. 3000 there seem to exist two distinct patterns of demand for less-preferred starchy staples, we thought it fit to examine the expenditure and price elasticities within this range. Demand estimates presented in Table 6.7 give an indication of the differences that may exist in the demand elasticities between the expenditure classes up to Rp. 1500 and those between

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7/ The estimated Engel's function for all expenditure groups indicates a negative range, a minimum level of consumption and a positive range respectively in the calorie consumption-expenditure relationship. The level of expenditure when consumption is at a minimum is derived using equation (5.3) in Chapter 5.

8/ The expenditure level when consumption is maximum is derived using the relation given in equation (5.3) of Chapter 5. Accordingly:

$$1500 \approx e^{14.29/2(.98)}$$

TABLE 6.7. INDONESIA: DEMAND COEFFICIENTS FOR CALORIES FROM LESS-PREFERRED STARCHY STAPLES IN THE EXPENDITURE RANGE UP TO RP. 3000

	Estimated Coefficient	"t" Ratio
Intercept	- 2.29	(0.7)
Intercept*D[a/]	10.58	(2.8)
Expenditure	1.04	(2.5)
Own Price	- 0.60	(2.18)
Rice Calorie Price	0.36	(0.6)
Expenditure *D[a/]	- 1.70	(3.6)
Own Price *D[a/]	- 0.92	(3.0)
Rice Calorie Price *D[a/]	0.13	(0.19)
	R^2 = 0.18	

NOTE: All variables are in natural logs. Dependent variable: log of calories from less-preferred starchy staples.

a/ Dummy variable, to represent expenditure classes Rp. 1500-3000.

Source: Indonesia,"National Socio-Economic Survey, 1976 - SUSENAS V" (raw data).

Rp. 1500 and Rp. 3000. The estimation equation was in the log-log form which allows the interpretation of the slope coefficients as the respective elasticities.

In this regression, the dummy variable represents the observations in the Rp. 1500-3000 range. As expected, the average expenditure elasticity for calories from less-preferred starchy staples in the lower expenditure classes is positive and slightly greater than unity in magnitude. For the rest of the expenditure classes, the expenditure elasticity coefficient turns out to be negative, as indicated in earlier results. The own-price elasticity coefficients reveal a much larger response to price changes among the upper expenditure levels than in the case of the lower ones. This is an important result from the point of view of the basic consumption model. These price elasticity coefficients signify the greater importance of the less-preferred staples as necessities for the lower expenditure groups. For both groups, the price of rice seems not to significantly affect the consumption of less-preferred calories.

The reasons for including fresh cassava in the less-preferred staples bundle have been noted. As a further check on the correctness of this move, the demand for calories from less-preferred starchy staples was estimated excluding calories from fresh cassava from the values of the dependent variable. The results, presented in Table 6.8, are consistent with the earlier results. These results also indicate an expenditure level of around Rp. 1500 as the threshold.

Expenditure elasticities for total calories, calories from starchy staples, and calories from rice for the expenditure range before and after the threshold were estimated and the results are presented in Table 6.9. In the lower range, the expenditure elasticity for total calories is around unity but remains relatively high beyond the threshold expenditure level of Rp. 1500.

Expenditure elasticities on total calories have to be viewed with caution due to problems encountered in accounting for total calories using SUSENAS V data. With regard to calories from starchy staples, the elasticity coefficient, which is 0.89 in the lower range, decreases to 0.54 in the upper expenditure range. This signifies the continued importance of calories from all starchy staples after meeting basic quantity considerations. Beyond the threshold, starchy staples are clearly dominated by rice, the preferred quality staple. Rice calories belong to the category of luxuries in the lower range of expenditures where expenditure elasticity for calories from less-preferred staples was found to be positive. The turning point in the consumption pattern of less-preferred calories seems to occur when expenditure elasticity for rice is around unity.

These results relate to consumption patterns aggregated at the national level. In view of Indonesia's great diversity, it is pertinent to ask whether the apparent evidence of threshold behavior is real or simply an outgrowth of regional, seasonal, and sectoral differences in consumption patterns.

TABLE 6.8. INDONESIA: DEMAND FOR CALORIES FROM LESS-PREFERRED STARCHY STAPLES EXCLUDING FRESH CASSAVA, 1976

	Estimate	"t" Ratio
Intercept	-88.5	2.55
Intercept*D[a/]	104.65	2.66
Expenditure	26.1	2.9
Expenditure Squared	-1.80	3.0
Own Price	-0.005	0.02
Rice Calorie Price	-0.74	1.2
Expenditure*D[a/]	-30.5	3.1
Expenditure Squared*D[a/]	2.07	3.3
Own Price*D[a/]	-2.3	6.8
Rice Calorie Price*D[a/]	-1.0	1.3
		R^2 = 0.32

NOTE: Dependent variable and all explanatory variables in natural logs.

a/ Dummy: expenditure group greater than Rp. 3000

Source: Indonesia,"National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

TABLE 6.9. INDONESIA: DEMAND FOR TOTAL CALORIES, STARCHY STAPLE CALORIES AND RICE CALORIES AMONG LOW-INCOME CLASSES, 1976

	Total Calories[a/]	Starchy Staple Calories[a/]	Rice Calories[a/]
Intercept	-1.39 (3.8)	-1.16 (3.5)	-6.32 (7.7)
Intercept*D[b/]	2.58 (5.2)	2.61 (5.9)	3.18 (2.9)
Expenditure	0.98 (19.8)	0.89 (20.2)	1.40 (12.8)
Expenditure*D[b/]	-0.35 (5.3)	-0.35 (6.0)	-0.42 (2.9)
Rice Calorie Price	-0.66 (14.0)	-0.68 (16.0)	-1.61 (15.3)
Price of Calories from Less-Preferred Starchy Staples	-0.20 (11.0)	-0.23 (13.7)	0.02 (0.66)
	R^2=0.67	R^2=0.67	R^2=0.54

NOTE: All variables are in natural logs. "t" estimates are in parentheses.

a/ Dependent variables

b/ Dummy: expenditure classes from Rp. 1500-3000

Source: Indonesia, "National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

Urban and Rural Sector Effects

The results of the model when disaggregated to reflect the differences between urban and rural consumption patterns are presented in Table 6.10. The estimated equation was specified to capture both urban/rural differences as well as differences in consumption patterns between the lower and upper segments in the expenditure range.

In this regression, rural per capita monthly expenditure classes of less than Rp. 3000 form the base expenditure range and the coefficients of the dummy variables represent deviations from the intercept and slope coefficients of the base expenditure range. The cut-off point in the expenditure range was set at Rp. 3000 on the basis of the earlier results. The purpose of this specification was to get a direct test of the significance of the deviations. Wherever necessary, separate estimates were obtained for the expenditure ranges represented by the dummy variables.

The results can be summarized as follows:

1. According to the two coefficients of the expenditure variables in the rural group, consumption of calories from less-preferred starchy staples will first increase as expenditures increase among lower expenditure classes. This indicates a positive expenditure elasticity for these calories up to an expenditure level around Rp. 1800, at which point calorie consumption from the less-preferred staples is at a maximum. Beyond this expenditure level, their consumption decreases as expenditures increase, signifying the perception of these calories as inferior.

2. Among lower expenditure classes in the urban sector, calories from less-preferred starchy staples are considered as inferior by all classes in the lower range.9/

While the estimated consumption patterns among the low-income rural households seem to be compatible with our consumption model, the urban behavior would appear to contradict it. Since the urban sector of Indonesia contained nearly 20 percent of the total population during the survey period (21, p. 1), it is important to understand the role of the less-preferred starchy staples in urban diets.

The distribution of income in the rural and urban sectors in 1976 indicates that nearly 45 percent of the rural population had per capita monthly expenditure levels less than Rp. 3000, whereas in the urban sector only 15 percent, one third of the figure for the rural sector,

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9/ Using the deviations represented by the dummy variable, the coefficients of the expenditure and expenditure-squared terms are derived to be -7.12 and 0.42 respectively in the case of the urban sector lower expenditure groups. These coefficients were also estimated separately and found to be statistically significant.

TABLE 6.10. INDONESIA: URBAN/RURAL SECTOR EFFECTS ON DEMAND FOR CALORIES FROM LESS-PREFERRED STARCHY STAPLES

	Estimated Coefficient	t Ratio
Intercept	-38.26	(-2.8)
Intercept*D1[a/]	70.37	(3.9)
Intercept*D2[b/]	62.65	(1.13)
Intercept*D3[c/]	32.33	(1.71)
Expenditure	12.00	(3.2)
Expenditure Squared	-0.80	(-3.2)
Expenditure*D1[a/]	-19.04	(-4.2)
Expenditure*D2[b/]	-16.93	(-1.13)
Expenditure*D3[c/]	-10.65	(-2.23)
Own Price	-0.82	(-5.6)
Rice Calorie Price	0.79	(2.6)
Own Price*D1[a/]	-0.28	(-1.6)
Own Price*D2[b/]	-0.20	(-0.78)
Own Price*D3[c/]	-0.82	(-4.8)
Rice Calorie Price*D1[a/]	-1.38	(-3.7)
Rice Calorie Price*D2[b/]	1.91	(1.8)
Rice Calorie Price*D3[c/]	-0.13	(-0.26)
	R^2=0.64	

NOTE: All variables are in natural logs.

a/ Dummy: expenditure classes less than Rp. 3000 in the urban sector.

b/ Dummy: expenditure classes greater than Rp. 3000 in the urban sector.

c/ Dummy: expenditure classes greater than Rp. 3000 in the rural sector.

Source: Indonesia,"National Socio-Economic Survey, 1976, SUSENAS V" (raw data).

had such incomes (21, p. 1). Ordinarily, one would expect that the relatively richer sector would have higher levels of calorie intake than the less-fortunate sector. That this is apparently not the case in Indonesia is indicated in Table 6.11, which gives a series of consumption statistics for the urban and rural sector.

Whichever way the calories are counted--either through the known quantities or through imputed quantities--the rural sector average caloric consumption stands substantially higher than that of the urban sector. The disparity is substantial even in the expenditure classes below Rp. 3000. We also estimated calorie consumption functions separately for urban Java and rural Java as well as for the urban and rural sectors as a whole. These estimates, given in Table 6.12, consistently show lower levels of caloric consumption in the urban sector compared with any expenditure level in the rural sector. For example, at per capita expenditure of Rp. 2000 the estimated total caloric consumption in the urban sector is 1231 calories per day, which compares sharply with a daily consumption of 1653 calories in the rural sector at the same expenditure level. At a higher expenditure level (Rp. 4000) the comparable estimates are 1670 and 2536 calories in the urban and rural sectors, respectively. Results for urban and rural Java--a grouping more geographically homogeneous than others--reveal no different picture.

In the rural sector, maize, cassava, and other roots and tubers contribute heavily to total caloric consumption. Consumption of these calories in the rural sector is five to six times higher than in the urban sector. On the other hand, average rice consumption in the two sectors does not appear to be substantially different. In fact, the low-income households in the urban sector appear to consume a somewhat higher level of rice.

In urban diets, the emphasis seems to be on quality rather than on quantity: this is implied by the relatively higher levels of expenditure on nonstaples and proteinaceous foods. The average expenditure on fish, meat, and milk is almost twice that in rural areas. However, it should also be noted--and this may be the principal reason that they spend more for fewer calories--that the average calorie price faced by the urban consumer is about 45 percent higher than in the countryside.

The last two columns of Table 6.11 give consumption statistics for the expenditure range up to Rp. 3000. They are useful for understanding some of the consumption adjustments necessitated by lower incomes. In both sectors, lower incomes are associated with an absolute increase in the consumption of less-preferred starchy staple calories. The expenditure on fish, meat and milk as a proportion of the total expenditure undergoes a somewhat similar decline in both sectors. However, in the case of fruits, vegetables, nuts and processed foods, the urban low-income consumer does not make an adjustment of a similar magnitude. At low expenditure levels in the rural sector, consumption of this bundle of food constitutes only two percent of the budget, which is quite low compared with the average allocation of 18 percent. In the urban areas, the low-income group spends 18 percent of its food budget on this food group, compared to an average figure for urban consumers as a whole of 26 percent. The difference is much less than that observed in rural areas, probably because the importance of prepared foods is much greater.

