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9. ABSTRACT

The food balance sheet technique has been employed by food economists and others for over 20 years. Developed by the Food and Agriculture Organization of the United Nations (FAO) just after World War II to aid in the assessment of food supplies in postwar Europe, it has undergone streamlining, standardization, and extensive use since that time. Despite the fact that reliable data for the compilation of food balance sheets are frequently not available in the underdeveloped areas of the world, estimated levels of apparent availability of foodstuffs derived from the balance sheet have a widely accepted as valid indicators of the national nutritional status of these countries. Translated into the usual common denominators-calories and grams of protein and fat-these figures have been used to rank nations as to degree of "nourishment" or "malnourishment" of their populations. They have also provided a statistical basis for the encouragement of food production efforts and marketing schemes and for the establishment of various national and international food policies: nutritional education, school lunch programs, food aid plans, and the like.

What follows is divided into 5 parts. Part II deals with the compilation and findings of the food balance sheet. In Part III the household budget survey is analyzed on an island-wide aggregated basis. Part IV compares the results of the food balance sheet and the budget survey. In Part V divergences from the average are discussed with regard to differences in location of residence, ethnic origin, and income levels. Part VI summarizes our conclusions and examines the usefulness of food balance sheet averages as parameters of tropical food economies.

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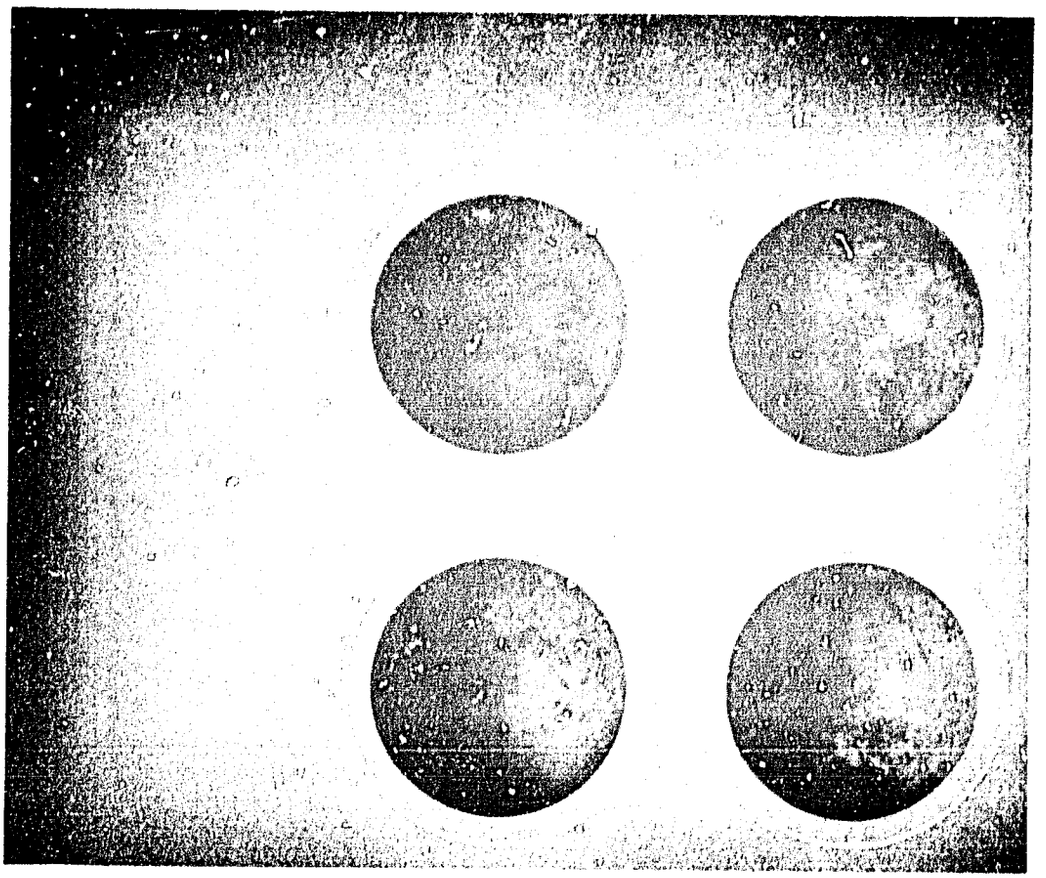

The Food Balance Sheet as a Parameter of Tropical Food Economies: The Case of Mauritius

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and
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Preface

The primary focus of this paper is on the strengths and weaknesses of the food balance sheet as an indicator of national nutritional status in low-income, tropical countries.

It is widely recognized that in high-income countries of the temperate zone, dietary patterns vary substantially among income levels and regional groups. This variation is well-documented with available data; consequently, national average figures are rarely used for planning purposes.

On the other hand, in low-income, tropical countries, there has been a tendency to accept and use food balance sheet results as meaningful indicators of nutritional status. Data on variation among racial groups, income levels, or regional populations are generally lacking and the universality of the poverty level frequently assumed.

Data from Mauritius are used in this study to explore the validity of these assumptions. The island was chosen for several reasons:

- Mauritius is a small, well-documented food economy.
- It is, in fact, virtually the only tropical food economy that can be accurately quantified.
- The population of the island is ethnically diverse and the range of income levels fairly broad.

Analysis of the Mauritian data falls logically into two stages. First, a comprehensive and reliable food balance sheet can be prepared from national production and trade data. Second, the findings of a detailed household budget survey can be used to illustrate the conformity of the individual consumption patterns with the expected dietary norm.

The Mauritian budget survey of 1961/62 is well suited to this comparison:

- The frame of the survey is the entire country; the sample is representative of more than 90 percent of the population.
- The survey was conducted during a 12-month period. Each household was sampled for 2 weeks, one in each of the 2 Mauritian agricultural seasons.
- Survey information on food consumption includes both quantity and expenditure data in great detail.
- Data on household size, age and sex structure, location, ethnic group, and expenditure class were also included.

In addition to comparisons of the food balance sheet and budget survey, a secondary product of this study is the derivation of nutritional benchmarks for other tropical Asian economies. Because Mauritius has a comparatively high per capita level of income and because a majority of the population is of Asian origin, food habits in the island may well be indicative of what can be expected in other areas of tropical Asia in the future.

The paper is adapted from Mrs. Simmons' M.S. thesis and is one of a series of inquiries into the food economies of tropical countries carried out under my direction. It is a pleasure to record that in its original form the paper was judged by the awards committee of the American Agricultural Economics Association to be the outstanding M.S. thesis completed in 1968. Mrs. Simmons devoted well over a year to the project, 3 months of which were spent in Mauritius. As so many Mauritians were of assistance, their names are listed in Appendix E. However, a special word of thanks is due here to the island's premier, The Honorable Sir Seewoosagar Ramgoolam, whose interest and help facilitated our task tremendously.

Guidance throughout on nutritional matters was provided by Professor A. G. van Veen, who at the time added distinction to Cornell's Graduate School of Nutrition.

Grateful acknowledgment is made of the generous financial support provided by the Foreign Demand and Competition Division of the United States Department of Agriculture's Economic Research Service. The study is one product of an investigation of world food and feed consumption and related production and distribution problems conducted under a cooperative agreement between the USDA and Cornell University.

Until recently Mrs. Simmons was on the staff of the Rural Economy Research Unit at Ahmadu Bello University in Nigeria. Her current mailing address is:

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It is my personal pleasure to recognize the superior work of a superior student.

T. T. P.

August 1973

The Food Balance Sheet as a Parameter of Tropical Food Economies: the Case of Mauritius

Emmy Bartz Simmons* and Thomas T. Poleman†

I. Introduction

The food balance sheet technique has been employed by food economists and others for over 20 years. Developed by the Food and Agriculture Organization of the United Nations (FAO) just after World War II to aid in the assessment of food supplies in postwar Europe, it has undergone streamlining, standardization, and extensive use since that time. Despite the fact that reliable data for the compilation of food balance sheets are frequently not available in the underdeveloped areas of the world, estimated levels of apparent availability of foodstuffs derived from the balance sheets have been widely accepted as valid indicators of the national nutritional status of these countries. Translated into the usual common denominators—calories and grams of protein and fat—these figures have been used to rank nations as to degree of "nourishment" or "malnourishment" of their populations (cf. 12; 24; 62; 63). They have also provided a statistical basis for the encouragement of food production efforts and marketing schemes and for the establishment of various national and international food policies: nutritional education, school lunch programs, food aid plans, and the like.

Helen Farnsworth has suggested that too much emphasis has been placed on comparing average nutritional levels and that there are "more appropriate and more promising applications" of the balance sheet technique (20:198). She includes the improvement of statistics of national food production and utilization, the measurement of changes over time in the pattern of food consumption, and the estimation of changes in the contributions of the agricultural sector and primitive food processors to the gross national product of the individual countries as such applications. Crucial to her argument is the question of whether the balance sheet's "defects are mostly of minor significance and mutually offsetting

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or whether they are large enough to distort the indicated levels and patterns of national food consumption" (20:181).

Our aim here is to investigate the food balance sheet of a low-income country where the defects of the data employed can be shown to be "mostly of minor significance" and thus where mean levels of nutrient availability can presumably be stated about as accurately as will ever be possible. Do the parameters of the food balance sheet convey a valid impression and may one generalize from them? Or do individual food habits vary so greatly that the notion of a national average is virtually meaningless?

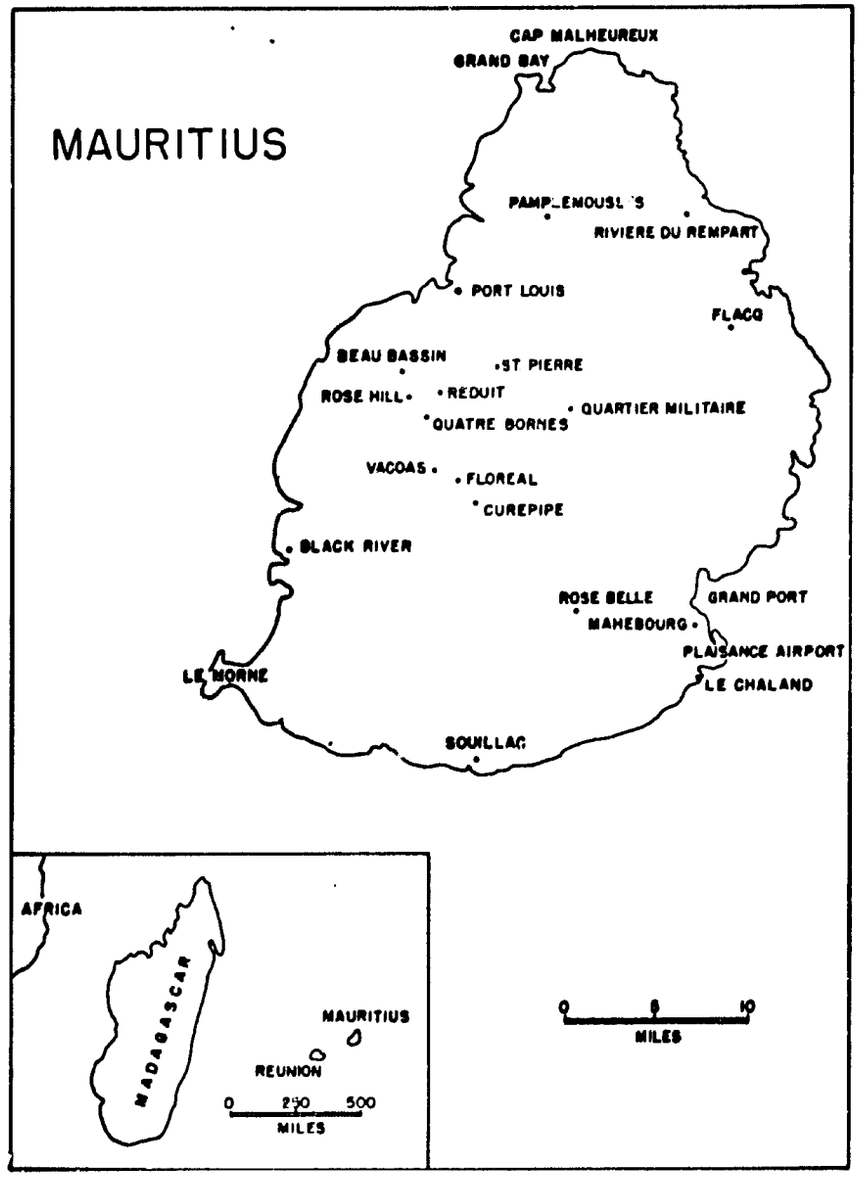
For such an inquiry Mauritius is ideally suited. An island of only 720 square miles but with almost a million inhabitants, it imports nearly 75 percent of its total food supply. Its nearest large neighbor is Madagascar, 550 miles to the west (map 1). Unrecorded entries of foodstuffs into the island are, by reason of its isolation, small. The major, and nearly sole, food product to leave Mauritian shores is raw sugar. Over 90 percent of all cultivable land is devoted to the production of sugar; and of the remaining 8 percent about half is planted to tea.