TABLE 6.11. INDONESIA: AVERAGE CONSUMPTION STATISTICS IN THE RURAL AND URBAN SECTORS, 1976

	All Expenditure Groups		Expenditure Groups up to Rp. 3000	
	Urban	Rural	Urban	Rural
1. Total "imputed" calories per day[a/]	2056	2534	1348	1716
2. Total "known" calories per day	1775	2303	1214	1586
3. Rice calories per day	1179	1213	866	797
4. Other starchy staple calories	66	400	84	417
5. Budget share on food (percent)	69	81	78	84
6. Calorie cost (known) per 1000 calories (Rp.)	63	43	46	37
7. Rice expenditure (Rp./month)	1304	1267	900	788
8. Fish expenditure (Rp./month)	422	311	139	98
9. Meat expenditure (Rp./month)	220	125	18	15
10. Milk expenditure (Rp./month)	209	53	23	10
11. 8 + 9 + 10 as a percent of 19	19	14	9	6
12. Nuts, fruits, vegetables and prepared foods expenditure (Rp./month)	1110	617	340	39
13. 12 as a percent of 19	26	18	18	2
14. Rice price (Rp./kg.)	139	131	137	124
15. Maize price (Rp./kg.)	92	74	80	71
16. Cassava price (Rp./kg.)	41	28	35	27
17. Clothing expenditure (Rp./month)	394	280	118	101
18. Taxes and insurance (Rp./month)	49	40	12	21
19. Total food expenditure (Rp./month)	4265	3428	1862	1805
20. Total monthly expenditure (Rp.)	6181	4232	2387	2148

a/ Calories from this group were imputed by dividing the expenditure on these items by twice the cost of known calories.

Source: Indonesia,"National Socio-Economic Survey - SUSENAS V,"1976 (raw data).

TABLE 6.12. INDONESIA: URBAN AND RURAL CALORIE CONSUMPTION FUNCTIONS, 1976

	Indonesia		Java	
	Urban	Rural	Urban	Rural
Intercept	7.67	7.91	7.61	7.80
	(182)	(317)	(85)	(260)
Intercept*D[a/]	0.41	0.65	0.31	0.48
	(9)	(22)	(3.5)	(11)
Inverse of Expenditure	-1108.5	-998.6	-1016.5	-950.4
	(11)	(23.5)	(5.5)	(18.4)
	R^2=0.62	R^2=0.78	R^2=0.78	R^2=0.88

NOTE: Dependent variable: log of total per capita calories. "t" ratios for estimates are in parentheses.

a/ Dummy: expenditure classes over Rp. 3000.

Source: Indonesia,"National Socio-Economic Survey, 1976 - SUSENAS V" (raw data).

Among low-income consumers total expenditures on food in urban and rural areas do not vary substantially. But the disparity in total calorie consumption appears to be substantial. The average rural low-income consumer seems to consume approximately 27 percent more calories than his urban counterpart.

The urban and rural consumption patterns, thus, present significant differences. Calorie sources as well as total calorie consumption are strikingly different; so are the patterns of income distribution in the two sectors. If one were to discern behavioral thresholds of nutritional adequacy in the urban sector, it would be necessary to redefine the preferred and less-preferred foods among starchy staples. The relevant substitutions to be monitored are between different qualities and grades of rice.

Regional Effects

To examine the impact of location on starchy staple consumption, we deviated from the customary procedure of dividing the archipelago into two broad categories: Java and off-Java. Instead, the provinces were grouped according to the less-preferred starchy staple ratio--the ratio of calories from maize, cassava and other roots and tubers to the total amount of calories from all starchy staples. This ratio was obtained from data on the average provincial diets. Those provinces that had a less-preferred starchy staple ratio of less than 0.15 were grouped together as Region A: those remaining formed Region B. Accordingly, Region A was comprised of Jakarta, Java West, Aceh, Sumatra North, Riau, Jambi, Sumatra West, Sumatra South, Bengkulu, Kalimantan West, Kalimantan Central, Kalimantan Selatan, Kalimantan Timur and Nusa Tenggara West. The rest of the provinces--Java Central, Yogyakarta, Java East, Sumatra North, Lampung, Bali, Sulawesi North, Sulawesi Central, Sulawesi South, Sulawesi South-East, Nusa Tenggara Timur and Maluku--formed Region B. The average daily per capita consumption of calories from starchy staples and the ratio of calories from less-preferred starchy staples to total starchy staple calories is shown in Table 6.13. Location of the provinces belonging to the two Regions is shown in Figure 6.2.

The purpose of this regional classification is to examine the relevance of the starchy staple consumption model separately in areas where maize, cassava, and other roots and tubers are produced abundantly and in other areas where these foods are produced minimally. The latter--Region A--has a high concentration of urban population as well as the major rice producing areas. Shown in Figures 6.3 and 6.4 are the patterns of consumption of calories from the less-preferred starchy staples and the total calories from the starchy staples in the urban and rural sectors of Regions A and B, respectively. The low levels of less-preferred starchy staple consumption in the urban and rural sectors of Region A are not surprising because this region was defined to be one with relatively low levels of their consumption.

Perhaps more interesting is the pattern of consumption of calories from the less-preferred starchy staples in the urban sector of Region B.

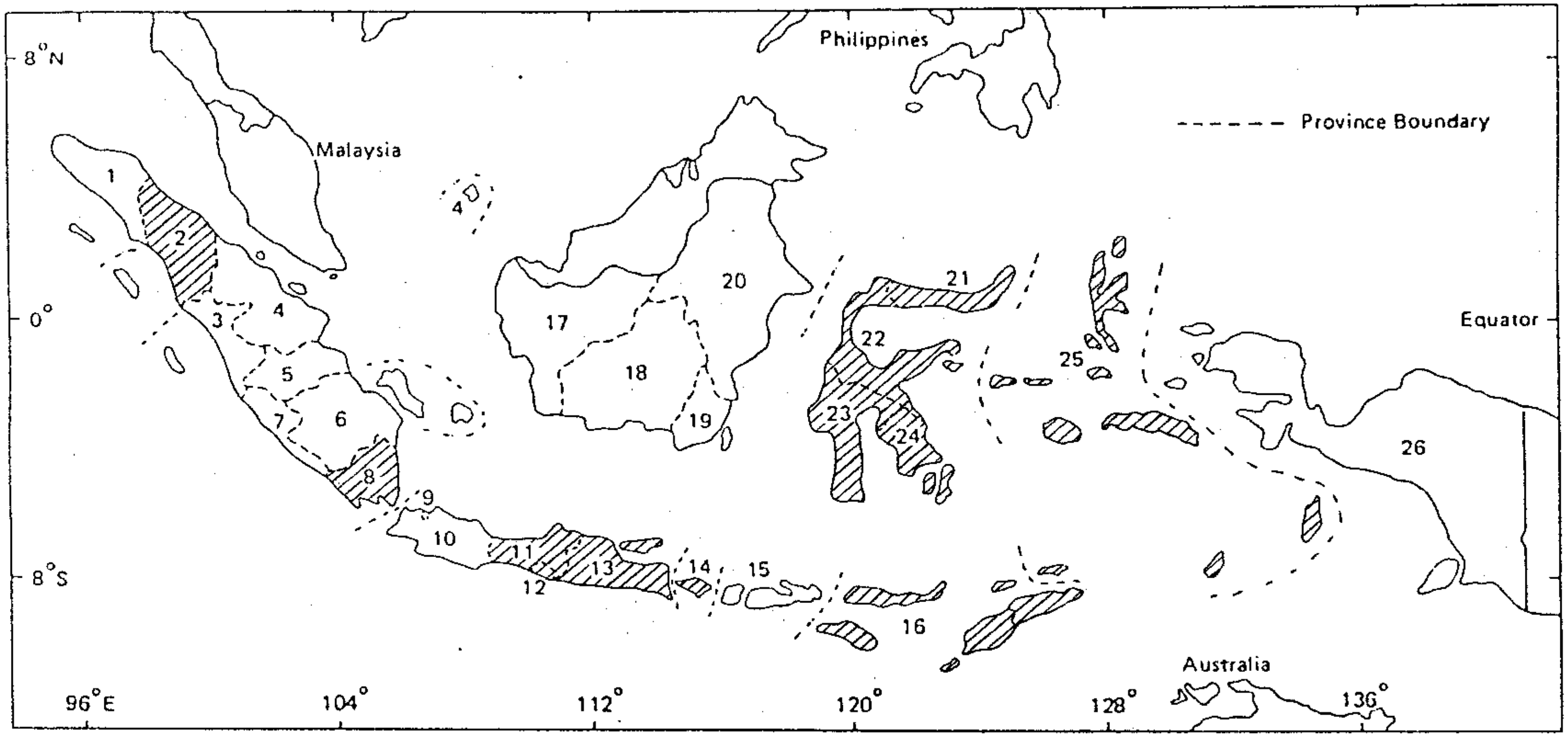
TABLE 6.13. INDONESIA: DAILY PER CAPITA CALORIE CONSUMPTION FROM STARCHY STAPLES IN THE PROVINCES, 1976*

Province	Province Number	1 Cassava	2 Cassava + Other Less-Preferred Starchy Staples	3 1 + 2 + Rice	Less-Preferred Starchy Staple Ratio[a/]
Region A					
Jakarta	9	20	32	1,183	.02
West Java	10	116	171	1,709	.10
Aceh	1	70	112	1,715	.06
Riau	4	116	206	1,638	.12
Jambi	5	123	210	1,900	.11
West Sumatra	3	44	97	1,650	.06
South Sumatra	6	104	147	1,751	.08
Bengkulu	7	74	216	1,856	.11
West Kalimantan	17	183	237	1,903	.12
Central Kalimantan	18	126	161	1,818	.09
South Kalimantan	19	97	145	1,699	.08
East Kalimantan	20	85	112	1,397	.08
West Nusa Tenggara	15	38	132	1,718	.07
Region B					
Central Java	11	176	355	1,355	.26
Yogyakarta	12	293	342	1,230	.28
East Java	13	256	561	1,146	.48
North Sumatra	2	229	349	1,887	.19
Lampung	8	463	541	1,757	.30
Bali	14	61	474	1,749	.27
North Sulawesi	21	141	555	1,707	.32
Central Sulawesi	22	205	926	1,797	.51
South Sulawesi	23	80	349	1,815	.19
S. East Sulawesi	24	416	1,189	1,865	.63
East Nusa Tenggara	16	550	1,228	2,261	.54
Muluku	25	516	1,285	1,767	.72

a/ Ratio of less-preferred starchy staple calories to total starchy staple calories.

*Source: Indonesia,"National Socio-Economic Survey, 1976 - SUSENAS V"(raw data).

FIGURE 6.2. INDONESIA: MAP SHOWING PROVINCES AND REGIONS A AND B*[1/]

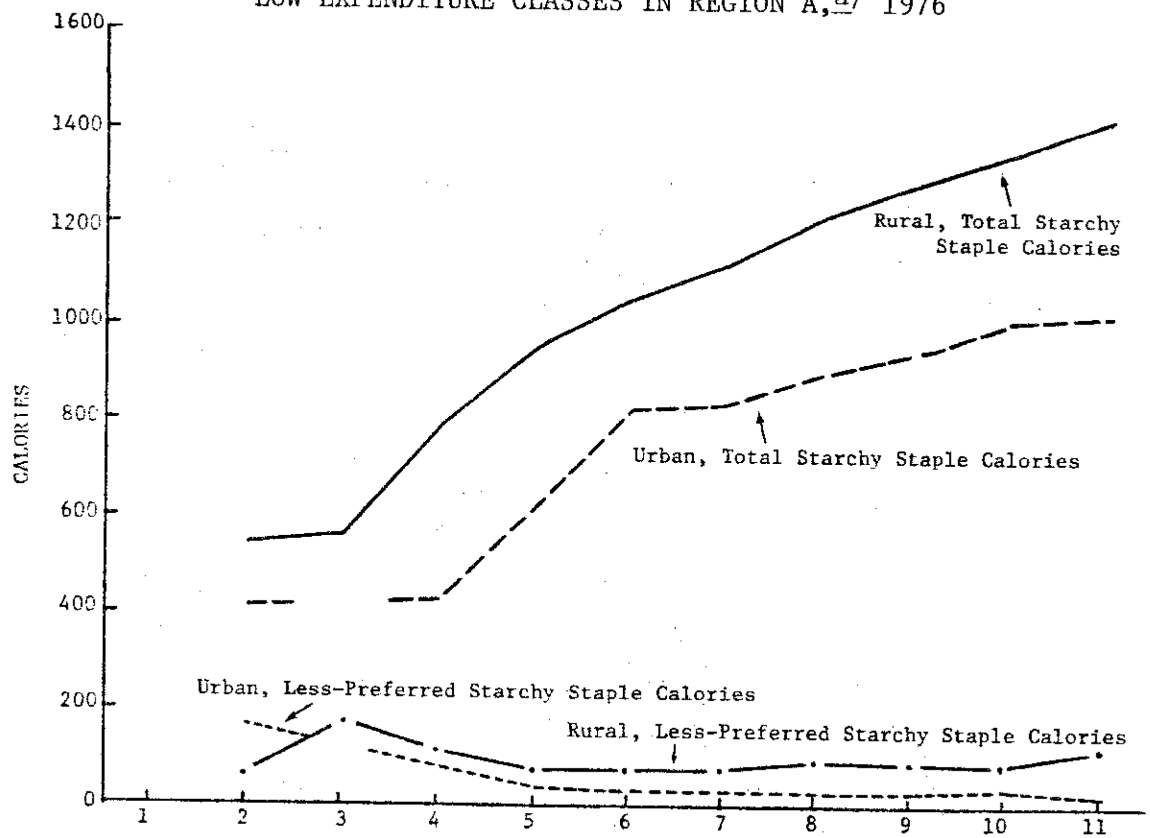


REGION A		REGION B (shaded)	
1 Aceh	9 D.K.I. Jakarta	2 Sumatera Utara	16 Nusatenggara Timur
3 Sumatera Barat	10 West Java	8 Lampung	21 Sulawesi Utara
4 Riau	15 Nusatenggara Barat	11 Central Java	22 Sulawesi Tengah
5 Jambi	17 Kalimantan Barat	12 D.I. Yogyakarta	23 Sulawesi Selatan
6 Sumatera Selatan	18 Kalimantan Tengah	13 East Java	24 Sulawesi Tenggara
7 Bengkulu	19 Kalimantan Selatan	14 Bali	25 Maluku
	20 Kalimantan Timur		26 Irian Jaya

1/ See text for definition of Regions A and B.

Source: Adapted from Lee-Jay Cho, et al., Population Growth of Indonesia (Honolulu: University Press of Hawaii, 1980), p. 4.

FIGURE 6.3. INDONESIA: PER CAPITA DAILY CALORIE CONSUMPTION AMONG LOW EXPENDITURE CLASSES IN REGION A,[a] 1976

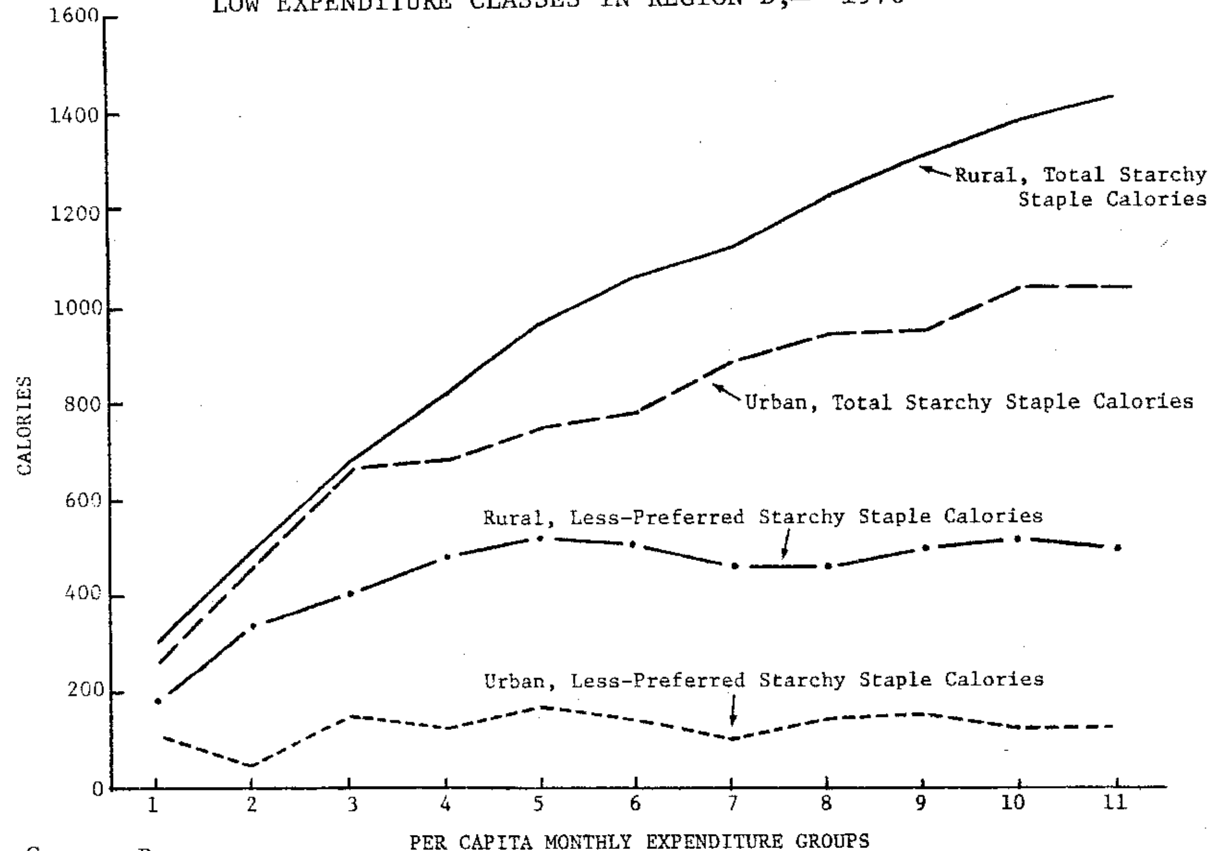


Group	Rp.	Group	Rp.	Group	Rp.
1	0-499	5	1250-1499	9	2250-2499
2	500-749	6	1500-1749	10	2500-2749
3	750-999	7	1750-1999	11	2750-2999
4	1000-1249	8	2000-2249		

a/ See text for definition of Region A.

Source: Indonesia,"National Socio-Economic Survey, SUSENAS V, 1976"(raw data).

FIGURE 6.4. INDONESIA: PER CAPITA DAILY CALORIE CONSUMPTION AMONG LOW EXPENDITURE CLASSES IN REGION B,[a] 1976



Group	Rp.	Group	Rp.	Group	Rp.
1	0-499	5	1250-1499	9	2250-2499
2	500-749	6	1500-1749	10	2500-2749
3	750-999	7	1750-1999	11	2750-2999
4	1000-1249	8	2000-2249		

a/ See text for definition of Region B.

Source: Indonesia,"National Socio-Economic Survey, SUSENAS V,"1976 (raw data).

On the average, these calories constitute only 14 percent of the total calories from all starchy staples consumed by the expenditure classes up to Rp. 3000. In the rural sector of Region B, the comparable figure is 42 percent. The implication is that the urban consumption patterns, whether in rice dominant or less-preferred staples dominant regions, exhibit certain uniform characteristics.

Demand functions for calories from the less-preferred starchy staples were estimated separately for the two regions using the same model as before. The results for Region B are presented in Table 6.14. The demand coefficients estimated using all observations in the expenditure range up to Rp. 3000 are in conformity with earlier results for all Indonesia and rural Indonesia. In fact, it is in Region B that the less-preferred starchy staple consumption model seems to be best operative, as indicated by the statistical significance of the expenditure coefficients. The maximum level of less-preferred calorie consumption among low-income consumers appears to occur at a relatively higher expenditure level--around Rp. 2100. The urban observations in Region B account for nearly 20 percent of all observations in that region. The results of testing the starchy staple consumption model on the urban observations clearly points to the inapplicability of our model to explaining the consumption behavior in that sector (Table 6.14). Alternative Engel's functions were tested on the same data, but none were able to capture any significant expenditure slope. This is not surprising if one considers the minimal variations in consumption seen throughout the expenditure range of concern (Figure 6.4).

The results for the urban and rural sectors of Region A had a close resemblance to the results obtained for the overall urban sector. Calories from less-preferred staples appear to be treated as inferior by the lower expenditure classes throughout this region. Demand estimates derived using a semi-log function are presented in Table 6.15. These results indicate negative expenditure elasticities in the lower expenditure range. In the upper expenditure range beyond Rp. 3000 the expenditure elasticity turns out to be positive but extremely small in magnitude.

The results for Region A fall into the same category as the overall urban sector results (Table 6.10); apparently, a different specification of the consumption model or the less-preferred foods may be required to explain consumption patterns in this region.

The pattern of income distribution revealed by the SUSENAS V sample indicates substantial differences between the two regions (Table 6.16).

In Region B, 43 percent of the sample expended not more than Rp. 3000 per month per capita on total consumption, whereas in Region A similar expenditure levels are experienced only by 13 percent of the sampled population. This distribution is significant because the sampled populations in the two regions are not substantially different in size. This general pattern of income distribution obtains for the urban and rural sectors of the two regions as well. Region A obviously is the richer region of the two.

TABLE 6.14. INDONESIA: DEMAND FOR CALORIES FROM LESS-PREFERRED STARCHY STAPLES IN REGION B[a]

	All Observations		Urban Observations Only	
	Estimate	"t" ratio	Estimate	"t" ratio
Intercept	-34.56	4.2	18.99	0.53
Intercept*D[b]	53.5	1.5		
Expenditure	10.41	4.70	-3.83	0.40
Expenditure squared	-0.68	-4.53	0.28	0.43
Own price	-0.86	-7.83	-0.67	4.35
Rice calorie price	0.42	2.12	2.24	2.83
Expenditure*D[b]	-14.2	1.48		
Expenditure squared*D[b]	0.96	1.50		
Own price*D[b]	0.19	1.03		
Rice calorie price*D[b]	1.81	2.30		
	R^2=0.55		R^2=0.17	

NOTE: The dependent variable and all explanatory variables are in natural logs.

a/ See text for definition; Region B consists of major producing areas of less-preferred starchy staples.

b/ Dummy: urban observations

Source: Indonesia,"National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

TABLE 6.15. INDONESIA: DEMAND FOR LESS-PREFERRED CALORIES IN REGION A, 1976

	Estimated Coefficient	t Ratio
Intercept	219.5	(.67)
Intercept*D[b/]	-1393.3	(4.09)
Expenditure	-82.39	(2.28)
Expenditure*D[b/]	173.6	(4.6)
Own Price	-311.9	(16.0)
Rice Price	47.23	(0.76)
Own Price*D[b/]	74.85	(3.5)
Rice Price*D[b/]	-116.2	(1.6)
		R^2=0.53

NOTE: Dependent variable: per capita calories from less-preferred starchy staples.

a/ All explanatory variables in natural logs.

b/ Dummy: expenditure classes over Rp. 3000.

TABLE 6.16. INDONESIA: REGIONAL CUMULATIVE PERCENTAGE DISTRIBUTION OF POPULATION IN URBAN AND RURAL SECTORS BY PER CAPITA EXPENDITURE CLASS*

	REGION A[a]			REGION B[a]		
Expenditure Class	Urban	Rural	Average	Urban	Rural	Average
< 1000	.0001	.0012	.0012	.0009	.015	.014
1000 - 1499	.0024	.011	.0102	.0109	.074	.065
1500 - 1999	.009	.047	.032	.0389	.193	.17
2000 - 2499	.028	.10	.069	.097	.338	.30
2500 - 2999	.064	.18	.13	.17	.47	.43
3000 - 3499	.12	.28	.21	.24	.58	.53
3500 - 3999	.18	.37	.29	.34	.67	.62
4000 - 4999	.33	.54	.45	.50	.79	.75
5000 - 5999	.47	.66	.59	.63	.86	.83
6000+	1.00	1.00	1.00	1.00	1.00	1.00

a/ See text for definition.

Source: Indonesia, "National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

Estimated calorie consumption functions for the two regions are shown in Table 6.17 and consistently point to lower levels of total caloric consumption in Region A than in any comparable expenditure class in Region B. The calorie consumption patterns in Regions A and B follow quite closely the patterns of consumption observed in the cases of urban and rural sectors, respectively. This resemblance is further evidenced in the consumption-related average statistics reported in Table 6.18. The basic factor explaining this resemblance seems to be the close correspondence in the pattern of income distribution between Region A and the urban sector and between Region B and the rural sector.