Sugar dominates the Mauritian scene, economically as well as visually, having consistently accounted for about 35 percent of the gross national product since at least the early 1950s (50:15; 42:13). It is not an unmixed blessing. Whereas 35 percent of the economically active population was estimated to be directly associated with the industry during the year 1960[1], increasing pressures to cut costs through further mechanization have been felt (50:11–14; 10). As yet, no significant alternative source of employment has been found.

Thus, there is virtually no subsistence food production on the island. The entire food economy is highly dependent on sales of one crop, which is in turn, highly dependent on the weather. Mauritius is situated in an area of tropical trade winds; occasionally the summer calm erupts into violent, destructive cyclones. In 1960, for example, two such cyclones reduced the sugar yield by half and destroyed numbers of homes and trees as well as many food crops. The gross national product dropped from Rs. 683 million in 1959 to Rs. 605 million in 1960.

To minimize both the climatic influence on annual food supply and the effects of changes in stocks, we have computed our food balance sheet as a 5-year average. The years chosen, 1960 through 1964, present several advantages. A population census was taken midway in the period, making it possible to have an accurate figure to use in converting national data to a per capita basis. A household budget survey, which is considered later for comparative analysis, was also conducted about halfway through the period—from June 1961 to June 1962. This should make the results of the food balance sheet and the household budget survey reasonably comparable.

[1]Burton Benedict, one of the foremost students of Mauritius, estimates that more than half of the population is dependent on the sugar industry (5).



Map 1. **Mauritius, with inset showing size and position relative to Madagascar.**

Most of the Mauritian population is of Indian origin. Substantial numbers of Creole, French, English, and Chinese persons contribute to the variety of tongues and customs that characterize Mauritian life. The proportions of the population in the major ethnic groups and the per-

Table 1. **Mauritius: ethnic composition of population, total and urban,— June 30, 1962***

Racial group	Total population	Urban population†
	percent	
All	100.0	31.1
Hindu	50.6	20.2
Muslim	16.2	13.7
General‡	29.9	18.7
Chinese	3.4	68.2

*Data from 41:I,6;II,17,24.
†"Urban" areas are the towns of Port Louis, Curepipe, Rose Hill, Beau Bassin, Vacoas/Phoenix, and Quatre Bornes.
‡"General" includes all those not designated otherwise—French, Creole, English, and other European are most dominant.

centage of each group that live in towns are indicated in table 1. The heterogeneity of ethnic backgrounds and the differences in patterns of residential location imply some measure of variety in dietary patterns. If the divergences from the "average" diet shown in the food balance sheet are large (indicating sharp differences due to ethnic origins and/or location of residence), the food balance sheet values automatically become less meaningful and instructive.

Conversely, if it can be shown that common residence on a small island has tended to meld diverse ethnic dietary patterns into a more homogeneous one and to minimize the rural-urban differences, the food balance sheet will in fact reflect the typical Mauritian's dietary pattern.

What follows is divided into 5 parts. Part II deals with the compilation and findings of the food balance sheet. In Part III the household budget survey is analyzed on an island-wide aggregated basis. Part IV compares the results of the food balance sheet and the budget survey. In Part V divergences from the average are discussed with regard to differences in location of residence, ethnic origin, and income levels. Part VI summarizes our conclusions and examines the usefulness of food balance sheet averages as parameters of tropical food economies.

II. The Food Balance Sheet for Mauritius

Comprehensive information on the net food supply available for human consumption may be presented by a food balance sheet. This is a method for bringing together data on the supply and use of various individual foodstuffs available to a country in a given period of time. The supply side of a balance sheet is made up of domestic production, net trade, and net changes in year-end stocks. On the utilization side are: seed use, animal food, waste on the farm and in distribution up to the

Table 2. **Mauritius: food balance sheet, 1960–1964**
(Population: 681,619 on June 30, 1962)

Foods	Production	Imports	Exports	Supply	Seed	Nonfood uses	Waste	Net food supply	Per capita				
									kg./yr.	gr./day	cal./day	Protein (gr./day)	Fat (gr./day)
	metric tons per year												
Cereals													
Rice, government	—	56,651.1	n.a.*	56,651.1	—	—	1,133.1	55,521	81.455	223.2	801.3	15.8	2.5
Rice, trader's	—	11,511.1	1,553.8	10,007.6	—	—	200.2	9,807	11.588	39.4	111.1	2.8	0.4
Wheat flour	—	25,692.4	132.2	25,560.2	—	—	511.2	25,049	36.779	100.7	351.1	9.9	1.3
Groats & cereals	—	81.6	—	81.6	—	—	—	82	0.120	0.3	1.2	—	—
Macaroni	—	118.4	—	118.4	—	—	—	118	0.173	0.5	1.8	—	—
Bakery products	—	191.0	0.6	190.4	—	—	—	190	0.279	0.8	3.9	—	0.2
Meal & flour, n.e.s.	—	1,537.6	0.2	1,537.4	—	—	—	1,537	2.255	6.2	32.5	0.5	0.1
Cereal preparations, n.e.s.	—	95.0	—	95.0	—	—	—	95	0.139	0.4	1.4	—	—
Total								92,399	135.558	371.5	1,331.9	29.0	4.5
Starchy roots													
Potatoes, Irish	4,107.8	4,281.2	0.6	8,388.4	654	—	667.4	7,017	10.295	28.2	19.7	0.5	—
Sweet potatoes	703.0	n.a.†	—	703.0	—	—	70.3	633	0.929	2.5	2.4	—	—
Manioc, arouille	920.2	2.6	—	922.8	—	201.7	72.1	649	0.952	2.6	2.6	—	—
Flours & flakes of potatoes, vegs., etc.	—	215.0	—	215.4	—	—	—	215	0.315	0.9	3.1	—	—
Total								8,514	12.491	34.2	27.8	0.5	—
Sugars													
Sugar, raw	485,917.8	—	479,139.2	6,778.6	—	—	—	6,779	9.945	27.2	95.5	0.3	—
Sugar, refined	19,333.2	72.0	332.7	19,072.5	—	—	—	19,073	27.981	76.7	296.8	—	—
Candy, confectionery	—	281.4	10.2	271.2	—	—	—	271	0.398	1.1	3.9	—	—
Total								26,123	38.321	105.0	396.2	0.3	—

Table 2. (continued)

Foods	Production	Imports	Exports	Supply	Seed	Nonfood uses	Waste	Net food supply	Per capita				
									kg./yr.	gr./day	cal./day	Protein (gr./day)	Fat (gr./day)
	metric tons per year												
Pulses and nuts													
Pulses, dried	—	6,018.6	60.8	5,987.8	—	—	—	5,988	8.785	24.1	81.9	5.3	0.4
Groundnuts (in shell)	108.6	281.6	—	693.2	—	—	—	693	1.017	2.8	10.9	0.5	0.9
Edible nuts, n.e.s.	—	71.4	0.6	73.8	—	—	—	74	0.109	0.3	0.8	—	0.1
Coconuts, ripe	—	846.0	—	846.0	—	—	—	846	1.241	3.4	5.5	0.1	0.5
Coconuts, immature	178.0	—	—	178.0	—	—	—	178	0.261	0.7	0.4	—	—
Total								7,779	11.413	31.3	99.5	5.9	1.9
Vegetables													
Tomatoes	5,419.8	—	—	5,419.8	—	—	511.9	4,908	7.196	19.7	37	0.2	0.1
Green & leafs	9,508.4	5.1	—	9,513.5	—	—	951.4	8,562	12.561	34.4	6.9	0.7	0.1
Other fresh & frozen	13,181.2	2,360.8	212.4	15,329.6	—	—	1,318.1	14,012	20.557	56.3	12.4	0.8	0.1
Dried, tinned	-	388.2	1.8	386.4	—	—	38.6	348	0.511	1.1	0.8	—	—
					—	—							
Total					—	—		27,827	40.825	111.8	23.8	1.7	0.3
					—	—							
Fruits													
Citrus	n.a	1,153.0	29.4	1,123.6	—	—	112.4	1,011	1.483	4.1	1.5	—	—
Apples	—	198.8	6.0	192.8	—	—	19.3	111	0.551	1.8	0.9	—	—
Other, fresh	2,676.8	234.0	0.2	2,910.6	—	—	291.1	2,620	3.844	10.5	4.3	0.1	0.1
ained	—	213.4	1.4	212.0	—	—	—	212	0.311	0.9	2.4	—	—
Preserved, prepared	—	215.2	0.2	215.0	—	—	—	215	0.359	1.0	1.3	—	—
Juices (1000 litres)	—	216.2	—	216.2	—	—	—	216	0.317	0.9	1.2	—	—
Total								4,718	6.965	19.2	11.1	0.1	0.1
Meats													
Beef	1,013.2	1,638.8	—	2,651.0	—	—	—	2,651	3.891	10.7	24.1	1.6	1.9
Pork	306.4	72.4	—	478.8	—	—	—	179	0.703	1.9	7.5	0.2	0.7
Goat	260.1	—	—	260.1	—	—	—	260	0.381	1.0	1.2	0.1	0.1
Mutton, Lamb	78.2	425.2	—	503.4	—	—	—	503	0.738	2.0	4.8	0.2	0.4