Regional variations in the consumption of starchy staples were also analyzed using data from Java and off-Java separately. The results of these estimations for Java, off-Java, East Java and Central Java are presented in Table 6.19. The data used in these estimations were confined to the rural sector. Estimated consumption patterns in off-Java, East Java and Central Java are consistent with our starchy staple consumption model. In these regions, calories from less-preferred starchy staples are treated as inferior beyond the range of expenditures between Rp. 1500 and Rp. 2000. When considering the entire rural sector in Java, the stipulated calorie consumption-expenditure relationship is not sufficiently established, perhaps because of the inclusion of rural observations from West Java. Consumption of maize, cassava, and other less-preferred staples is minimal in West Java.

Seasonal Effects

The three survey rounds were used to approximate the effects of season on starchy staples consumption. The same consumption model was tested with data from each round separately and the results are presented in Table 6.20. As before, observations used were limited to the expenditure range up to Rp. 3000. Dummy variables were used to separate the urban effects.

According to these results, the expected calorie consumption-expenditure relationship seems to hold in the case of the first two rounds. In the results for the first two rounds, the coefficients of the expenditure variables have the expected signs indicating the range of positive and negative expenditure elasticities of demand for calories from less-preferred staples. The coefficients are statistically significant but the standard errors of the coefficients appear to be larger than in the case of earlier results. The third round results fail to establish the existence of the stipulated consumption behavior during the period from September to December. During this period of the year in 1976, food consumption had been relatively low according to SUSENAS V data. For instance, average per capita consumption of known calories in this period was around 1890 per day, whereas the comparative estimates were 2157 and 2318, respectively, during the first two rounds. Calories consumed from starchy staples during the third round were 200 less than the average observed in the first two rounds. Consistent with short supplies, the prices of the starchy staples were highest during this period. One of the important features observed during the third round was the relatively high consumption of dried cassava. For the lowest expenditure groups, calories from gaplek provided

TABLE 6.17. INDONESIA: REGIONAL CALORIE CONSUMPTION FUNCTIONS, 1976

	Region A[a/]		Region B[a/]	
	Estimated Coefficient	t Ratio	Estimated Coefficient	t Ratio
Intercept	7.82	(89)	7.90	(261)
Intercept*D[b/]	0.33	(3.8)	0.51	(12.7)
Inverse of Expenditure	-1123.9	(6.4)	-985.2	(19.5)
Inverse of Expenditure*D[b/]	-1071.8	(5.3)	-1390.2	(11.3)
		R^2=0.45		R^2=0.64

a/ See text for definition.

b/ Dummy: expenditure classes over Rp. 3000.

Source: Indonesia,"National Socio-Economic Survey, 1976 - SUSENAS V" (raw data).

TABLE 6.18. INDONESIA: REGIONAL CONSUMPTION-RELATED STATISTICS, 1976*

	Region A[a]	Region B[a]
1. Total "imputed" calories per day[b]	2338	2398
2. Total "known" calories per day	2084	2155
3. Rice calories per day	1390	1017
4. Other starchy staple calories	101	461
5. Budget share on food (percent)	75	79
6. Calorie cost (known) per 1000 calories (Rp.)	58	72
7. Rice expenditure (Rp./month)	1508	1058
8. Fish expenditure (Rp./month)	480	222
9. Meat expenditure (Rp./month)	195	114
10. Milk expenditure (Rp./month)	150	66
11. 8 + 9 + 10 as a percent of 19	19	13
12. Nuts, fruits, vegetables, and prepared foods expenditure (Rp./month)	938	645
13. 12 as a percent of 19	21	20
14. Rice price (Rp./kg.)	137	130
15. Maize price (Rp./kg.)	86	74
16. Cassava price (Rp./kg.)	36	29
17. Clothing expenditure (Rp./month)	392	249
18. Taxes and insurance (Rp./month)	41	46
19. Total food expenditure (Rp./month)	4335	3120
20. Total monthly expenditure (Rp.)	5780	3949

a/ See text for definition.

b/ Calories from this group were imputed by dividing the expenditure on these items by twice the cost of known calories.

Source: Indonesia, "National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

TABLE 6.19. INDONESIA: DEMAND FOR CALORIES FROM LESS-PREFERRED STARCHY STAPLES AMONG EXPENDITURES CLASSES LESS THAN RP. 3000 IN RURAL SECTORS OF JAVA AND OFF-JAVA, 1976

	Off-Java	Java	East Java	Central Java
Intercept	-33.15 (2.20)	-25.26 (1.46)	-31.71 (2.33)	-49.97 (2.63)
Expenditure	10.30 (2.50)	8.54 (1.86)	9.37 (2.60)	14.87 (2.90)
Expenditure Squared	-0.71 (2.61)	-0.56 (1.83)	-0.61 (2.51)	-0.97 (2.84)
Own Price	-1.10 (9.30)	-0.86 (2.12)	-1.14 (1.90)	-0.51 (0.80)
Rice Calorie Price	0.06 (0.25)	2.10 (2.91)	0.11 (0.18)	1.11 (0.94)
	R^2=0.29	R^2=0.30	R^2=0.46	R^2=0.46

NOTE: Dependent variables and all explanatory variables in natural logs.

Source: Indonesia,"National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

TABLE 6.20. INDONESIA: DEMAND FOR CALORIES FROM LESS-PREFERRED STARCHY STAPLES AMONG EXPENDITURE GROUPS LESS THAN RP. 3000, DURING THREE SURVEY ROUNDS, 1976

	Round One (January-April)		Round Two (May-August)		Round Three (September-December)	
Intercept	-36.9	(2.8)	-34.7	(1.9)	-15.6	(0.76)
Intercept*D[a/]	58.8	(0.70)	36.2	(0.28)	-97.6	(1.3)
Expenditure	11.36	(2.5)	11.1	(2.3)	6.10	(1.14)
Expenditure Squared	-0.75	(2.5)	-0.74	(2.2)	-0.43	(1.24)
Own Price	-0.35	(1.6)	-0.97	(4.2)	-0.74	(4.3)
Rice Calorie Price	0.23	(0.5)	1.48	(3.5)	1.20	(2.11)
Expenditure*D[a/]	-15.3	(0.6)	-8.53	(0.25)	23.07	(1.24)
Expenditure Squared*D[a/]	0.98	(0.6)	0.55	(0.25)	-1.42	(1.20)
Own Price*D[a/]	-0.84	(2.1)	-0.31	(0.6)	-0.70	(0.48)
Rice Calorie Price*D[a/]	2.22	(1.3)	4.11	(2.6)	-0.87	(3.5)
	R^2=0.49		R^2=0.48			R^2=0.48

NOTE: Dependent variable and all explanatory variables in natural logs. "t" ratios are in parentheses.

a/ Dummy: urban observations

Source: Indonesia,"National Socio-Economic Survey, SUSENAS V," 1976 (raw data).

more calories than did rice. Gaplek is traditionally viewed in many areas as a fall-back commodity in periods of shortages (7). Once supplies return to normal, or income rises, consumers switch back to rice. Starchy staple consumption among low-expenditure classes during the third round is represented in Figure 6.5.

At the lowest expenditure levels, calories from less-preferred starchy staples appear to be dominant, with dried cassava providing most of the calories. As expenditure levels increase, consumption of dried cassava and maize decrease allowing larger amounts of rice calories to be consumed. The role of fresh cassava as a calorie source appears to be minimal compared with dried cassava and maize. Beyond an expenditure level of around Rp. 1250, dominance of rice is established, although calories from less-preferred staples continue to contribute strongly to energy supplies.

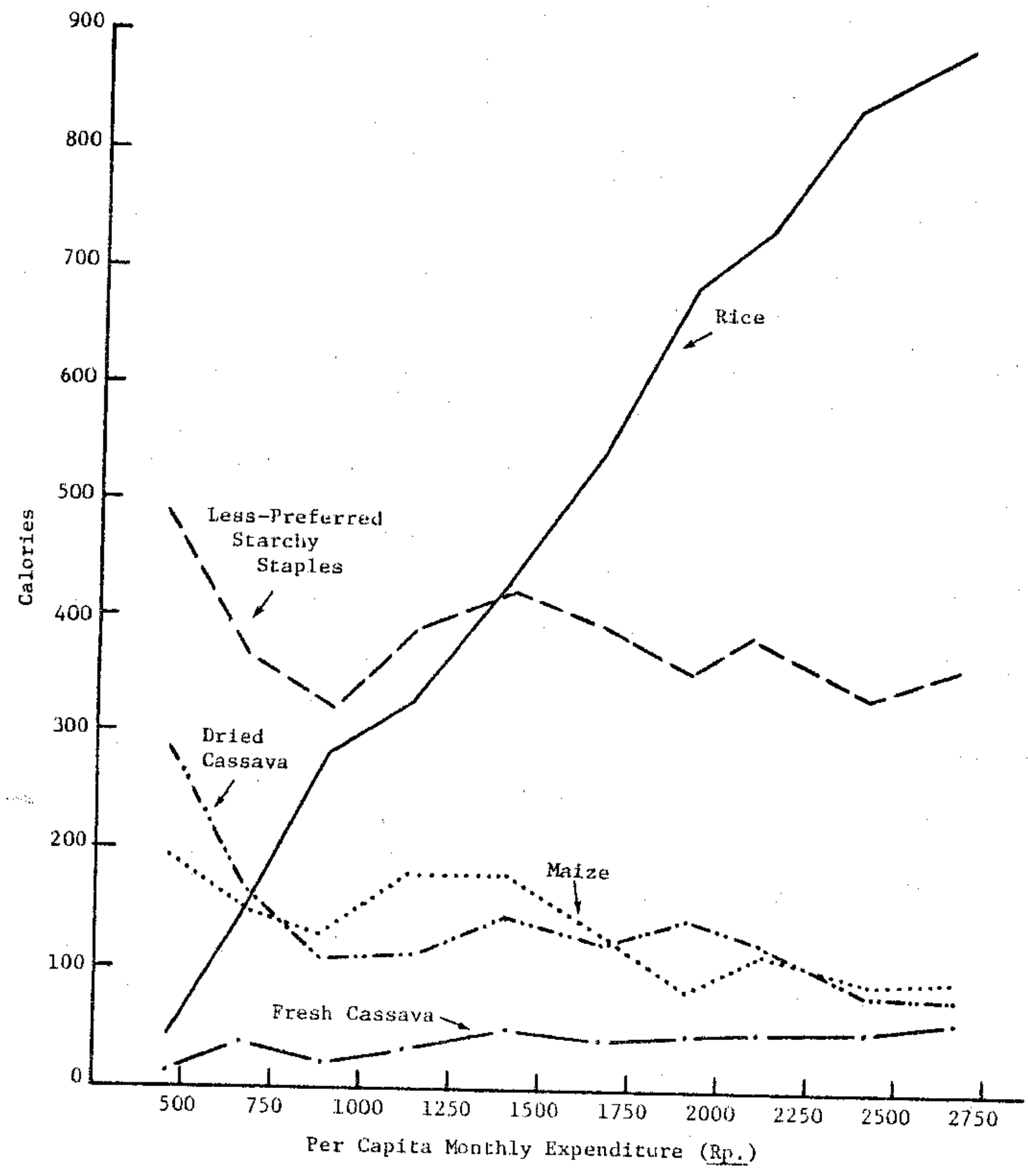
The picture in Figure 6.5 raises an important question: Does the negative relationship between calories from less-preferred starchy staples and the level of expenditures among households at the lower end of the expenditure range indicate perceived calorie adequacy, as hypothesized in the threshold concept? That it most certainly does not is apparent from two factors: Firstly, the reported per capita daily calorie consumption by the lowest expenditure class is in the neighborhood of 700 calories, which by any standard is insufficient. Secondly, the positive relationship between income and consumption of the less-preferred staples that begins around Rp. 750 casts a clear suspicion over the data points in the earlier range. The onset of a negative relationship between the two variables beyond an expenditure level of approximately Rp. 1250 is, on the other hand, consistent with the observed behavior in the first and second rounds of the survey.

The patterns of consumption observed during round two, which are similar to those observed in round one, are depicted in Figure 6.6. This figure gives a clear indication of the fact that calories from less-preferred staples as well as calories from rice have been increased with increasing expenditure levels, beginning at the lowest. The negative relationship between calories from less-preferred staples and expenditure levels begins around Rp. 1250 per capita monthly expenditure. The statistical results in Table 6.20 confirm these relationships.

Conclusions

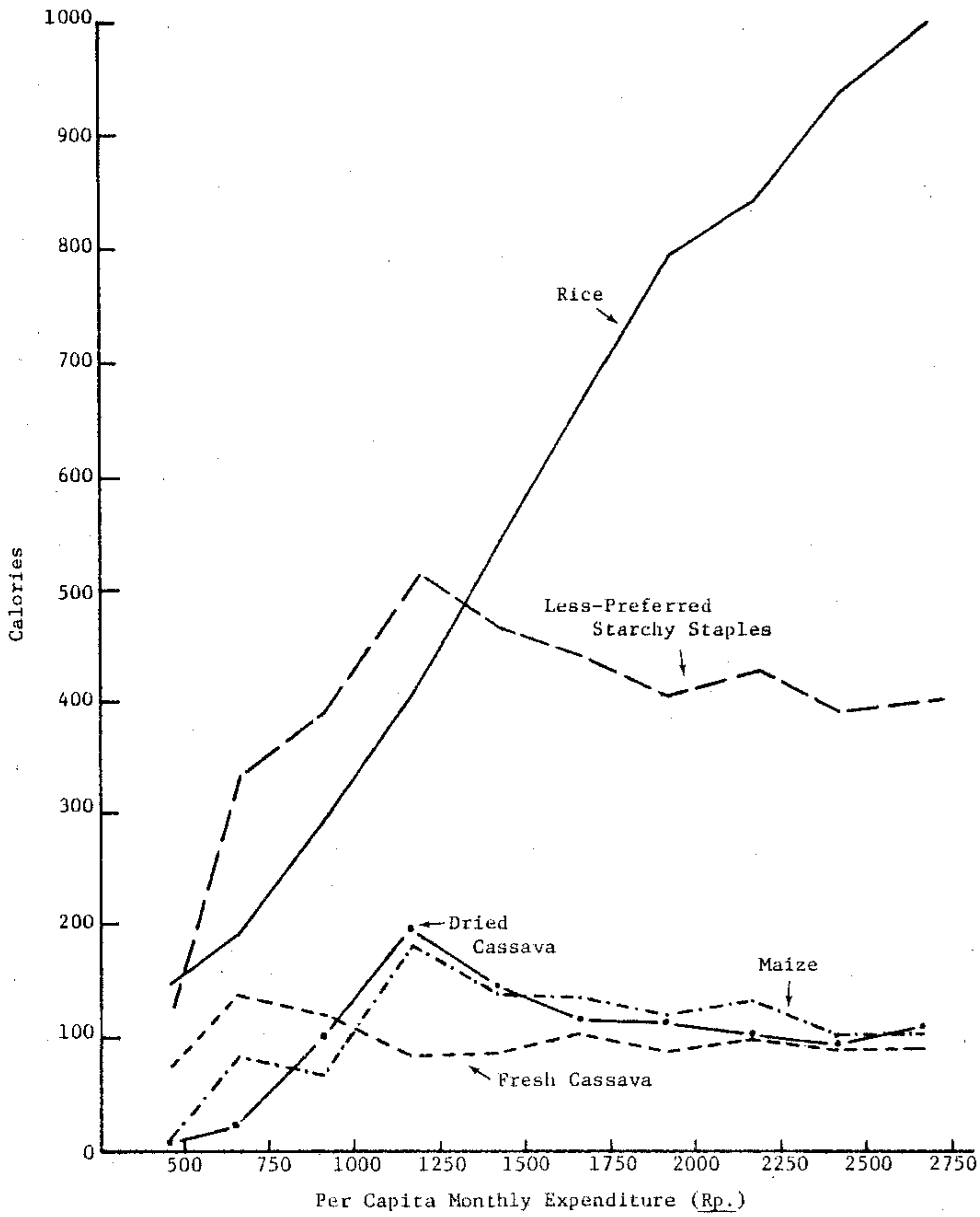
The Indonesian results broadly confirm the hypothesized consumption behavior with regard to what we defined as the less-preferred starchy staples. For the general case of low-income consumers in Indonesia, we find a section with lowest expenditure levels where calories from maize, cassava, and other roots and tubers are considered as normal as calories from rice. This section consists of households whose per capita expenditure levels do not exceed approximately Rp. 1500 per month. These households, as expenditures increase, tend to consume more calories from rice as well as other starchy staples. Beyond an expenditure level of around Rp. 1500, calories from less-preferred starchy staples become inferior. Their consumption tends to be reduced as expenditure levels

FIGURE 6.5. INDONESIA: PER CAPITA DAILY CONSUMPTION OF CALORIES FROM STARCHY STAPLES AMONG LOW-INCOME CLASSES IN THE RURAL SECTOR DURING SEPTEMBER-DECEMBER (ROUND 3), 1976



Source: Indonesia,"National Socio-Economic Survey, SUSENAS V, 1976 (raw data).

FIGURE 6.6. INDONESIA: PER CAPITA DAILY CONSUMPTION OF CALORIES FROM STARCHY STAPLES AMONG LOW-INCOME CLASSES IN THE RURAL SECTOR DURING MAY-AUGUST (ROUND 2), 1976



Source: Indonesia, National Socio-Economic Survey, SUSENAS V, 1976 (raw data).

increase. Consumption of calories from rice, on the other hand, continues to increase with increasing levels of expenditure, reflecting the all-important role of rice--the preferred staple--in the diet.

Of relevance to this pattern of consumption behavior is the relative cost of calories from different sources. Calories from the preferred cereal--rice--cost Rp. 23 per 1000 calories for the average consumer in the expenditure range up to Rp. 3000. The cost of calories from other starchy staples averaged considerably less: Rp. 13 per 1000. Wheat the analysis of data at the national level indicated was the possibility of identifying an expenditure threshold where quality considerations in caloric consumption begin to be substituted for quantity considerations.

The validity of the threshold concept was then tested on disaggregated data and the possibility of threshold behavior being distorted by regional, seasonal, and sectoral differences was examined. Consumption patterns in rural areas of Indonesia appeared to be in accordance with the hypothesized behavior. The per capita monthly expenditure level at which calories from less-preferred staples tended to become inferior was estimated to be around Rp. 1800. This higher level, compared to the thresholds for all Indonesia, most probably is of greater validity. Consumption of calories from less-preferred staples in the urban areas indicated a pattern substantially different from the rural areas. In the urban sector, these calories were not as important as they were in the rural diets. Among almost all low-income urban households, calories from less-preferred staples appeared to be perceived as inferior. Furthermore the data pointed to lower levels of calorie consumption in the urban sector, despite the fact that the urban sector was the richer of the two. Urban consumption tended to emphasize high-cost calories. Considering the relative roles of rice and other staples in the urban areas, one may expect the income-induced substitutions to occur among different grades and qualities of rice. The data lacked sufficient detail for us to examine such behavior.

The impact of location on starchy staple consumption was examined by dividing the archipelago into two broad regions based on the ratio of calories from less-preferred staples to total starchy staple calories. The purpose of this classification was to understand the differences in average consumption patterns between regions where the less-preferred staples were readily available and where they were not.

Region B, by definition, contained provinces that had relatively higher levels of less-preferred starchy staple production. The results from Region B provided the strongest statistical support for the thresholds concept. In this region too, a range of expenditures where expenditure elasticities were negative for calories from less-preferred starchy staples was observed, but beyond a relatively higher expenditure level of Rp. 2100.

In Region A, on the other hand, almost all low-income consumers seemed to consider calories from less-preferred staples as inferior.

Here again, as with the urban sector, the quantity/quality substitutions we seek probably occur between different types and grades of rice.

With respect to seasonal influences, the first and second rounds provided parameter estimates that were consistent with the stipulated model. These results for individual rounds were less-strong statistically compared with the eariler results. The third round, which was conducted during a period of supply shortages, appeared to contain consumption behavior inconsistent with the stipulated threshold hypothesis. A strong inference is that data for the very poor collected during times of shortage should be interpreted with care.

In general, however, analysis of the Indonesia data provides broad support for the concept of behavioral thresholds. The nutritional implications of this conclusion will be addressed in the final chapter.

CHAPTER VII. THE CASE OF PERU

The analysis of Peruvian food consumption enables us to test the validity of the behavioral threshold concept in a geographical setting very different from Indonesia's. The objective, of course, is to test the universality of the concept. In this chapter, the same methodology used in analyzing the Indonesian data will be tested on a portion of a large socioeconomic data set--the Encuesta Nacional de Consumo de Alimentos (ENCA, the Peruvian National Food Consumption Survey). Following Ferroni, we will concentrate on the survey sample that represented the Central and Southern Sierra of Peru (12).1/ But, as he points out, the conclusions based on this important subset of the survey "are believed to apply to all of the Peruvian Andes and, to some degree, to the Ecuadorian and Bolivian highlands as well" (12, p. 6).

Diets in the Peruvian Andes

One of the salient features of the Andean diet is the wide diversity of staples. This feature contrasts with the diets found in many other regions, such as monsoon Asia, where one staple is frequently pervasive. Diversity of the diets, no doubt, has been the result of the strategic adoption of farming to suit the varying natural endowments. A lucid profile of this diversity is given by Ferroni (12, pp. 48-49):

> Subsistence diets reflect ecological conditions and local farming practices. The herding communities of the Andean plateau above 3900 meters (the Puna region) derive the bulk of calories and nutrients from meat, potatoes and the cereal-like goosefoot plants quinua (Chenopodium quinua) and canihua (Chenopodium paullidicaule). Traditional diets of the high Sierra (between 3,100 and 3,900 meters) include potatoes, barley, the chenopods and broad dry beans. At lower Sierra elevations or where high-altitude communities have access to agricultural land at various altitudinal levels, maize tends to replace barley and the chenopods, and the calorie importance of the potato diminishes in exchange for an increase in the subsistence production of

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1/ The data set used in this study is the same that was used by M. A. Ferroni in his analysis of the urban bias in Peruvian food policy as a part of his Ph.D. dissertation. Having worked at ENCA's central offices in Lima, he has had substantial insights into many aspects of the survey which are discussed in 12. Obviously, the descriptive sections of this chapter draw heavily from his work.

oca (Oxalis tuberosa) and other tubers. Sugar cane and bananas are additional important energy sources available to families controlling farm land at the bottom of inter-Andean valleys.

One of the crucial food policy concerns in Peru centers around the tendency of imported foods to displace indigenous dietary components. As would be expected, these tendencies are most marked in the urban areas. In the average diet of the population of Lima, the five "modern" items--wheat bread, noodles, rice, sugar and vegetable oil--account for more than 55 percent of total calories purchased and consumed (12, p. 49). Of these, wheat and vegetable oils are imported commodities. The urban tendency to consume more and more of these "modern" foods has had its impact on the rural setting. Many rural consumers will opt for wheat bread and rice[2/] instead of potatoes. As will be noted later, the imported components in the Sierra diets are substantial. These dietary aspirations are commonly explained by the demonstration effect of the more modern diets of the urbanized sections of the society. Our interest in these dietary changes focuses on one important question: Do they provide any indications of dietary adequacy? The Sierra portion of the ENCA survey is analyzed for this purpose.