Venison	38.5	—	—	38.5	—	—	—	39	0.057	0.2	0.2	—	—
Poultry	131.5	131.6	—	266.1	—	—	—	266	0.390	1.1	1.3	0.1	0.1
Other (incl. offals)	n.a.‡	180.2	0.6	179.6	—	—	—	180	0.264	0.7	0.9	0.1	—
Dried, salted, smoked	—	95.0	0.2	94.8	—	—	—	95	0.139	0.4	2.0	0.2	0.1
Tinned, prepared	—	296.8	0.6	296.8	—	—	—	297	0.436	1.2	2.8	0.3	0.2
Total								4,773	7.002	19.2	11.8	2.8	3.5
Eggs													
Fresh hens'	1,228.8	38.6	0.1	1,267.3	—	—	—	1,267	1.859	5.1	7.3	0.6	0.5
Fish													
Fresh (all kinds)	1,125.2	484.1	0.2	1,609.1	—	—	—	1,609	2.361	6.5	4.0	0.6	0.2
Salted, smoked, dried	—	1,335.1	0.6	1,334.8	—	—	—	1,335	1.959	5.4	9.6	1.5	0.4
Crustacea, molluscs	20.8	181.6	2.6	199.8	—	—	—	200	0.293	0.8	0.2	—	—
Tinned	—	1,100.2	0.1	1,099.8	—	—	—	1,100	1.614	4.4	9.7	0.9	0.7
Octopus	192.2	109.2	—	301.1	—	—	—	301	0.442	1.2	8.8	0.2	—
Total								4,545	6.669	18.3	32.3	3.2	1.3
Milk, milk products													
Fresh, whole, cows'	18,000.0	15.8	—	18,015.8	—	—	—	18,016	26.431	72.4	43.1	2.1	2.2
Condensed, sweetened	—	743.0	21.0	722.0	—	—	—	722	1.059	2.9	9.7	0.2	0.2
Dried (all kinds)	—	1,958.7	26.1	1,932.6	—	—	—	1,932	2.834	7.8	36.6	2.2	1.8
Cheese (all kinds)	—	160.3	0.2	160.1	—	—	—	160	0.235	0.6	1.8	0.1	0.1
Milk foods	—	305.5	—	305.5	—	—	—	306	0.450	1.2	4.6	0.2	0.1
Total								21,136	31.009	84.9	96.1	5.1	4.4
Fats and oils													
Soya oil	—	1,160.0	0.4	1,159.6	—	—	—	1,160	6.515	17.9	158.2	—	17.9
Cottonseed oil	—	1,370.1	32.5	1,133.8	—	—	—	1,131	1.661	4.6	40.7	—	4.6
Coconut oil	—	523.1	11.2	509.2	—	509.2	—	—	—	—	—	—	—
Oil from seeds, nuts, n.e.s.	—	1,018.2	7.0	1,011.2	—	—	—	1,011	1.527	4.2	37.1	—	4.2
Margarine	—	1,208.6	20.0	1,188.6	—	—	—	1,189	1.711	4.8	34.6	—	3.9
Shortening, ghee	—	76.0	—	76.0	—	—	—	76	0.111	0.3	2.6	—	0.3
Butter	—	339.8	12.6	327.2	—	—	—	327	0.480	1.3	9.3	—	1.1
Total								8,227	12.069	33.1	282.5	—	32.0

Table 2. (continued)

Beverage	Production	Imports	Exports	Supply	Seed	Nonfood uses	Waste	Net food supply	Per capita				
									kg./yr.	gr./day	cal./day	Protein (gr./day)	Fat (gr./day)
	litres												
Alcoholic beverages													
Beer	1,120,771.6	2,189,552.6	71,998.2	3,535,326.0	—	—	—	3,535,326	5.187	14.2	4.0	—	—
Wine	5,112,599.1	133,923.0	216,003.8	5,300,518.6	—	—	—	5,300,519	7.776	21.3	23.1	—	—
Cider	—	15,972.1	—	15,972.1	—	—	—	15,972	0.067	0.2	0.1	—	—
Spirits	1,515,755.8	†33,152.6	10,625.8	1,638,282.6	—	—	—	1,638,283	2.404	6.6	14.7	—	—
Total								10,520,100	15.434	42.3	42.2	—	—
Total											2,398.8	19.2	88.5

•All rice exports and reexports are deducted as "Rice, trader's".

†Imports of sweet potatoes are included as imported vegetables.

‡Some offals are sold from local slaughterhouses, but the quantity is not available.

"retail level", industrial nonfood use, the processing or extraction losses involved in turning the product (especially cereals and oil seeds) into the form in which it is usually sold, and the net food supply available for human consumption. The latter is customarily converted into nutritional content (calories and grams of protein and fat) available per capita per day.

A food balance sheet for Mauritius is given in table 2. Changes in stocks have been ignored for the most part because the period of time chosen for analysis is an average year. The 5 years, 1960–1964, over which this average was taken are assumed to have been ample time to even out significant fluctuations of stocks that may have occurred after a particularly productive or destructive season. Feed and manufacturing uses are combined into the simplified category, *Nonfood uses*, in the Mauritian case, because neither livestock consumption nor the manufacturing sectors using inputs of foodstuffs are significant.

Sources of Data

Many food balance sheets are built around data that contain a large element of conjecture, either by the persons who compile the original data or by the author himself, especially regarding local food production. While even in a country as small as Mauritius not all local production is accounted for by ordinary statistical procedures, the size of the island vastly lessens the problem of supplementary estimation. The Extension Division, the Fisheries Division, and the Veterinary Department of the Department of Agriculture provided most of the estimates of local commodity production used in the balance sheet. In the few cases where a judgment as to the "best" estimate was required, the opinions of officials associated with these departments were taken into account. The work of A.S.M. Hall and the Marketing Board are cited in Appendix A with special reference to products (primarily local milk and potatoes) handled by that organization. The Census of Industrial Production, conducted by the Central Statistical Office in 1964, is the source of information about local food processing. All other data sources are included in the detailed discussion of the food balance sheet items presented in Appendix A.

Trade in Mauritius is subject to close surveillance and quantification because only the harbor of Port Louis is large enough to be used by ocean-going vessels. Most imported foodstuffs are subject to tariff, but because of the geographical situation, evasion of duty is not a practical enough incentive to affect accurate reporting of imports. Since the country is highly dependent on the revenues from sugar exports, exports are also reliably reported. Because of Mauritius' economic dependence on trade, the annual reports of the Department of Customs and Excise have been heavily relied upon as major sources of export and import data. Additional information on sugar trade was obtained from the reports of the Chamber of Agriculture.

Only one significant source of food in Mauritius is not subject to customs duties. Imports from the nearby island of Rodrigues and the few other small dependencies are not taxed, but they are recorded by both the Department of Customs and Excise and the Department of Agriculture. These figures were cross-checked and, in some cases, the more detailed and descriptive accountings given by the Department of Agriculture were found preferable.

The nutritional conversion factors used in deriving the last 3 columns of the balance sheet are from both regional and international food composition tables. Imported foods are given the values applicable to the region of origin; the nutrient values of locally produced commodities have been based primarily on the international average values employed by the FAO (23). These have been adjusted with results of proximate composition analyses done in Mauritius in 1944 and with other local information (cf. 67). The factors employed and their sources will be found in Appendix B.

Balance Sheet Results

The food balance sheet compilation yields an apparent availability of some 2400 calories daily for an "average" Mauritian. More than half of these calories are from cereals; approximately 40 percent are from rice alone. Moreover, cereals account for almost 60 percent of the available protein, suggesting a protein supply of a rather "low" quality.

Sugar and fats and oils are the next most important contributors of calories in the Mauritian diet, supplying 16 percent and 12 percent of

Table 3. **Mauritius: food group totals, food balance sheet 1960–1964***

Food group	Daily per capita supply			
	Grams	Calories	Protein (gr.)	Fat (gr.)
Cereals	371.5	1,334.9	29.0	4.5
Starchy roots	34.2	27.8	0.5	-
Sugars	105.0	396.2	0.3	-
Pulses	31.3	99.5	5.9	1.9
Vegetables	111.8	23.8	1.7	0.3
Fruits	19.2	11.4	0.1	0.1
Meats	19.2	44.8	2.8	3.5
Eggs	5.1	7.3	0.6	0.5
Fish	18.3	32.3	3.2	1.3
Milk	84.9	96.1	5.1	4.4
Fats and oils	33.1	282.5	-	32.0
Alcohol	-	42.2	-	-
Total	833.6	2,398.8	49.2	48.5

*Calculated from table 2.

the total calories, respectively. No other individual food group accounts for more than 4 percent of the calorie supply. According to the balance sheet, the average Mauritian purchases 38.3 kilograms of sugar annually, an average of 105 grams per day. While this is less than the amount apparently consumed by the average individual on the Caribbean sugar island, Barbados (where consumption is nearly 50 kg. per capita annually), it is a considerably greater amount than that consumed in other tropical, low-income countries. In 1958, for example, the average Nigerian is thought to have consumed only 2 kg. sugar; the average Indian, 6 kg.; the Ghanaian, 8 kg.; the Kenyan, 11 kg.; the Filipino, 13 kg.; and the Colombian, 21 kg. (29).

The pulse and dairy products groups contribute a small but significant amount of calories, 8 percent of the total, and provide nearly 25 percent of the protein supply. All other food groups (starchy roots, vegetables, fruits, meats, eggs, fish, and alcohol for consumption) together account for only 8 percent of the calories and less than 20 percent of the total protein supply. Tables 3 and 4 show these findings in more detail, summarizing the balance sheet by food group totals in both absolute and percentage terms.

The balance sheet totals indicate supplies available at the "retail level". In order to approximate actual ingestion rather than availability, it is necessary to make allowance for losses in the marketing chain, the home, and for plate waste. Evidence on the amount of such losses is very difficult to obtain. In the United States a reduction of 15 percent is considered appropriate, while in most Asian countries, a 5 percent adjustment is thought sufficient.

Table 4. **Mauritius: restatement of food balance sheet food group totals, in percentage terms, 1960–1964***

Food group	Calories	Protein	Fat
		percent	
Cereals	55.6	58.9	9.3
Starchy roots	1.2	1.0	-
Sugars	16.5	0.6	-
Pulses	4.1	12.0	3.9
Vegetables	1.0	3.5	0.6
Fruits	0.5	0.2	0.2
Meats	1.9	5.7	7.2
Eggs	0.3	1.2	1.0
Fish	1.3	6.5	2.7
Milk	4.0	10.4	9.1
Fats and oils	11.8	-	66.0
Alcohol	1.8	-	-
Total	100.0	100.0	100.0

*Calculated from table 2.

An allowance of 10 percent is customarily applied by the FAO to food supply data for tropical Africa (19). Mauritian habits of food purchasing and preparation suggest that this figure is not grossly out of line. Because shopping for food is an almost daily task, storage loss is minimized. From observation, table waste in the average household seems relatively small.

Applying this percentage reduction to the balance sheet totals, we may estimate apparent per capita daily ingestion to be 2159 calories and 44.3 grams of protein, of which 11.7 grams are from animal sources. If inferences as to nutritional adequacy are to be drawn, these are the figures that must be compared with requirements.

Nutritional Requirements

The state of the science of nutrition is such that it is impossible to specify national food requirements with precision. Instead, various organizations, most notably the FAO and the U.S. National Research Council, but at least 15 other entities in as many countries, have devised tables of recommended dietary allowances (cf. 21; 26; 51a) from which national figures may be inferred. The general approach is to set forth allowances for "reference" beings large enough to take into account the substantial variations that occur between individuals, plus a "safety factor", and then to adjust these according to the average physical size of the population, its age and sex structure, the temperature of the environment in which they live, and the amount of work they do.

The results are commonly taken to be "requirements". Manifestly they are not, particularly since, in practice, it has up to now proved impossible to quantify differences in national levels of energy expenditure.[2] But in the absence of anything better, we are obliged to fall back on them as rough benchmarks.