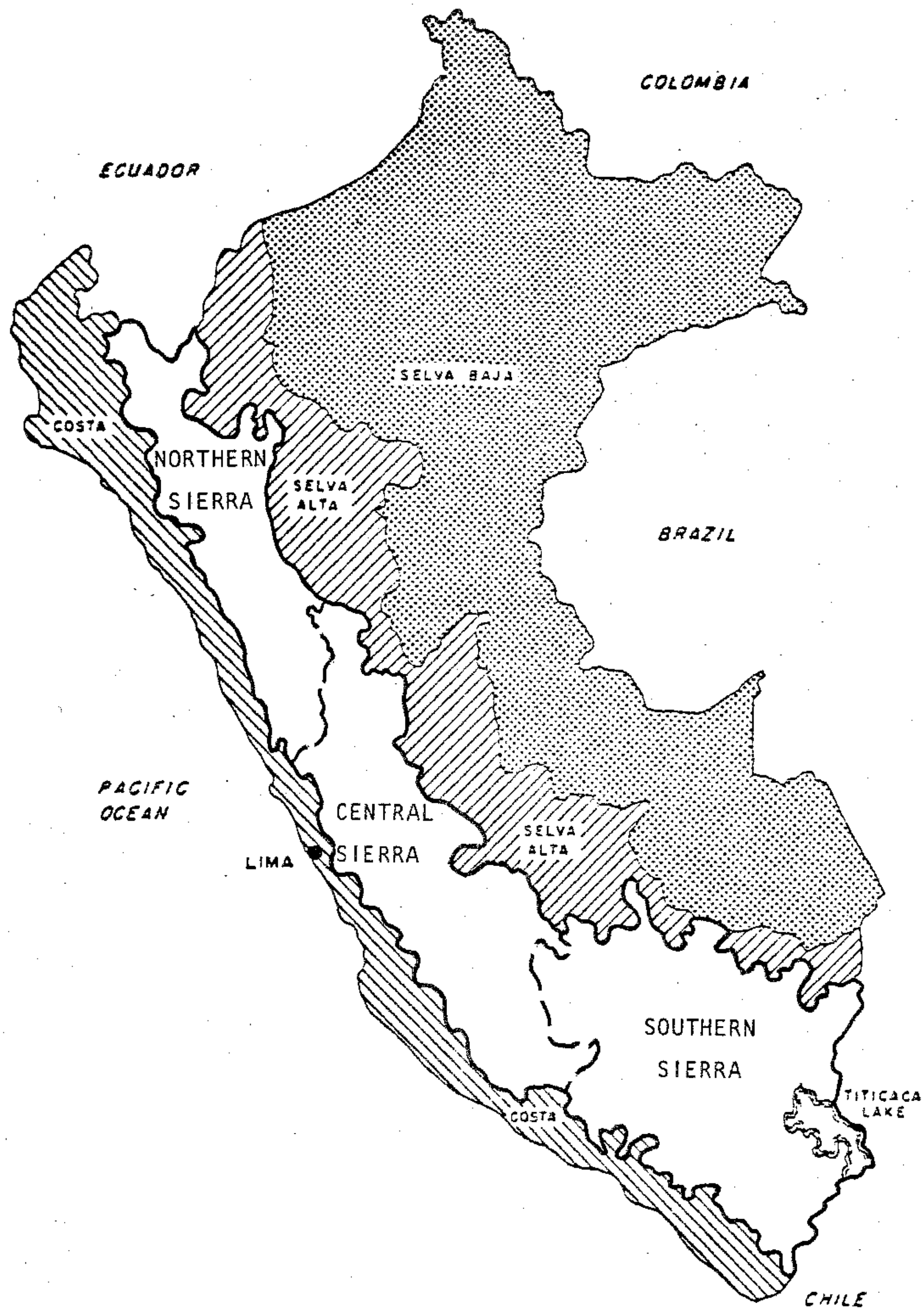
The Peruvian National Food Consumption Survey

The Peruvian Encuesta Nacional de Consumo de Alimentos--ENCA--was a nationwide survey carried out between August 1971 and August 1972. The survey sample included 8000 families selected to represent three out of every 1000 households in each of nine geographical regions. In order to permit the comparison of food consumption patterns between major ecological zones, the ENCA sample was drawn independently in the nine regions. The weights of the regional samples were derived from the population of each region in 1970, which was estimated using the 1960 population census. In most of the regions, the sample representation has been subsequently found to be within three percent of the population values (12, p. 27). The subsample used in the present analysis consists of 1,958 observations drawn from the Central and Southern Sierra regions. The original data set from the Sierra was checked for consistency by Ferroni and some 120 observations were eliminated because of erroneous information contained in them. Figure 7.1 shows the Sierra divisions in Peru.

Data collection was carried out through a period of one year, so that significant seasonal variations in food consumption could be obtained. The food consumption of each household was closely monitored by an enumerator who visited each household at least twice a day. Data collection was not limited to the recording of monetary expenditures. Physical quantities of foods purchased and produced by the consumer were recorded, along with estimates of the food actually consumed at different meals. The number present at each meal was also recorded and was used to derive more accurate estimates of per capita nutrient intake. The task of recording actual consumption involved the weighing of all foods prepared for consumption.

2/ Rice has to be "imported" to the Sierra from the coastal areas.

FIGURE 7.1. PERU: REGIONAL DIVISIONS USED IN ENCA*



*Source: M. A. Ferroni, "The Urban Bias of Peruvian Food Policy: Consequences and Alternatives" (Ph.D. dissertation, Cornell Univ., 1980), p.30.

Precision was further ensured by estimating the edible portion of foods and weighing the discarded portions, such as peels and bones. Even the weight of plate wastes and leftovers was determined to derive refined figures of actual consumption. Recall was limited to minor meals such as breakfast. Changes in household foodstocks were monitored daily by subtracting the quantities determined on any survey day from the initial quantities. In view of this elaborate methodology, one can reasonably expect a high degree of accuracy in the ENCA food consumption data.

The survey also recorded annual family incomes. ENCA attempted to obtain an account of year-round income generating activities by using a straightforward questioning procedure. But Ferroni questions whether such questioning and limited time spent on this aspect of the survey resulted in complete data on annual incomes (12, p. 43).

Table 7.1 summarizes the dietary characteristics observed in the Central and Southern Sierra.

The single most important starchy staple for most of the population is the potato, consumed fresh or in a variety of processed forms. It is well known that the geographic origin of the potato is the Andes. Several hundred varieties reflecting adaptations to specific Sierra ecological zones exist; all reported varieties are grouped under the common name "potatoes" in Table 7.1. Other roots and tubers, such as olluco (Ullucus tuberoses), occa (Oxalis tuberosa), and mashua (Tropaelum tuberosum) contribute to the diets only minimally. But the contribution to total calories from cereals as a group--rice, wheat, barley, maize and quinua--figures more prominently than the roots and tubers group. Needless to say, the relative importance of the individual items may vary according to specific geographical location; what Table 7.1 indicates is the average contribution of the major staples as derived from the combined Sierra sample. Apparent per capita consumption of calories stands at 2251 per day, which is about 100 calories above the recommended caloric intake for this region.3/

Income-class specific calorie consumption levels are shown in Table 7.2 for the nine income classes. The inverse relationship between the starchy staple ratio and income is as expected, and the magnitude of these ratios is also in the expected range, except in the highest income level. This somewhat illogical feature among the uppermost income class was found in the case of Indonesia too. The consistent upward movement of the composite calorie prices with increasing income is a clear indication of increased dietary diversity in response to enhanced income.

An important aspect of this diversity may be explained by the data given in Figure 7.2. It also gives a clear indication of the set of preferred and less-preferred staples in the Sierra diet. Clearly, the

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3/ Using the anthropometric data and the indices of family presence in the data set, Ferroni calculated an ideal caloric intake level by adjusting the FAO/WHO recommendations (12, p. 85). The weighted average of these ideal requirements, which has been calculated for the urban and rural sectors separately, worked out to 2151 calories.

TABLE 7.1. PERU: AVERAGE DAILY PER CAPITA CONSUMPTION OF PRINCIPAL STAPLES IN CENTRAL AND SOUTHERN SIERRA, 1971-72*

Food	Calories
Potatoes	390
Wheat Bread	229
Rice	123
Noodles	93
Barley	177
Maize	232
Quinua	119
Other Calories	888
TOTAL Calories	2251

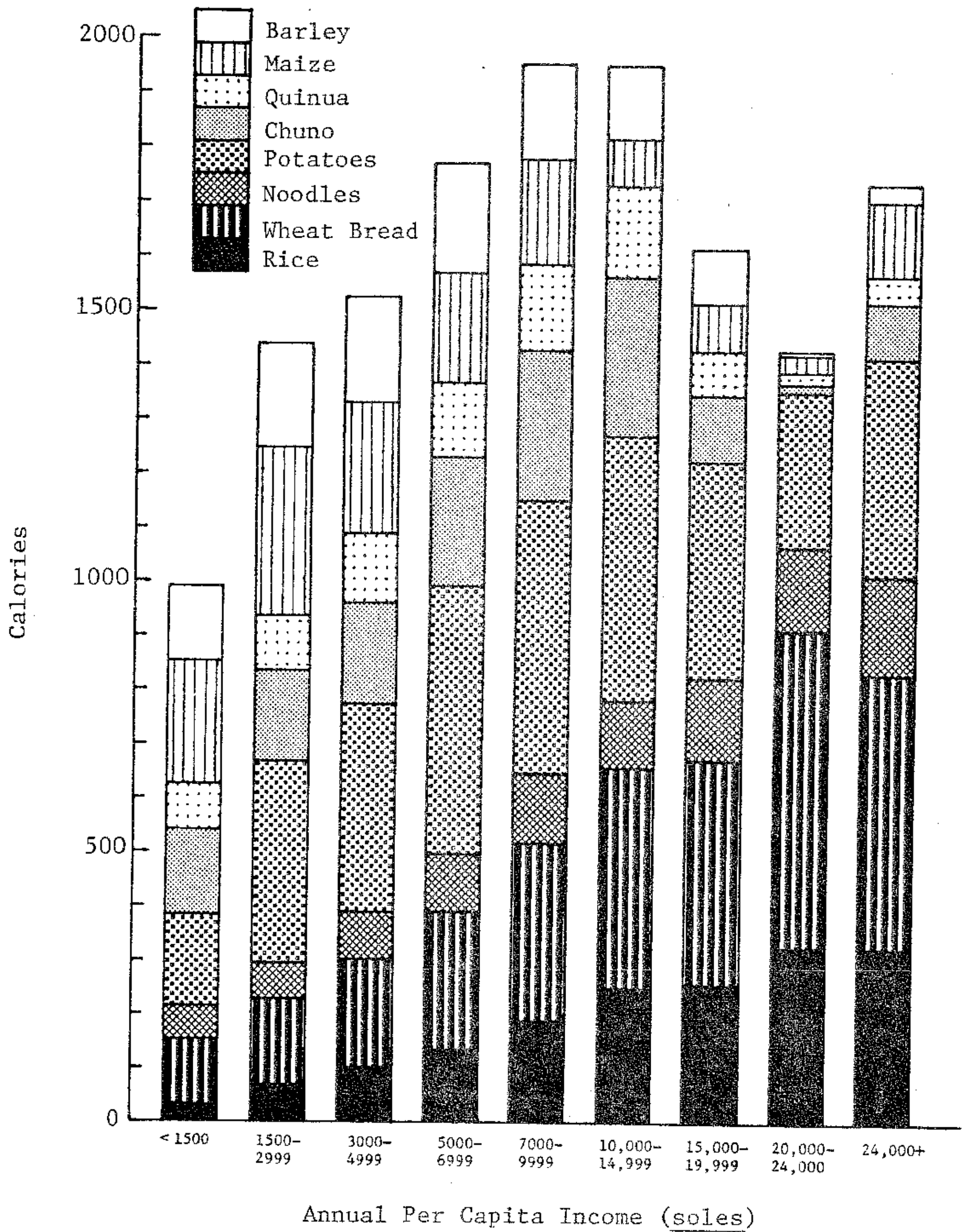
*Source: Peru, "Encuesta Nacional de Consumo de Alimentos (ENCA), 1971-72" (raw data).

TABLE 7.2. PERU: APPARENT DAILY CONSUMPTION OF CALORIES AND COMPOSITE CALORIE PRICES BY INCOME CLASS IN CENTRAL AND SOUTHERN SIERRA, 1971-72

Income Class	Frequency in Sample	Per Capita Income	Per Capita Daily Calories		Composite Calorie Price	Starchy Staple Ratio
			Starchy Staples	Total		
(soles, annual)					(1000 calories)	
< 1500	198	1,004	1,164	1,378	1.69	.88
1500-2999	522	2,232	1,521	1,854	2.73	.82
3000-4999	544	3,920	1,708	2,257	3.84	.75
5000-6999	311	5,929	1,928	2,604	4.51	.74
7000-9999	183	8,282	2,145	2,911	5.26	.73
10,000-14,999	114	12,024	2,148	2,968	6.25	.72
15,000-19,999	41	16,520	1,704	2,754	7.75	.61
20,000-24,999	17	22,094	1,278	3,231	7.52	.40
25,000+	28	45,849	1,824	3,230	11.47	.56
Average	(1958)	5,395	1,695	2,251	3.93	.75

Source: Peru,"Encuesta Nacional de Consumo de Alimentos, 1971-72"(raw data).

FIGURE 7.2. PERU: APPARENT DAILY CONSUMPTION OF CALORIES FROM MAJOR STARCHY STAPLES BY INCOME CLASS IN CENTRAL AND SOUTHERN SIERRA, 1971-72



Source: Peru,"Encuesta Nacional de Consumo de Alimentos, 1971-72" (raw data).

most preferred staples are wheat bread, rice and noodles. Their consumption seems to increase throughout the income range. Potatoes, chuno and quinua also belong to the category of preferred staples for a large section of the population in the lower half of the income range. Barley and maize are the less-preferred calorie sources; they are the first to be given up in favor of the fancier staples as income permits. They are also the relatively cheaper calorie sources. As indicated in Table 7.3, a thousand calories from maize and barley cost at least 15 to 20 percent less than what it costs to get a similar amount from rice.