The steps in the computations followed to obtain the Mauritian average daily recommended allowances for calories and protein using the international formulae employed by the FAO (21; 26) are given in Appendix C and need not be detailed here. It is instructive, however, to define the reference man and woman and to summarize the assumptions incorporated in the calculations:

Reference man: 25 years of age, healthy, free from disease, physically fit, and actively engaged in 8 hours of work a day; weighs approximately 60 kilograms.

[2] Tacitly, most formulae assume that the energy expenditure patterns found in the industrialized temperate zone are duplicated the world over, an assumption that seems unlikely, but which, because of the difficulty in measuring energy output among rural people in the tropics, has been hard to disprove. Recent engineering breakthroughs have changed this situation. Building on the facts that oxygen consumption (ergo, energy expenditure) and heart rate are predictably correlated for each individual and that cardiac characteristics can now be either sensed remotely through telemetry or accumulated in tiny electrochemical integrators, it is now relatively easy to measure energy expenditure under free-ranging conditions. See 53a.

Reference woman: Differs from the reference man only in weight—she is estimated to weigh about 50 kilograms.

Further assumptions are:

- Mauritius has a mean temperature of 22.5°C., which reduces needs to 93.75 percent of the standard FAO allowance for calories.
- To achieve full physical development, children in Mauritius require the same quantity of calories and protein that American and West European children are believed to need.
- On the average, Mauritian infants are breast-fed for four months (61).
- The net protein utilization (NPU) of the Mauritian rice-based diet equals 65.

A comparison of the average intake figures with the calculated allowances for calories and protein in table 5 suggests that a sufficient amount of calories and a slightly less than adequate amount of protein are available to the average Mauritian.

Since the differences between the recommended allowance and the apparent ingestion of calories is so small—10 calories—it is probable that many persons consumed less than the recommended amount. It certainly cannot be stated that the supply of calories is excessive. Without additional information on the disparity of availability of foodstuffs to urban and rural persons, persons of varied incomes, or other distinctive population groupings, it is impossible to posit any hypotheses about the distribution of actual available supplies around the balance sheet mean.

Judgments on the gravity of the indicated shortfall in protein are also subject to the constraint of the lack of information about the actual distribution of the protein that was consumed. Since the allowance was calculated in such a way as to allow for the needs of about 95 percent of the population (that is, sufficient to provide the minimum allowance for a wide range of individual variation), an average deficiency of 4.7 grams may not constitute a serious deficiency in the diet of most Mauritians. However, maldistribution of the amount that is available to the wealthier groups may mean that the poorer segments are consuming substan-

Table 5. **Mauritius: food balance sheet apparent per capita daily ingestion of calories and protein compared with the FAO allowance***

	Calories	Total protein	Animal protein
		grams	
Allowances	2,148	49.0	
Food balance sheet	2,159	44.3	11.7

*Balance sheet totals from table 2; allowances from Appendix C.

tially less than the minimum thought necessary to maintain health and work potential.

The proportion of animal to total protein is rather low (only 26.4 percent of the total is from animal sources), but in the light of recent questioning of the superiority of animal over plant protein, it is difficult to say much about the protein quality. The adjustment to a low net protein utilization, however, does make some allowance for a high proportion of the protein to be derived from plant sources.

Comparison of the Balance Sheet Results with Other Countries

Food balance sheet results are frequently used as the bases for international comparison of food supplies and nutritional conditions. Apart from questions of whether sufficient data exist for reliable quantification and whether a single balance sheet average can adequately reflect a nation's dietary pattern, there are drawbacks to such comparisons. Figures of availability are usually compared; what may be substantial differences in wastage rates and in physiological requirements tend to be ignored for the sake of simplification. Yet a comparison like that in table 6 can legitimately point up broad differences in dietary patterns and gross calorie availabilities, and go far toward placing Mauritius in international perspective.

The data suggest that average calorie availability in Mauritius compares favorably to that in South Asia, but is somewhat below that found in East and West Africa and the more developed countries. As to the sources of these calories, Mauritians appear to consume cereals in amounts similar to East Africans, Pakistanis, Indians, and Malagaches. The West African dependence on starchy roots and tubers is emphasized in the table; Mauritians, by comparison, eat only token amounts. The high sugar consumption in Mauritius is also noteworthy: it is exceeded only in Brazil and the United States.

Protein availability seems comparable to that of the underdeveloped world as a whole. Of the peoples listed in the table, substantially greater amounts are available only to Americans, among whom, transitory crazes to the contrary,[3] the principal nutritional problems are those of overnourishment and obesity.

Perhaps the best single indicator of dietary quality is the starchy staple ratio, that portion of total calories supplied by the starchy staple foods—the cereals and starchy fruits, roots, and tubers. Diets dominated by the starchy staples are, because of their low cost of production and market price, a characteristic of poorer peoples everywhere; and the starchy staple ratio is almost always inversely correlated with the stage of economic development.

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[3]To the same persons who gave us *Hunger in America* we are indebted also for some of the more precise misinformation about the world food situation.

Table 6. **Comparison of food balance sheet results: Mauritius, other tropical, low-income countries, and the United States***

	Pakistan	India	Madagascar	Mauritius	Brazil	East Africa	West Africa	United States
Years	1960-63	1960-63	1962	1960-64	1960-62	1959-61	1959-61	1959-61
Total calories	2090	2020	2220	2396	2780	2390	2460	3190
Total protein (gr.)	47.7	51.5	48.2	49.2	66.3	65.2	51.8	95.3
Calorie sources:								
Starchy staples	1519	1372	1907	1363	1428	1888	1953	763
Cereals	1510	1346	1567	1335	1066	1592	839	664
Starchy roots	9	26	340	28	362	296	1114	99
Sugar	149	188	77	396	425	103	37	501
Pulses	52	216	46	100	292	155	160	105
Vegetables	11	2	18	24	7	19	25	198
Fruits	45	27	36	11	120			
Meats	18	6	79	45	197	86	49	540
Eggs	2	1	1	7	13			
Fish	5	3	13	32	13			
Milk	156	108	13	96	93	57	15	431
Fats and oils	134	93	26	283	189	81	221	654
Starchy staple ratio	72.7	67.9	85.9	56.8	51.4	79.0	79.4	23.9

*FAO, *Food Balance Sheets* (1965); and USDA, *World Food Budget, 1970* (For. Agr. Econ. Rept. No. 19, Oct. 1964).

By this criterion Mauritius comes off rather well. Its ratio of 57 percent is well below those found in Africa and South Asia, and not greatly in excess of the Brazilian figure of 51 percent.

III. The Mauritius Family Budget Inquiry

Quantitative insights into the extent to which food consumption patterns in Mauritius diverge from the mean figures yielded by the balance sheet computation can be obtained from analysis of the Mauritius Family Budget Inquiry. The survey was conducted in 1961/62 under the direction of Mr. Wolf Scott of the International Labor Organization (ILO) with the cooperation of the Central Statistical Office. The primary objective of the survey was the "provision of weights for the new consumer price indices" (58:4). Since almost 85 percent of the labor force in Mauritius is considered to be wage earning, the official index used for wage-adjustment purposes is an important concern. The survey that was conducted, however, provides a great deal of other information that can be analyzed for various purposes. Questions on income, property ownership, family size and composition, and occupation were included as well as those on expenditure.

Sampling and Survey Procedures

Among other budgetary data, the daily food purchases of 894 households (286 urban, 608 rural) were recorded for two 1-week periods during the survey year. This began in June 1961, and ended in June 1962. The first week of recording took place during the "crop" season; this season is characterized by increased employment, both in the sugar and service industries, and, according to the survey results, by greater expenditure levels. It is also a period of generally uneventful weather (as opposed to the cyclonic instability of the "intercrop" season) and is thus a period of fairly predictable production and local food crop prices, notably of fruits and vegetables.

The intercrop season, on the other hand, is a period of slack employment, since daily labor is then no longer used so intensively on the sugar estates. Expenditures drop and prices are subject to violent fluctuations, as when cyclones destroyed a large portion of the crops in February 1962. "The price of *pommes d'amour*, for example, rose from 73 cents per kilo in December 1961 to 367 cents in April 1962 to fall again to 47 cents in July 1962" (58:11). The second week of recording, which took place during this season, contributed to a more accurate picture of *average* yearly expenditure. The specific weeks for interviewing any particular household were chosen randomly.

Sample households were selected according to a 2-stage stratified random sample design. The entire island was divided into zones on the basis of previously defined legislative constituencies. These constituencies

were adjusted to make them comparable in population, which resulted in a total of 39 zones (13 urban and 26 rural) with approximately 13,000 residents each.

The zones implicitly stratified the population by location of residence (urban and rural) and, to some extent, by ethnic group. It would have been desirable to stratify by income group as well, but such data were not available, although it has been possible to use post-stratification with regard to income.

Three sampling points were chosen systematically from a listing of the localities in each zone. A locality was defined as a village, town, or group of adjacent villages having a population of at least 500 persons. The selection of only 3 clusters (localities) per zone minimized travel time and facilitated interviewer schedules. The primary units of the survey, sample households, were then chosen randomly from listings of all the households in the selected localities. The household listings were drawn up on the basis of information in "postmen's registers", cadastral survey lists, and supplementary interviewer enumerations.

Households were defined for purposes of the survey as "a single person or group of persons sharing a common household purse" (58:6). The family, as the title indicates, was thus not the basic unit of the sample. Two groups of households were excluded on the basis of income (58:5):

- Those households in which the chief wage earner received more than 1000 rupees per month were excluded for administrative reasons; they "required a different interviewing technique as well as a very much larger sample".
- Those households occupying temporary shelters after they had been made homeless by the 1960 cyclones were also not included; it was assumed that their expenditures under such conditions were not normal.

It was estimated that the two excluded groups represented only 6 percent of the total population (58:6).

The final sample contacted between June 23, 1961 and January 15, 1962 (the first round) consisted of 1016 households and included 5757 persons. Replication of this sample in the second round (January 15, 1962 to June 4, 1962) was carried out for reasons of cost reduction and convenience of interviewing. It was estimated that the sampling error would be neither reduced nor enlarged to an extent that would justify the drawing of a new sample. Thus attempts were made to contact the households interviewed in the first round. Of these, only 913 were successfully reinterviewed. In the official analysis of the survey, the sample used included the households that did not respond in the second round. However, only 890 "matched" households (those having comparable and complete information in both rounds) are used in our analysis. It seemed reasonable to use only those households with data for both rounds because the official analysis revealed an 8 percent difference in expenditure between rounds and slightly different seasonal consumption (58:10).

Mechanics of Analysis

The findings of the survey were originally punched on cards. Because these cards were no longer available in 1966, we rerecorded the pertinent information by hand in Mauritius from the original questionnaires and later transferred it to cards at Cornell University for computer processing. The data were subsequently written on magnetic tape for ease of handling. Although this process no doubt allowed some errors in the form of reversed numbers, missed items, and the like to creep in, it also provided an opportunity for an extensive visual check on the internal consistency and quality of the data.

Our procedure was to record directly from the original hand computations of the survey schedules the weekly equivalents of items which were recorded for a period greater than a week. These items were recorded as "house" expenditures (rent, repair, etc.), "fixed" expenditures (insurance, radio licenses, tuition, etc.), and "other" expenditures (bus fares, cigarettes, clothing, etc.) on a weekly basis.

Food information was collected daily during the survey. It was most often (59 percent of the time) recorded by the householder or a neighbor in a notebook each day and then transferred to the survey schedule by the interviewer on his visit. Some householders (14%) kept the record directly on the survey forms; others (27%) relied on the daily record-keeping visit of the interviewer. Records were kept for 8 days; 1 day's schedule of purchases (usually the first day's) was discarded later.

We aggregated each sample household's items of food purchases into one of 96 coded classes (Appendix D). Each of these classes represents a fairly homogeneous group of foods in terms of nutrient composition. Both quantity and value of each food item were recorded. Values simply referred to the amount purchased; but since the quantities were in common household and market units, a great many standardizing conversions had to be performed with the quantity data.

Fortunately, quantities of most food items were expressed in terms of one particular unit. But a few commodities were recorded in two or more entirely different measures. *Poisson salé* (dried, salted fish), for example, is a major food item purchased either by the piece or the pound. We decided to apply a standardization factor for the number of pieces per pound and convert all purchased quantities of *poisson salé* into "numbers of pieces" before punching. Although this meant that after aggregating daily purchases into weekly totals a reverse conversion back to pounds had to be carried out, it avoided the need to punch such numbers as 1/50 of a pound, 7/25 of a pound, and so forth.

Once quantities were standardized, the same nutrient conversion factors (Appendix B) used in the food balance sheet computation were applied to them.

The end result of the various standardizations and conversions are the daily per capita figures of food weights and nutrients presented on p. 25.

Only one rather devious method of estimating weight and nutrient equivalents needs further explanation. Some commodities were quantified by numbers only—biscuits, for instance. For an approximation of the weight of a biscuit, an average weight per 5 cents' worth (a common unit) of expenditure on biscuits and *gateaux* was applied. Only on snacks did we despair; a cup of tea and a piece of bread have no common denominator.

Possible Sources of Error

A comparison of the ethnic and residential breakdown of the original sample and the total populations reported in the 1952 and 1962 censuses is given in table 7. The similarity is striking. To be sure, the urban general and rural Muslim groups were slightly underrepresented in the sample, while rural Hindus were somewhat overrepresented. In other respects the allocation was almost perfectly proportional. For analytical purposes, therefore, we have assumed that the sampling bias is not seriously distorting.

Table 7. **Mauritius: composition of the total population compared with the sample of the Family Budget Inquiry, 1961–1962***

Population group	Family Budget Inquiry sample households		Total population	
	By number of households	By persons in households	1952 census†	1962 census‡
	percent			
Urban	32.7	34.4	35.0	34.1
General§	11.0	12.6	15.1	14.5
Hindu‖	9.7	10.9	10.7	10.2
Muslim	6.9	8.3	6.6	7.0
Chinese	2.2	2.6	2.6	2.3
Rural	67.3	65.6	65.0	65.9
General§	15.3	13.8	14.5	15.3
Hindu‖	42.8	42.5	40.8	40.4
Muslim	8.5	8.5	8.7	9.2
Chinese	0.8	0.8	1.0	1.1
Total	100.0	100.0	100.0	100.0

*Data source: Wolf Scott, *The Mauritius Family Budget Inquiry*, p. 66, (Mauritius, Cent. Stat. Off.), 1962; and Mauritius Cent. Stat. Off., *1962 census of Mauritius and its dependencies* 1:6 (1963); 2:17–40 (1964).

†Available when sample was designed.

‡Not available until after survey was completed.

§Includes all persons of origins not designated Hindu, Muslim, or Chinese—Creole, Franco-Mauritian, European, etc.

‖Includes other small Indian groups—Tamil, Telugu, etc.

There are, however, other possible sources of bias and measurement error. The interviewer may have influenced the answers given by the householders, or he may simply have forgotten to record some items. "Survey suggestion" may also have had an effect. The respondent, in an attempt to please the interviewer, may have given false information intentionally or unintentionally—because of illegal sources of income, embarrassment, and the like. The "end-period effect", noted in surveys of this nature by Prais and Houthakker (56:36), may also have played a role. Interviewees may have included exceptional, but recently made, expenditures that did not technically belong to the survey period. Other errors may have resulted from ignorance on the part of the questionnaire designer, the interviewers, the respondents, or the data analysts.

The interpretation of the data also presents a number of possible limitations. The assumption most relevant to this paper is that the amount of food purchased is equivalent to that available for consumption during the weeks under consideration. This is a frequent assumption in consumption studies,[4] and seems not unreasonable in the case of Mauritius. Since the island is small and markets easily reached, most food is purchased daily, or at least on a once-a-week basis. Rice and cooking oil are sometimes purchased in bulk, but it is probable that the random selection of survey weeks mitigated the possibility of two periodic bulk purchases by the same household. It is also likely that the purchases of those who did buy large quantities of certain commodities during the survey week were balanced by households that had similar buying habits but did not happen to make a bulk purchase during the survey week itself and hence apparently consumed less than "normal" amounts of these commodities.

No account of stocks was taken. Not only are such data hard to obtain with the multipurpose survey method; it is also probable that the quantities stored by most households at any one time are not too large, given Mauritian housing, weather, and food-purchasing conditions.

Only a small quantity of those foods that supply significant amounts of calories or protein is not purchased. As detailed in Appendix A, few households in either rural or urban areas have kitchen gardens. Thus, the assumption of identity between purchases and supplies available for consumption seems a tenable one.

Any errors in sample data are, of course, magnified when extrapolated to larger population groups. We have noted that the ethnic and residential composition of the sample were both representative of Mauritius as a whole. More troublesome is the application of the subsample results to specific subpopulations. The Muslim sample households, for example, were not drawn as a sample of the total population of Muslim households. The application of these results to this subpopulation, therefore, is not perfectly equivalent to the application of results that would have

[4]See, for instance, 2.

been obtained if the sampling design had specifically designated a Muslim sample to be drawn from a totally Muslim population.

Where we feel the data are limited, or could be questioned, we state explicitly in each phase of the analysis just which factors were taken into consideration and how they were weighted in forming a judgment.

Dietary Findings

The typical Mauritian diet is centered around rice and curry. J. H. Gorvin, writing during the World War II rationing experience caused by the disruption of trade and food shipments, stated, "There is, however, little likelihood, not to say possibility, that these changes, enforced by circumstances, have 'come to stay'. The bulk of the population seems only too anxious to revert to its age-old 'rice and curry' habits as soon as

Table 8. **Mauritius Family Budget Inquiry: average daily per capita purchases of foodstuffs***

Food item	Quantity	Calories	Protein
	grams		grams
Cereals	428.2	1,453.1	32.5
Bread	76.2	194.2	6.3
Flour	47.0	164.0	4.6
Ration rice	248.1	890.5	17.6
Trader's rice	56.9	204.4	4.0
Fish, poultry	24.2	25.7	3.5
Fresh fish	15.6	9.7	1.4
Poisson salé	3.9	7.0	1.1
Fresh octopus	0.7	0.5	0.1
Bombli	0.9	1.7	0.3
Sardines	-	-	-
Tinned fish	3.1	6.8	0.6
Poultry	...†	...†	...†
Meat	12.5	22.7	2.0
Beef, veal	3.7	8.4	0.6
Mutton, lamb	0.8	1.9	0.1
Pork	0.2	1.0	-
Goat	1.9	2.3	0.3
Venison	0.3	0.3	0.1
Liver, kidney, etc.	0.6	0.8	0.1
Meat, n.e.s.	5.0	8.0	0.8
Fats, oils	30.7	270.2	-
All oils	29.9	264.1	-
Margarine	0.7	5.3	-
Fat, ghee, shortening	0.1	0.8	-
Dairy products	126.2	126.1	5.9
Fresh milk	116.6	79.5	4.1
Tinned milk	1.5	4.9	0.1
Butter	2.5	17.6	-
Cheese	-	-	-
Dried milk	5.6	24.1	1.7

Table 8. (continued)

Food item	Quantity	Calories	Protein
	grams		grams
Eggs	2.4	3.4	0.3
Legumes	34.4	118.3	7.7
Lentils	15.5	53.8	3.5
Dholls	10.4	35.2	2.3
Peas	6.4	22.1	1.4
Beans	1.7	5.8	0.4
Other legumes	0.4	1.4	0.1
Vegetables, fruits	127.3	43.7	2.1
Potatoes	28.5	20.0	0.5
Other roots‡	...	...	...
Pommes d'amour	27.6	5.2	0.3
Brèdes	55.7	11.2	1.1
Oranges	2.7	0.9	-
Apples	1.2	0.6	-
Other fresh fruit	11.3	4.6	0.1
Peanuts	0.3	1.2	0.1
Sugar	68.9	261.2	0.2
White sugar	53.8	208.3	-
Raw sugar	15.1	52.9	0.2
Spices	16.0	-	-
Salt	14.0	-	-
Prepared spices	0.4	-	-
Fresh spices	1.6	-	-
Alcoholic beverages (ml.)	23.3	43.3	-
Beer	2.6	0.7	-
Rum	17.7	39.3	-
Wine	3.0	3.3	-
Whiskey, other spirits	-	-	-
Miscellaneous	62.3	50.4	-
Snacks, meals§	...	...	..
Biscuits	8.0	27.0	...‖
Soft drinks	51.0	23.4	-
Tea (dry)	3.1	-	-
Coffee (powdered)	0.2	-	
Cocoa, milk drinks	-	-	-¶
Total		2,418.1	54.2‖

*Based on unpublished data from the Mauritius Family Budget Inquiry.

†Unable to calculate amount of poultry purchased; too difficult to distinguish between quantities recorded as "1 chicken" and those recorded as "1 pound".

‡Category "other roots" should include amounts of onion, garlic, and ginger purchased.

§Snacks and meals present problems of quantification because of their diverse nature. Can be validly considered only from expenditure point of view.

‖Biscuits commonly eaten in Mauritius are 3 types: *gateaux indiens, gateaux francais,* and ordinary cookies and cream crackers. *Gateaux indiens* no doubt make a protein contribution, since they usually contain a legume, either whole or as a flour. However, it was impossible to estimate distribution of total "biscuit" among 3 varieties. No protein contribution has been calculated.

¶Total protein is 54.2 grams, of which 11.6 (21.4%) are animal protein.

the opportunity permits" (33). The wartime changes, involving the increased consumption of wheat flour and maize, did disappear and Mauritians have seemingly reverted to their "age-old habits". While the range of foods available on the island is probably larger today than it was 20 years ago, the staple foods have remained the same. Maize is no longer an important enough food to be quantitatively considered.

"Average" diet

An idea of the relative contributions of the various food groups to the diet is given in table 8—a rather unwieldy tabulation of average apparent daily consumption of all members of the 890 sample households. Its more striking features, particularly the predominance of the cereals group, are summarized in table 9, which expresses the contributions of the food groups to total calories and protein in percentage terms.

The quantitative data give support to the qualitative impression conveyed by Gorvin. A large quantity of rice is eaten with a small amount of meat or fish and a more substantial portion of vegetables and legumes. Fresh fish, beef, and fresh milk are quantitatively the most popular sources of animal protein; lentils, of vegetable proteins other than those obtained from the cereals. *Brèdes*, to use the Mauritian term for all leafy green vegetables, are popularly consumed as a side dish—made either as a stew with other vegetables and spices, or steamed alone.[5]

[5]See 18 for a more culinary discussion.

Table 9. **Mauritius Family Budget Inquiry: average food group contributions to calories and protein***

Food group	Calories	Protein
	percent	
Cereals	61.0	60.1
Fish, poultry	1.1	6.3
Meat	1.0	3.7
Fats, oils	11.3	–
Dairy products	5.3	10.9
Eggs	0.1	0.6
Legumes	5.0	14.2
Vegetables, fruits	1.8	3.9
Sugar	11.0	0.4
Spices	–	–
Alcoholic beverages	0.3	–
Miscellaneous	2.1	–
Total	100.0	100.0†

*Based on unpublished data from the Mauritius Family Budget Inquiry.
†Figures may not add to 100.0, due to rounding.