In the next section, we examine these dietary preferences under the starchy staple consumption model introduced in Chapter V.

Estimation of the Consumption Model

In analyzing the 1,958 observations in the Sierra sample, the same procedures were used as in Indonesia, but not in the same degree of detail. Although the ENCA sample was also large, we did not have access to information on regions other than the Central and Southern Sierra, and even for these regions, we lacked individual food price information. Yet the data seemed to be rich enough to test the conceptual model of starchy staple consumption for the region as a whole. In estimating the demand equations, we were able to include a composite calorie price as an explanatory variable which was not possible in the case of Indonesia owing to the lack of quantity data for many foodstuffs. Conversely, we were unable to estimate the impact of prices of individual or groups of staples in the Peruvian study.

The main results of estimating the demand for calories from the less-preferred starchy staples--maize and barley--are given in Table 7.4. As with the Indonesian data, a series of regressions with dummy variables differently defined in each was run in order to identify the lower income range in which the consumption model would be best operative.

The expected Engellian relationship was best represented when all the observations were used in the estimation. The estimates of the coefficients of the income variables were highly significant in this regression. It must be noted that, unlike the case in Indonesia, consumption of calories from less-preferred staples did not show an increasing trend at the upper extreme of the income range. According to the results shown in Table 7.5, the per capita income level around which consumption of calories from less-preferred starchy staples is at a maximum is approximately 2100 soles as estimated using equation (5.3) in Chapter V. This result appears to be consistent with the pattern of consumption observed in Figure 3.6 in Chapter III. Up to this income level the income elasticity for these calories is indicated to be positive. Throughout the rest of the income range beyond it a negative income elasticity is indicated. This income level of 2100 soles provides the threshold where

TABLE 7.3. PERU: AVERAGE CALORIE PRICES OF MAJOR STAPLES IN THE COMBINED CENTRAL AND SOUTHERN SIERRA SAMPLE, 1971-72

Commodity	Price Per 100 Calories Soles (1971/72)	Index (rice = 100)
Rice	.314	100
Wheat Bread	.329	105
Noodles	.330	105
Potato	.477	152
Barley	.255	81
Maize	.266	85
Quinua	.362	115

*Source: Marco A. Ferroni, "The Urban Bias of Peruvian Food Policy: Consequences and Alternatives" (dissertation, Cornell University, 1980), p. 195.

TABLE 7.4. PERU: DEMAND FOR CALORIES FROM LESS-PREFERRED STARCHY STAPLES IN CENTRAL AND SOUTHERN SIERRA, 1971-72

	Estimated Coefficients	t Ratio
Intercept	-8.90	3.3
Income	3.83	5.8
Income Squared	-0.25	6.2
Calorie Price	-0.43	4.5
		R^2=0.10

NOTE: All variables are in natural logs.

Source: Peru,"Encuesta Nacional de Consumo de Alimentos, 1971-72" (raw data).

TABLE 7.5. PERU: DEMAND FOR CALORIES IN THE INCOME RANGE LESS THAN 6,000 SOLES IN CENTRAL AND SOUTHERN SIERRA, 1971-72

	Estimated Coefficients	t Ratio
Intercept	-5,859.22	13.7
Intercept*D[a/]	322.9	0.31
Income	1,090.10	18.23
Calorie Price	-739.4	17.26
Income*D[a/]	17.97	0.4
Calorie Price*D[a/]	-351.27	5.10
R^2 = 0.45		

NOTE: Dependent variable: per capita total calories per day. Explanatory variables are in natural logs.

a/ Dummy: incomes over 3,000 soles.

Source: Peru, "Encuesta Nacional de Consumo de Alimentos, 1971-72" (raw data).

quality considerations begin to be substituted for quantity considerations. For about 20 percent of the population in the sample, maize and barley--the less-preferred staples--are not inferior staples.[4/]

The effects of income and calorie price on per capita total calorie consumption were estimated using a semi-log function, the results of which are presented in Table 7.5. This estimation was designed to get a direct test on differences in the income and price effects between the lower income classes and the middle income classes. Accordingly, the estimation was limited to the observations below an income level of 6000 soles. Within this range, the middle income range was defined to be the income levels between 3000 and 6000 soles. This range was represented by a dummy variable. Using these results, daily per capita total calorie consumption at an income level around 2100 soles was estimated to be approximately 1800 calories.[5/]

These results also indicate a calorie income elasticity of around 0.60 at a calorie consumption level of 1800 calories. This appears as a reasonable estimate of the calorie response to income changes at a consumption level where, according to the tested hypothesis, only basic calorie requirements have been met. Between the two income ranges specified, the estimated price coefficients differ significantly. Using the coefficient of the price variable in the lower income range, a calorie price elasticity of 0.41 is estimated at a total calorie consumption level of 1800. The calorie price elasticity estimated at a calorie consumption level of 2150 is 0.51.[6/] Since an income of more than 3000 soles is required to achieve the recommended calorie consumption level of 2150, the price coefficient of the upper income range was used to derive a calorie price elasticity in this range. The difference in the calorie price elasticities observed at the two calorie consumption levels, though small in magnitude, is indicative of the difference in the relative importance of calories at the two levels of consumption. Usually, a larger response to price is associated with consumption of commodities considered less necessary.

4/ The proportion of the sampled population with per capita incomes of less than 2100 soles was estimated to be approximately 20 percent, by a linear interpolation of the relevant data points in Table 7.2.

5/ The average calorie price used to derive this estimate was 2.50 soles per 1000 calories. This calorie price was derived through a linear interpolation of data given in Table 7.2. An Engel's curve estimate derived using income only as the explanatory variable resulted in a similar estimate of the total calories at an income level of 2100 soles.

6/ On the basis of the recommended daily allowances by the FAO/WHO minimum and ideal per capita daily allowances of calories were estimated by Ferroni. The minimum allowances for Southern and Central rural Sierra were 1819 and 1756, respectively. The ideal allowances for the two areas were 2148 and 2123, respectively (12, p. 85).

Conclusions

The Central and Southern Sierra portion of the ENCA data set has enabled us to test the hypothesized consumption relationship between income and calories from less-preferred starchy staples. The results are satisfactory in relation to the estimates of the slope coefficients. But it is important to note the low explanatory power of the regressors, as indicated by the low R^2 of the overall regression reported in Table 7.4. There is an indication that, when incomes allow consumption of better quality diets, maize and barley are the two major starchy staples that will be substituted away first. Given the pattern of income distribution observed in 1971-72, they were important sources of calories for about a fifth of the population. Only when total daily per capita consumption reached around 1800 calories did the less-preferred staples begin to be substituted away. At this level of caloric consumption, small changes in the price of overall calories had only minimal effects on caloric consumption. At higher levels of caloric consumption, these price changes tended to have a greater impact, indicating that at higher levels of total calories, they were not as necessary as before.

CHAPTER VIII. FINDINGS AND THEIR IMPLICATIONS

This research was prompted by the current disagreement about the extent of malnutrition in the developing world. It was noted that the number of persons identified as nutritionally deprived in recent studies ranged from 0.4 to 1.2 billion. Such a range of estimates reflects the problems associated with determining realistic nutritional allowances for different populations, accounting for food availabilities, and measuring the impact of income on a population's access to food. Instead of adopting the usual methodology--or refinements of it--of matching food availabilities with nutritional recommendations to identify those malnourished, the present research was designed to test the viability of using revealed dietary preferences to make objective inferences about the perceived dietary adequacy or inadequacy of households.

It was hypothesized, following Poleman, that the point in the continuum of incomes where households begin to purchase calories from costlier but more preferred starchy staples instead of cheaper but less-preferred staples would provide a threshold reflective of perceived dietary adequacy. The rationale for this hypothesis was derived from Bennett's analysis of the evolution of diets that accompanied economic development in the West. He noted that the very poor would seek to maximize the nutritional return per unit of expenditure by building their diet around the cheapest starchy staples. As incomes increased, and the necessity for buying quantity alone diminished, quality considerations would begin to manifest themselves. The purpose of this research was to empirically test the validity of the behavioral approach in understanding the nutritional problem. It required a search for income-induced thresholds where significant substitutions of quality for quantity take place. While there may be more than a single way of monitoring income-induced quantity-quality shifts, it was found most reasonable, given the level of economic development and complementary food market structures prevailing in the developing world, to concentrate on the changes in dietary preferences within the starchy staples food group.

Methodology

The initial investigation into behavioral thresholds involved four countries from two continents: Sri Lanka and Indonesia from Asia and Brazil and Peru from South America. These countries have conducted socioeconomic surveys employing some of the most sophisticated methodology available. Although these surveys may not have overcome all of the problems of food and income accounting, they were, nevertheless, among the best available and have been widely used in serious attempts to analyze food and other social policies.

In the initial investigation, nationally aggregated data for the four countries were analyzed. The preliminary investigation offered an indication that important substitutions of quality for quantity do occur within the starchy staples food group. Accordingly, a closer examination was conducted on data from Indonesia and Peru.

Results

The following important results were found in relation to threshold behavior:

1. Sri Lanka provided a case where income-induced substitutions within the starchy staples food group occur between different qualities of the same basic commodity. Although rice is all-pervasive in the Sri Lankan diet, open market rice and rationed rice were apparently viewed as two different commodities by the average Sri Lankan consumer. In his preference hierarchy, rationed rice appeared to be the less-preferred; as incomes increased, the tendency was to consume more of the quality rice.

2. In Brazil, rice and wheat bread are the major preferred staples; cassava flour and maize constitute the less preferred. Income-induced shifts from quantity to quality were clearly evident as one moved from the poorest to the next income level.

3. In Indonesia, rice is the most cherished starchy staple: only among a very few at the highest income levels does rice consumption and income show a negative relation. For the poorest, cassava and maize--fresh cassava, dried cassava, cassava flour, fresh maize, dried maize and maize flour--are significant calorie sources. That they are generally less-preferred was clearly indicated by the substitutions that occurred when incomes increased. The identified thresholds indicated that quality substitutions took place at relatively low levels of expenditure.

   In the case of Indonesia, the analysis also revealed that the observed consumption behavior in the rural sector, which contains nearly 80 percent of the population, is more amenable to identification of a particular income threshold than is the urban sector. Further highlighted was the need to be cautious when selecting the starchy staples to be monitored. In the urban sector and rice producing areas, a different specification of the less-preferred starchy staples would have been in order.

4. In Peru, the average consumer in Central and Southern Sierra has a large bundle of starchy staples to choose from, but the revealed preferences in the ENCA data make it clear which ones are less preferred. Maize and barley, which play a significant role in the diets of the poorest, are soon substituted away, as

income increases, for the more preferred staples, potatoes, wheat bread and rice. In terms of thresholds, the Peruvian data gave clear evidence of the existence of income-induced dietary thresholds.

Nutritional Implications

The principal findings of this study are summarized in Table 8.1. In it appear the country-specific income thresholds and the levels of apparent per capita daily calorie consumption at which they occur.

In Sri Lanka, a significant substitution of quality for quantity seems to occur at a per capita monthly expenditure level of approximately Rs. 20. The approximate threshold calorie intake level of 1940 calories is the mean calorie intake reported at this expenditure level. As in the Sri Lankan case, threshold income and calorie intake levels are approximated in the case of Brazil, because of lack of disaggregated data. The Brazilian thresholds at the national level occur approximately at an annual per capita income level of 1200 cruzeiros with a per capita calorie consumption of around 1660 calories; in the North-Eastern region of Brazil, the comparative figures are 1100 cruzeiros and 1530 calories.

The Indonesian and Peruvian thresholds are more specific. In Indonesia, at the national level the threshold per capita monthly expenditure level and per capita daily calorie intake level are Rp. 1500 and 1250 calories; in the rural sector, the comparative expenditure and intake levels are Rp. 1800 and 1560 calories. In the rural areas of the regions where maize, cassava, and other roots and tubers are grown, the threshold expenditure level is estimated at Rp. 2100 with a corresponding calorie intake estimated at 1700. In the mountain regions of Peru, the threshold calorie intake level is around 1800 which is achieved at an annual income level of around 2100 soles.