Table 10. **Mauritius: Family Budget Inquiry apparent per capita daily ingestion of calories and protein compared with FAO allowances***

	Calories	Total protein
		grams
Allowances	2,148	49.0
Family Budget Inquiry	2,176	48.8

*Family Budget Inquiry totals from table 8; allowances from Appendix C.

Nutritional adequacy

When compared with the allowances recommended by the FAO for calories and protein, the average diet indicated by the Family Budget Inquiry seems nutritionally sufficient. If 10 percent of the figures on apparent availability in table 8 are deducted as an allowance for table and home storage waste, comparison of the recommended allowances and the actual estimated intakes suggests that the average Mauritian is consuming almost exactly what he is believed to need (table 10).

IV. Balance Sheet and Budget Survey Compared

The two techniques of food supply assessment approach the same parameter independently and from different points of view. The food balance sheet quantifies average availabilities from the supply side, whereas the budget survey approach is from the consumption side. Before using the budget survey findings to evaluate the divergence in consumption patterns around the balance sheet mean, it is therefore necessary to determine how closely the two means approximate one another.

Average Availabilities

Such a comparison is made in table 11. In aggregate, the estimates of calorie and protein availabilities are quite close, both approaches indicating that the average Mauritian purchases foodstuffs containing about 2400 calories daily. Daily protein availability of 54.2 grams per capita is implied by the budget survey, while the balance sheet suggests a level 5 grams lower.

The budget survey points to a significantly greater consumption of milk, pulses, and cereals than does the balance sheet. The balance sheet, on the other hand, suggests greater consumption of sugar, vegetables, and meats (table 12). This is not unexpected. With the exception of milk, the commodities that play a greater role in the budget survey dietary pattern are all typically consumed in greater quantities by lower income

Table 11. **Mauritius: comparison of food balance sheet and Family Budget Inquiry availabilities, by major food groups***

Food group	Food balance sheet			Family Budget Inquiry		
	Grams	Calories	Protein (gr.)	Grams	Calories	Protein (gr.)
Cereals	371.5	1,334.9	29.0	428.2	1,453.1	32.5
Starchy roots	34.2	27.8	0.5	28.5	20.0	0.5
Sugar, syrups	105.0	396.2	0.3	68.9	261.2	0.2
Pulses	31.3	99.5	5.9	34.7	119.5	7.8
Vegetables	111.8	23.8	1.7	83.3	16.4	1.4
Fruits	19.2	11.4	0.1	15.2	6.1	0.1
Meats†	19.2	44.8	2.8	12.5	22.7	2.0
Eggs	5.1	7.3	0.6	2.4	3.4	0.3
Fish	18.3	32.3	3.2	24.2	25.7	3.5
Milk, milk products	84.9	96.1	5.1	123.7	108.5	5.9
Fats and oils	33.1	282.5	-	33.2	287.8	-
Alcoholic beverages	...	42.2	-	...	43.3	-
Miscellaneous	...‡	...	...	62.3	50.4	...§
Total		2,398.8	49.2		2,418.1	54.2

*Calculated from data in tables 2 and 8.
†Poultry figures not included in the budget inquiry data.
‡Figures for miscellaneous items not available through the balance sheet approach.
§Not available. See note || in table 8.

Table 12. **Mauritius: percentage comparison of food balance sheet and Family Budget Inquiry availabilities, by major food group***

Food group	Food balance sheet		Family Budget Inquiry	
	Calories	Protein	Calories	Protein
	percent			
Cereals	55.8	58.9	61.0	60.0
Starchy roots	1.2	1.0	0.8	0.9
Sugars, syrups	16.5	0.6	11.0	0.4
Pulses	4.1	12.0	5.0	14.4
Vegetables	1.0	3.5	0.7	2.6
Fruits	0.5	0.2	0.3	0.2
Meats	1.9	5.7	1.0	3.7
Eggs	0.3	1.2	0.1	0.6
Fish	1.3	6.5	1.1	6.5
Milk, milk products	1.0	10.4	4.6	10.9
Fats and oils	11.7	-	12.1	-
Alcoholic beverages	1.8	-	0.3	-
Miscellaneous	...	...	2.1	...
Total†	100.0	100.0	100.0	100.0

*Calculated from table 11. †Detail may not add to totals, due to rounding.

groups. One might anticipate that the budget survey (which did not include the upper income levels) would emphasize them. Conversely, meat and sugar are typically highly income-elastic and tend to be observed in greater quantities by a measure that reflects all income groups.

Certain disparities between the balance sheet and budget survey averages can be related legitimately to the inability of either technique to yield absolutely precise estimates. Unintentional omission of some home-produced or gift items by the households being surveyed, purposeful omission by the respondent for reasons of legality (especially regarding "canefield" slaughter of animals), or because of intrafamily noncommunication (generally affecting snacks and alcoholic drinks), or simply our inability to account for the quantity of certain recorded items, no matter how frequently purchased or how important in the diet (5 cents' worth of garlic, for instance), are all cumulative "errors" that work toward disparities. The food economist expects them and is gratified when, as in this study, they turn out to be negligible.

Nutritional Considerations

The following tabulation repeats the levels of calories and protein ingestion implied by the two approaches and the recommended allowances yielded by the FAO formulae:

	Calories	Total protein (gr.)	Animal protein (gr.)
Allowances	2,148	49.0	
Food balance sheet	2,159	44.3	11.7
Family Budget Inquiry	2,176	48.8	11.6

If both the formulae and the 10 percent allowance for waste and loss between the retail level and the mouth are valid, "marginally sufficient" would seem an accurate description of the average diet, a description not inconsistent with the qualitative and medical evidence.

Quality of Mauritian foodstuffs

The rice preferred by most Mauritians is parboiled, although in recent years, raw, highly milled rice from Madagascar seems to have found an increasing market (43). None of the rice imported into Mauritius is enriched in any other way. The nutritional advantages of parboiled rice (higher thiamin and iron content) may be partly lost on Mauritians, however. It is the custom to wash and rinse the rice thoroughly several times before cooking; and it has been estimated that 70 to 80 percent of the vitamin content and most of the iron is depleted by this practice (61).

Although the vegetable group does not make a large calorie contribution to the Mauritian diet, it is an important source of vitamins and minerals. Rice and curry are traditionally supplemented by chutneys (using onions, *pommes d'amour*, fresh green spices) and a dish of *brèdes*. The vitamins contributed by the vegetable dishes do not compensate for those lost in washing the rice, but they are at least conserved to a great extent by the cooking methods. The basic methods of cooking *brèdes* are: as a stew, which includes the cooking liquid (and vitamins in solution) and lightly steamed, in which case cooking losses are also minimized (61).

The liberal use of spices in the diet is frequently associated with a high intake of ascorbic acid, but the fine chopping and crushing involved in the preparation of *massala*[6] and chutneys tends to reduce the direct nutritional contribution. The possibility of the hot spices acting as an appetite stimulant may be of importance in the support of marginal cases of nutrition, but this has never been proven.

Nutritionists who have worked in Mauritius in the last few decades have always encouraged consumption of fruits—presumably for their ascorbic acid content. Mauritians do not consume as much fruit as one would expect. Local fruits (except for bananas) are looked upon with some disfavor, though imported fruits (oranges and apples particularly) are highly prized. While papaya trees thrive in the Mauritian climate and even withstand cyclones quite well, they are not extensively cultivated.

The national food laws do require the enrichment of flour and salt. Specifications for enriched flour are noted in Appendix A. A campaign to enrich the locally made salt with iron (in the form of iron pyrophosphate) was begun by Dr. Gordon Stott in 1959. According to an inspection team that checked on this in July 1965, the enrichment had been carried out only sporadically for lack of strict control of both the enriching material and the nonenriched, but competing, imports. Dried skim milk enrichment was also part of the campaign and was successfully carried out for a few years. By January 1963, however, all dried milk supplies used to serve school children were no longer enriched.

Medical evidence

Other data that comment on the apparent average dietary in Mauritius are the national health and mortality statistics. The rate of infant mortality in particular has been suggested by the FAO to be an indicator of protein sufficiency or deficiency. "... the synergism between infection and protein malnutrition is the major factor in the high morbidity rates. ... Mortality among children 1–4 years of age in countries where the diet of the child during and after weaning is grossly deficient is 20 to 50 times higher than in the USA and Western Europe" (26:28). In Mauritius, the infant mortality rate was 134.8 per thousand in 1941. In 1950, it

[6] *Massala* is a mixture of spices used in the preparation of curry.

had decreased to 76.3 per thousand; from 1960 to 1964, it steadily declined from 69.5 per thousand to 56.7 per thousand. The eradication of malaria in the late 1940s and early 1950s no doubt accounted for a great amount of the early decrease. Still, the infant mortality rates of the 1960s were at least 3 times greater than those of the United States.

The mortality rate among Indo-Mauritian infants is judged to be generally higher than that of the Chinese, Creole, and European ethnic groups (61). It is interesting to correlate this fact with the information that the intrafamily distribution of food is different for the Indo-Mauritians and the others. Indo-Mauritian households generally follow the men-children-women-and-babies order of food service, while the families of other ethnic origins, as a rule, eat as one group. It is difficult to say whether this correlation is significant.

Specific causes of death among children 0 to 5 years of age as reported by the Registrar's Department showed "diseases of early infancy" and "digestive" diseases to be the greatest causes of mortality. Data for the entire population indicate that in 1961, 3.2 percent of the annual deaths were caused by pregnancy, 13.9 by diseases of the digestive system, 11.0 percent by diseases of early infancy, 10.2 percent by respiratory diseases, and 4.9 percent by infectious and nutritional disease. Anemias alone account for 94.0 percent of the deaths in the last category.

That nutritional disease, and specifically anemia, is an important concern is corroborated by the study of Gordon Stott (WHO) and Dorothy Miley (FAO) on the prevalence of anemia in Mauritius. Investigations in 1959 "showed clearly that anemia in the island was predominately of the iron-deficiency type, being characterized by progression from a normocytic hormochromic blood picture to one that is microcytic, hypochromic and responds to iron" (60:788). Presence of hookworm in a large majority of the population (school health authorities estimate that about 80 percent of the school children have parasites) causes chronic blood loss and increases the need for dietary iron. Stott (60:789) summarizes that:

> Low dietary iron and blood loss from hookworm infection appear to be the most important factors predisposing to the development of widespread anemia in Mauritius. The increased frequency of this condition in women and children is largely accounted for by the extra drain on body iron stores associated with growth, menstruation, pregnancy, and lactation.

It was this conclusion that led to the campaign to enrich foods with iron.

The qualitative and medical data, then, generally bear out the balance sheet and budget survey averages. Calories and protein appear to be reasonably adequate and do not make for a general picture of hunger and disease. The slightly cereal-heavy diet of the budget survey (which was weighted by the greater representation of lower-income groups) corroborates the indicated prevalence of mineral (especially iron) deficiency. Only if rice were enriched with iron at the national level would this particular deficiency be avoided.

V. Divergences from the Average

Now that the food balance sheet and the consumption survey have been shown to yield similar pictures of the diet of the "typical" Mauritian, the questions remain: Is there in fact a developing nation that consists primarily of "average" persons who consume these average amounts of foodstuffs? And if there is no such nation, what meaning do the deviations from the statistical norms have for policy decisions? To those concerned with pinpointing the need for nutrition education, estimating the benefits of the subsidization of staple commodities or a grain enrichment program, or formulating policy for a Grow-More-Food campaign, the validity of the assumption that the "typical" diet pattern adequately describes a nation's population is crucial.

In this section, divergences from the averages computed in sections II and III are derived through further analysis of the budget survey and are examined in an attempt to answer these questions. Three variables are considered: location of residence, ethnic background, and level of income.

Ignored are the effects of household size; all calculations are on a per capita basis. In common with most analyses of household budget surveys, this is done for ease of calculation. Nevertheless the implications of the omission should be recognized. First of all, it tacitly assumes that consumption per capita is a function only of income per capita. No account is taken of the fact that household size and income are positively correlated in many developing societies (cf. 53:145–46); and, more importantly, it ignores those economies of scale which may accrue to larger families when making their purchases. The person living alone, for instance, who desires a taste of cauliflower for dinner may have no alternative but to purchase the same quantity as the family of 3 or 4.

A second limitation of the omission is that it does not allow us to take into account differences in the age and sex characteristics of the households, differences that may influence the consumption of particular commodities. Households with many small children, for example, may consume more than average quantities of milk; those with more adult working males, more meat. However, except in the case of certain commodities, the distortions introduced are probably minimal. Houthakker and Taylor note that while "it is not strictly correct to give all persons equal weight irrespective of age and sex...the limited evidence...suggests that equal-weight scales do not produce too much distortion" (36:35). Similarly, when as in this study, "the analyses are based on averages of a number of households not grouped by age or sex, the differential effects of variations in composition are likely to average out between households" (56:89).

Effect of Location of Residence

Although public transportation and access to urban markets are readily available to every villager in Mauritius, urban and rural dietary patterns

Table 13. **Mauritius Family Budget Inquiry: average daily per capita purchases of foodstuffs, urban and rural households***

Food items	Rural			Urban		
	Quantity	Calories	Protein	Quantity	Calories	Protein
	gr.		gr.	gr.		gr.
Cereals	461.3	1,591.1	35.5	356.5	1,178.8	26.9
Bread	66.4	169.1	5.5	95.5	213.5	7.9
Flour	61.8	215.5	6.1	17.7	61.8	1.7
Ration rice	278.9	1,001.3	19.8	186.8	670.7	13.3
Trader's rice	57.2	205.2	4.1	56.5	202.8	4.0
Fish, poultry	21.0	26.2	3.4	24.7	25.2	3.3
Fresh fish	14.8	9.2	1.3	17.2	10.7	1.5
Poisson salé	4.1	7.4	1.1	3.5	6.2	0.9
Fresh octopus	0.9	0.7	0.1	0.1	0.3	0.1
Bombli	1.1	2.0	0.3	0.5	1.0	0.2
Sardines	0.1	0.2	-	-	0.1	-
Tinned fish	3.0	6.7	0.6	3.1	6.9	0.6
Poultry†	...	...	...	...	...	...
Meat	8.3	15.1	1.3	20.6	37.8	3.0
Beef, veal	2.6	5.9	0.1	6.0	13.5	0.9
Mutton, lamb	0.7	1.8	0.1	0.9	2.1	0.1
Pork	0.1	0.1	-	0.5	2.1	0.1
Goat	1.9	2.1	0.3	1.7	2.1	0.2
Venison	0.3	0.3	0.1	0.2	0.3	-
Liver, kidney, etc.	0.2	0.3	-	1.3	1.7	0.2
Meat, n.e.s.	2.5	4.0	0.1	10.0	16.0	1.5
Fats, oils	31.2	275.3	-	29.6	259.6	-
All oils	30.5	269.7	-	28.6	252.7	-
Margarine	0.6	4.1	-	1.0	6.9	-
Fat, ghee, shortening	0.1	1.2	-	-	-	-
Dairy products	121.0	117.0	5.1	136.3	111.6	7.1
Fresh milk	113.2	77.2	4.0	128.3	81.1	4.3
Tinned milk	1.1	3.8	0.1	2.2	7.2	0.2
Butter	2.5	18.0	-	2.1	17.0	-
Cheese	-	-	-	-	-	-
Dried milk	4.2	18.0	1.3	8.1	36.3	2.6
Eggs	2.0	2.8	0.2	3.2	1.6	0.1
Legumes	38.0	130.1	8.5	27.5	90.5	6.2
Lentils	17.0	58.7	3.8	12.7	40.1	2.9
Dholls	11.6	39.1	2.6	8.0	27.0	1.8
Peas	7.5	25.8	1.7	4.3	14.7	0.9
Beans	1.1	4.9	0.3	2.2	7.5	0.5
Other legumes	0.5	1.6	0.1	0.3	1.2	0.1
Vegetables, fruits	116.1	11.4	1.9	149.9	17.9	2.3
Potatoes	29.5	20.6	0.5	26.7	18.7	0.5
Other roots‡	...	...	...	...	...	...
Pommes d'amour	26.5	5.0	0.3	30.0	5.6	0.3
Brèdes	17.1	9.1	0.9	72.9	11.6	1.1
Oranges	2.1	0.7	-	3.7	1.2	-
Apples	1.1	0.5	-	1.6	0.8	-

Table 13. (continued)

Food items	Rural			Urban		
	Quantity	Calories	Protein	Quantity	Calories	Protein
	gr.		gr.	gr.		gr.
Other fresh fruit	9.5	3.9	0.1	14.8	6.1	0.1
Peanuts	0.3	1.3	0.1	0.2	0.9	-
Sugar	70.3	267.7	0.1	66.2	248.3	0.2
White sugar	58.7	227.1	-	14.2	171.0	-
Raw sugar	11.6	40.6	0.1	22.0	77.3	0.2
Spices	18.8			1.0		
Salt	17.1			7.7		
Prepared spices	0.3			0.7		
Fresh spices	1.1			2.0		
Alcoholic beverages (ml.)	26.5	49.0	-	16.9	31.7	-
Beer	3.0	0.8	-	2.3	0.7	-
Rum	19.9	44.2	-	13.3	29.5	-
Wine	3.6	1.0	-	1.3	1.5	-
Whiskey	-	-	-	-	-	-
Miscellaneous	61.0	17.9	-	115.9	78.9	-
Snacks, meals§	...	...	...	...	...	...
Biscuits, gateaux	7.2	21.5	...‖	9.1	32.1	...‖
Soft drinks	51.0	23.4	-	102.0	16.8	-
Tea (dry)	2.6	-	-	1.1	-	-
Coffee (powdered)	0.2	-	-	0.1	-	-
Cocoa, milk drinks	-	-	-	-	-	-
Total		2,561.2	56.3		2,117.9	49.1

*Based on unpublished data from the Mauritius Family Budget Inquiry.
†See note † in table 8.
‡See note ‡ in table 8.
§See note § in table 8.
‖See note ‖ in table 8.

are not precisely the same. Indeed, in several aspects, they differ quite widely from each other and from the average diet presented above. Two fairly obvious factors may explain the existence of this differential. First, incomes in rural areas are on the average somewhat lower than in urban centers. (The disparity in monthly expenditure levels between urban and rural households is discussed later.) Second, the time needed to go to a town to shop limits the range of urban purchases made by the rural householder. Since towns are concentrated in the western and central portions of the island, this has a certain effect on rural buying habits. Most of the cold stores and meat markets are found in the urban areas. Where storage facilities prohibit the purchase of meat 3 or 4 days before use (as they do in most rural households), one must either do without or take the time to travel to the urban markets. Fresh fish availability, it

must be noted, is not subject to this restriction; bicycle vendors commonly supply rural villages and sugar estate housing projects almost daily.

Average per capita daily purchases in the rural and urban areas are presented in detail in table 13 and summarized in percentage terms in table 14. Major points of contrast are found in both the absolute calorie totals and in the relative importance of certain food items. Probably the most striking difference is the substantially greater quantity of calories—2565 as opposed to 2150—purchased by rural consumers. That this mirrors the more active life followed in the countryside, and not some positive income differential, is attested to by the fact that virtually the entire discrepancy is accounted for by greater purchases of cereals, particularly ration rice, shown in table 15 to be among the cheapest sources of calories.

The point is reinforced by the relative contributions of bread and flour. Urban residents purchase less than a third as much flour but about 50 percent more bread than rural householders. Bread is almost twice as expensive per thousand calories as flour and is doubtlessly purchased more frequently by persons with higher incomes. Ethnic differences, however, play some part. The rural population is heavily Indo-Mauritian, whereas the urban population contains a greater proportion of the other ethnic groups (see table 1). The *chappaties* and *pourris* of the Indo-Mauritian diet are made at home from purchased flour, so consumption of flour is expected to be higher in predominantly Indo-Mauritian areas.

Table 14. **Mauritius Family Budget Inquiry: food group contributions to total calorie and protein purchases, urban and rural households***

Food group	Rural		Urban	
	Calories	Protein	Calories	Protein
	percent			
Cereals	63.1	63.2	55.6	54.6
Fish, poultry	1.0	5.9	1.2	6.5
Meat	0.6	2.3	1.8	6.1
Fats, oils	10.9	-	12.2	-
Dairy products	4.6	9.6	6.8	14.4
Eggs	0.1	0.4	0.2	0.8
Legumes	5.2	15.1	4.3	12.6
Vegetables, fruit	1.6	3.4	2.3	4.7
Sugar	10.6	0.2	11.7	0.4
Spices	-	-	-	-
Alcoholic beverages	0.4	-	0.2	-
Miscellaneous	1.9	-	3.7	-
Total†	100.0	100.0	100.0	100.0

*Computed from table 13.

†Details may not add to totals, due to rounding.

Table 15. Mauritius: average costs of major food items, 1961–1962*

Food item	Cost per 1000 grams	Cost per 1000 calories
	Mauritian rupees†	
Ration rice	0.60	0.17
Trader's rice	0.60+	0.17+
Bread	0.70	0.27
Flour	0.48	0.14
Fresh fish	2.79	4.50
Poisson salé	3.50–4.00	1.97–2.25
Bombli	3.50	1.97
Pilchards (tinned)	2.00+	0.90+
Sardines (tinned)	5.60	2.54
Beef, first-class	5.25	2.33
Goat	3.00	2.44
Oil, cooking (cc.)	1.85	0.21
Fresh milk (cc.)	4.35–0.50	0.58–0.83
Tinned milk	2.50	0.74
Lentils	1.00–1.10	0.29–0.32
Dholl	1.00–1.10	0.29–0.32
Potatoes	0.79	1.13
Pommes d'amour	1.19	6.26
Dry onions	1.14	3.08
Green beans	0.83	2.59
Eggplant	0.57	2.85
Chouchou (chayote)	0.42	1.62
Brède Martin	0.53	2.40
Brède Malbar	0.49	2.23
Squash	0.30	1.30
White sugar	0.46	0.12
Raw sugar	0.32	0.09

*Data from Central Statistical Office, Extension Division of Department of Agriculture, Family Budget Inquiry, and personal investigation. These prices subject to much fluctuation within a year.