When drawing any implications from the results, it is necessary to be aware of some of the limitations of the methodology. The less-preferred starchy staple consumption model is based on the fundamental premise that meeting of energy needs supercedes all other considerations in food consumption when choices are constrained by very low budgets. It may well be possible that some people perceive meeting of certain other nutrient needs, such as protein, equally important even under conditions of extreme poverty. This is an issue that has to be examined separately. Further, our results have been derived from data not collected for the explicit purpose of discerning behavioral thresholds among low-income consumers. These results, therefore, have to be viewed as broad approximations rather than precise estimates. Of crucial importance to nutrition are the estimates of calorie intake levels at the income thresholds. This follows from the hypothesis that the income thresholds are indicative of perceived nutritional adequacy. The concept of perceived nutritional adequacy can contain an explicit but limited meaning. The perception of adequacy is in relation to the most basic of the energy requirements. Beyond that, there may be many other less easily identifiable but important thresholds of perceived satisfaction of other nutritional needs.

TABLE 8.1. A SUMMARY OF BEHAVIORAL THRESHOLDS AND COMPARATIVE CALORIE INTAKE LEVELS*

	Sri Lanka	Brazil	Indonesia	Peru
Threshold income expenditure (per capita) a/	≈20 b/	≈1200 b/ ≈1100 c/	1500 b/ 1800 d/ 2100 e/	2100 f/
Threshold calorie intake estimate (per capita daily)	≈1940 b/	≈1660 b/ ≈1530 c/	1250 b/ 1560 d/ 1700 e/	1800
Recommended calorie intake (average daily per capita) g/	2200	2242	2100	2150

* Threshold estimates for Sri Lanka are based on published data in Sri Lanka, Department of Census and Statistics, Socio-Economic Survey of Sri Lanka, 1969/70 - Special Report on Food and Nutritional Levels (Colombo 1972).

Threshold estimates for Brazil are based on published data from Fundacao Instituto Brasileiro de Geografia e Estatistica, Estudo Nacional da Despesa Familiar: Consumo Alimentar Antropometrica; Dados Preliminares 4 vols. (Rio de Janeiro, IBGE, 1977).

Threshold estimates for Indonesia are based on raw data from National Socio Economic Survey - SUSENAS V - 1976 conducted by Central Bureau of Statistics, Indonesia.

Threshold estimates for Peru are based on raw data on Central and Southern Sierra section of the Encuesta Nacional de Consumo de Alimentos - ENCA - 1971-72, conducted by the Ministry of Agriculture, Peru.

a/ Sri Lanka: Monthly expenditure, 1969-70 rupees
Brazil: Annual income, 1974-75 cruzeiros
Indonesia: Monthly expenditure, 1976 rupiah
Peru: Annual income, 1971-72 soles

b/ At the national level.

c/ North-East region of Brazil.

d/ Rural sector in Indonesia.

e/ Rural sector in areas where maize, cassava and other roots and tubers are heavily consumed.

f/ Central and Southern Sierra of Peru.

g/ Sources:

Sri Lanka: Department of Census and Statistics, Socio-Economic Survey of Sri Lanka, 1969-70 - Special Report on Food and Nutritional Levels (Colombo 1972).

Brazil: Cheryl Williamson-Gray, Food Consumption Parameters for Brazil and Their Application to Food Policy (International Food Policy Research Institute, Research Report No. 32, Sept. 1982).

Indonesia: John A. Dixon and Rudolf S. Sinaga, "Food Consumption Patterns in Indonesia" (paper presented at the Third Asia Congress of Nutrition, October 6-10, 1980, Jakarta).

Peru: Marco A. Ferroni, "The Urban Bias of Peruvian Food Policy: Consequences and Alternatives" (unpublished Ph.D. dissertation, Cornell University, 1980).

In their crudest form, the estimated threshold calorie consumption levels among the four countries studied show substantial diversity. They range from 1250 calories estimated as the national threshold in Indonesia to the national-level threshold of 1940 calories in Sri Lanka. However, two of the threshold estimates must be dismissed as invalid. They are the national-level thresholds estimated for Brazil at 1660 calories and for Indonesia at 1250 calories.

The less-preferred starchy staple in the Brazilian case was cassava. But the importance of cassava as a source of calories is most pronounced in the North-East region of the country. In other regions, cassava consumption is less important and the substitutions to be examined occur between other foods. Therefore, it is necessary to be region-specific in the analysis of Brazilian data. The threshold observed in the North-Eastern part of Brazil--1530 calories--is thus the only valid one.

The Indonesian average threshold should be dismissed on similar grounds. It was observed that the less-preferred calorie sources--maize, cassava, and other roots and tubers--play a far less important role in the urban sector than in the rural sector. In the urban sector, the substitutions to be monitored are between foods other than these staples, the various qualities of rice. Because of this misspecification of the commodities with regard to the urban sector, the average results do not provide a realistic threshold. The rural sector thresholds are the ones to be considered--1560 calories estimated for the overall rural sector of Indonesia and 1700 calories estimated for the rural sector in regions where maize, cassava, and other roots and tubers are relatively in better supply.

Although the aggregated data for Sri Lanka do not provide sufficient information for a clear identification of the thresholds, the observed rice consumption patterns allow reasonable inferences to be made. The fact that a part of a free low-quality rice entitlement was foregone for the sake of better quality rice (even among the poorest consumers) is suggestive of threshold behavior. The average per capita daily calorie consumption in the less than Rs. 20 income class is estimated at 1940. Considering the fact that a free quantity of rice has been made available and the income effect of this free ration, it may not be unreasonable to expect even the poorest households have a calorie consumption level not too different from this average.

The North-East Brazilian estimate of perceived calorie adequacy was not derived out of a precise threshold. It is from the evidence of clear substitutions seen in the case of the lowest reported income aggregation. The North-East Brazilian threshold so derived points to a calorie consumption level of 1530, which appears to be relatively low compared to the other thresholds identified. The observed low intake level may be either a result of poor data or, perhaps, a true reflection of minimal calorie needs. The ENDEF methodology incorporated some of the most refined consumption survey techniques and there is almost no serious discussion of the possibility of underreporting in this survey. Nevertheless, cassava flour consumption may have been underreported, given its low social status. This calorie source is considered a typical poor man's food in a society where rapid social changes are occurring due to urbanization and modernization. ENDEF data have been widely used to understand the living conditions in Brazilian society, but some of the findings appear to be confusing. Williamson-Gray, who conducted an intensive analysis of the ENDEF findings, raises the question as to why persons whose calorie consumption is more than 400 calories below their recommended requirements would have an income elasticity of calorie intake as low as 0.22 (43, p. 35). Having observed a tendency to substitute quality for quantity even by the poorest of the reported income classes, she expresses the suspicion that, although a large number of Brazilians do not meet recommended calorie levels, they may in fact not be acutely hungry (43). In an analysis of the same data set, Bhalla observed that those who consume only 80 percent of the recommended calorie intake choose to consume nonfood items rather than food. This behavior suggests "either that the data understates (sic) calorie intake and/or that the nutritional requirements have been overstated" (2, p. 89). If the present data have understated food consumption, then better data should reveal a higher level of calorie consumption at the behavioral threshold. If data problems have been minimal, the observed calorie consumption level at the lowest income aggregation may be a realistic representation of minimum energy requirements as inferred from the clear substitution of quality for quantity in starchy staples consumption.

In Indonesia, the threshold calorie intake level observed in the rural sector of areas where less-preferred starchy staples are grown is around 1700 calories. Though this figure may be representative of basic energy requirements of these populations, one cannot ignore some of the data problems. Other analyses of SUSENAS V data have pointed to the possibility that there may be serious underreporting of consumption by the lower income classes (7, 8). Justification for such a belief can arise from certain aspects of social behavior and also from the survey methodology.

In the first place, as Dixon pointed out, the poor may perceive it socially enhancing to underreport consumption of the poor-man's food--maize, gaplek and the like. This social motivation may be found in both rural and urban societies, but is probably more common in the cities, where demonstration effects have a greater propensity to influence society. Second, the SUSENAS V methodology, by using the recall method of data collection, may also have indirectly contributed to underreporting. It is well known that memory lapses, even over a short period of time, may be substantial. Compounding this was the sampling error which led to overrepresentation of the urban households in the sample. There is also the very real possibility that calorie consumption may have been undercounted as a result of the failure to record quantity information on the consumption of a large number of foodstuffs--especially fruits, nuts, vegetables and prepared foods. Although expenditure on these items was, on the average, less in the rural areas than in the urban, these foods are important contributors to total calories. The methodology that was adopted to count these unknown calories was obviously not perfect and may have contributed to the abnormally low total calorie figures.

The Peruvian threshold indicates perceived energy adequacy at approximately 1800 calories. This threshold is for a population that lives in the mountain regions of Peru. The Peruvian results are from a sample where a stronger case for accuracy can be made on methodological grounds. The ENCA sample was self-weighted and drawn in three stages, and the probability of selection of primary and secondary sampling units was proportional to the population size. This procedure avoided oversampling of any particular sector. In addition, the Sierra sample used in our analysis contained a relatively small number of urban observations--which minimized urban-biases in food consumption reporting. Compared with the Indonesian survey, the Peruvian sample contains better information on food consumption. Not only were all food items recorded by quantity and by their nutritional content, but the enumerators were also instructed to weigh the commodities and estimate actual consumption by those present at meal time. These thorough steps do not necessarily mean that all inaccuracies have been eliminated, but they do provide a stronger basis for reliability.

A striking feature of the threshold calorie intake levels reported in Table 8.1 is that they all fall below the officially recommended intake levels. This is not surprising considering the fact that the recommended allowances are not minimum requirements. The recommended calorie intake levels shown in Table 8.1 have been derived on the basis of FAO/WHO specifications for recommended levels of intake. The problems associated with devising minimum calorie standards were discussed in detail in Chapter II. Suffice it to say that recommended average intake levels are consciously overstated to take care of imprecise knowledge. The fact that the recommended allowances do not provide a suitable basis for defining minimum calorie requirements has been clearly brought out by the adoption of a lower standard by the FAO in recent studies.

The new minimum critical level of calorie requirements, which is estimated at 1.2(BMR), was adopted to minimize the possibility of counting adequately nourished persons as malnourished. The 1.2(BMR) criterion for minimum needs is by no means universally accepted, nor are the procedures to be used in adjusting it to suit particular country situations. On the whole, this new methodology seems to contain a substantial degree of arbitrariness.

The minimum energy requirements derived from the behavioral threshold approach are based on the preferences of the consumers. To the extent that the basic assumptions underlying the threshold approach are reasonable, the threshold calorie intake levels may be fair indications of the minimum amount of calories required to meet basic energy needs. That these in fact are reasonable proxies for minimal needs is further suggested by some of the additional results observed in Peru, and particularly the calorie price elasticity differences at different calorie consumption levels. It is likely that monitoring of (total) calorie price elasticities holds better promise than using income elasticities in understanding minimum critical energy needs. The reason for this is that consumption of calories is not merely a function of energy needs alone. Calories are consumed irrespective of whether food consumption has been for the purpose of meeting energy needs or for some other purpose.

It was observed that the Sierra consumer at a daily consumption level of around 1800 calories allows total calorie price change to affect calorie consumption to a significantly lesser degree than do consumers at higher levels of calorie consumption. The calorie price elasticity relevant at the recommended level of calorie consumption carries the implication that calories per se have become less important as a necessity and that they could be substituted away for other needs.

It was not possible to search for such a phenomenon in Indonesia because of the data limitations. But a study by Ahluwalia, cited in 2, indicates that the case may be true for Indonesia too. Using evidence for urban Java and for the period 1970-1976, he has concluded that changing prices began to have a significantly different effect on calorie consumption among consumers having intakes above the relatively low level of 1750 calories.

What can be concluded regarding the nutritional implications of our application of the threshold concept? One must be cautioned that the results are tentative in the sense that they were based on data which were not collected for the express purpose of discerning thresholds in the food consumption behavior of the relatively low income classes. The samples used in the analysis have been drawn on demographic guidelines; they have been designed to reflect populations as a whole and not particular social groups. A sample drawn with a heavy emphasis on the poorer sections of the population would be more suitable for examination of threshold behavior. Yet, the results obtained in this study have major implications. Most importantly, they confirm the broad validity of the threshold approach to hunger quantification. Properly used, it could be a powerful new tool to enable governments and international agencies to specify with considerable precision the number of persons at risk nutritionally. Secondly, they strongly suggest that the energy requirement figures used in the traditional methodologies for estimating the extent of hunger--those derived from officially recommended dietary allowances--are too high and therefore that these methodologies have exaggerated the problem. Finally--and this is very tentative--they suggest that minimum energy needs of large and diverse population groups are likely to fall somewhere within the range of from 1500 to 1950 calories per person per day.

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