†One Mauritian rupee = US$ 0.21

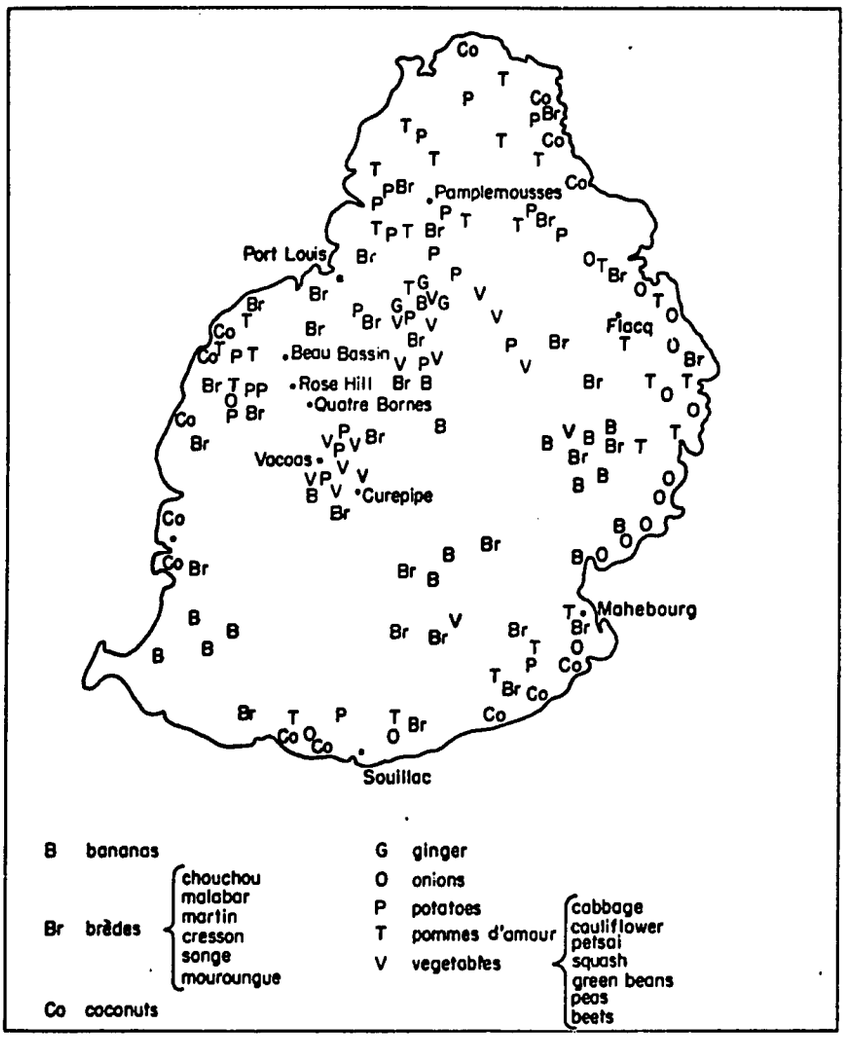
A number of other contrasts and similarities warrant mention:

- Both groups consume fish in similar quantities. The slightly greater consumption of canned fish in the urban areas and of *poisson salé* and *bombli*[7] in the rural districts may be significant, but the difference can be explained only in a qualitative way. *Poisson salé* (and *bombli*) can be bought in very small pieces and their strong flavor spices up a dish of pulses or vegetables considerably; pilchards or other tinned fish, on the other hand, are more expensive per unit and cannot be used as sparingly as *poisson salé*.

[7] *Poisson salé* refers to many varieties of salted, dried fish; *bombli*, to the bummalo or "Bombay duck".

- The higher meat consumption in the urban areas is to be expected, given the general marketing conditions. Only the urban abattoirs slaughter daily; rural abattoirs at Flacq, Souillac, and Mahenbourg are open only on weekends. Religious prohibitions on certain types of meat (pork for Muslims, beef for Hindus) are not obvious here, but, as with flour, the urban and rural patterns have been affected through the implicit weighting by ethnic group.
- Rural Mauritians apparently eat fewer dairy products, including fresh milk, than do urban dwellers. There may be two reasons for this. First—although cows are kept in rural areas, milk production per animal is low, and the opportunity cost of family consumption of the limited supply is high. Furthermore, the cows are generally not kept by Muslims, Chinese, or members of the general population, so even these rural dwellers must pay cash for milk. Income could thus be a primary constraint on increased consumption of fresh milk. Second—because of limited storage facilities, rural families may find it more convenient to use dried milk, but its costliness forces them to restrict its use, also. Most school children during the survey period received 200 cc. of reconstituted dried skim milk each school day. The calorie and protein contributions of this amount are not included in the tables.
- Rural dwellers seem to compensate for lower meat consumption by eating more legumes. They also consistently purchase a greater quantity of each type of pulse.
- Urban residents apparently eat more vegetables and fruits. Underreporting of home-produced foods used in the rural areas may account for this statistic, or it may be a reflection of the availability of such foods in those areas. Most of the fruit and vegetable supply comes from specialized market-gardening regions (map 2) and is sold primarily in the daily urban markets. The low proportion of families with kitchen gardens for household use is noted in Appendix A. Only 16 percent of rural families indicated cultivation of kitchen gardens; less than 5 percent of urban dwellers did. Rural supplies may be limited by this factor and/or the income effect.
- The higher level of sugar consumption in rural areas may be a reflection of its low cost per 1000 calories.
- The ready availability of snack foods (biscuits, *gateaux*, and soft drinks) in urban areas is no doubt a major reason for the greater calorie contribution of those foods in the diets of urban residents.

In short, different patterns of consumption seem ascribable to both the average rural and average urban dweller. The less active townsman purchases significantly smaller quantities of the cheaper energy foods, the cereals and sugar, than his rural counterpart but rather more of the more expensive "preferred" foods. Aside from ethnic identity, the key determining factors seem to be availability, income, and energy expenditure level.



Map 2. **Foodcrop distribution in Mauritius.**

Effect of Ethnic Identity

We noted earlier that despite the ethnic heterogeneity of Mauritius, the dietary pattern of the Indo-Mauritians, rice and curry, is the dominant one and has been adopted at least partially by all other groups. Certain religious restrictions and the preference for particular dishes by some ethnic groups do, however, have an effect on the patterns of food consumption.

Several of these differences are revealed in table 16, which is set up in index form. The average rural and urban diets were each taken to equal 100; the quantities purchased by rural consumers of different ethnic origins are thus compared with the rural average and, similarly, the purchases of urban groups with the urban average.

The rural Chinese dietary pattern exhibits the most extremes: low consumption of flour and dholl; no consumption of ration rice, brown sugar, or rum; and relatively high consumption of beef, pork, butter, tinned milk, and eggs. However, the small size of this group minimizes its effect in the weighted averages.

Religious restrictions on the consumption of certain meats are clearly indicated. Muslim substitution of beef for prohibited pork and the Hindu preference for mutton, goat, and venison over beef are obvious in both the rural and urban sectors. Although the general population is faced with no such restrictions, meat choices for that group seem to favor beef, pork, liver, and kidneys.

The relatively greater consumption of fresh milk by both rural and urban Hindu persons reflects the predominance of that group as the owners of milk cows and the fact that some of them are vegetarians. The apparent preference for tinned milk by both urban and rural Chinese may be associated with the frequency of Chinese ownership of retail stores.

It is apparent that the rural average heavily reflects the Hindu dietary pattern. Not only are Hindus numerically the dominant rural ethnic group, they purchase food in greater quantities than the average rural dweller. It is members of this group who do rather more than their share of the heavy labor, and accordingly it is they who need the more calories. The rural general population seem to consume rather less quantitatively, but a larger range of foodstuffs.

Hindus, on the other hand, do not dominate the average urban pattern, although the index on dietary contrasts does point up the predominantly Hindu consumption of flour, mutton, goat, and venison. Urban Chinese do not seem to consume a diet as specialized as their rural counterparts; indeed, their dietary pattern differs markedly only in the large amount of pork they eat.

One indication of the degree to which the two averages reflect the diets of all ethnic groups may be had by a comparison of the mean ranges[8] of the two sets of index numbers. In neither instance is the range small, but the computation implies that the urban average pattern (=100) is more "representative" of all urban ethnic groups than the rural figure is for its groups. The very specialized food habits of the rural Chinese account for a great deal of the variation, of course, but even when Chinese residents are excluded and the range calculated on the basis of

[8]Urban mean range is computed by taking the mean of the ranges among urban ethnic groups for each commodity. Rural mean range is computed similarly.

Table 16. **Mauritius Family Budget Inquiry: index of contrast in dietary patterns of ethnic groups***

(Average rural and average urban = 100)

Food item	Rural				Urban			
	General	Hindu	Muslim	Chinese	General	Hindu	Muslim	Chinese
Cereals								
Bread	96	101	101	113	97	106	97	100
Flour	20	130	75	8	28	191	102	3
Ration rice	100	102	95	0	102	103	93	102
Trader's rice	32	117	96	1731†	105	96	102	77
Fish, poultry								
Fresh fish	132	92	89	199	97	110	97	69
Poisson salé	98	101	92	173	128	82	83	93
Bombli	66	107	120	9	78	126	117	6
Tinned fish	93	109	74	123	119	96	72	119
Meat								
Beef	217	2	371	614	142	3	151	183
Mutton	41	137	14	0	58	209	35	0
Pork	150	50	0	5,100	85	0	38	1,443
Goat	13	146	5	133	12	239	60	29
Venison	80	120	0	620	63	229	0	0
Liver, kidneys	250	23	250	0	207	15	53	56
Meat, n.e.s.	167	56	217	0	117	62	135	56
Fats, oils								
All oils	92	119	90	120	86	117	100	99
Margarine	56	112	92	167	127	85	85	65
Dairy								
Fresh milk	32	121	99	107	87	107	110	101
Tinned milk	63	111	68	729	99	65	123	266
Butter	96	100	100	217	96	113	96	62
Dried milk	212	68	96	87	177	67	38	10
Eggs	74	96	128	602	102	115	63	182
Legumes								
Lentils	79	108	92	101	106	101	98	18
Dholls	59	119	73	6	75	130	113	20
Peas	60	115	93	93	87	123	100	36
Beans	119	105	49	16	127	86	86	31
Vegetables, fruits								
Potatoes	49	116	100	52	82	117	116	36
Pommes d'amour	85	106	95	69	101	98	97	100
Brèdes	89	105	86	210	110	99	86	102
Fresh fruit	89	111	60	168	93	137	67	58
Sugar								
White	91	102	103	68	97	104	111	39
Brown	156	83	105	0	138	73	92	14
Alcoholic beverages								
Rum	102	121	3	0	132	139	10	0
Wine	200	100	0	100	250	0	0	0
Miscellaneous								
Biscuits	111	91	111	91	102	89	119	68
Soft drinks	109	91	127	291	89	91	122	111

*Based on unpublished data from the Mauritius Family Budget Inquiry. See text for discussion.

†Almost all rural Chinese are traders.

the three remaining groups, the urban mean range is still the smaller. One is tempted to infer from this that urbanization tends to promote a greater homogeneity in eating patterns. But it may simply mirror the greater ethnic balance found in the towns.

Effect of Income

Analysis of the effect of income on food consumption and dietary composition can be done with greater rigor and is the usual basis of studies in which national food demand characteristics are projected into the future. Cross-sectional surveys (such as the Mauritius Family Budget Inquiry) form the customary basis for these projections, the not unreasonable assumption being that as a household's circumstances change over time, the new patterns it will adopt will be similar to those of a household already in those circumstances at the time of the survey.

Tacitly ignored are problems that are of minor significance in the short run. These arise from the interdependence of consumption and expenditure patterns, and complications such as the consumer's resistance to change and the effect that changes in expectations have on his decisions.

The greatest difficulty in determining the effect of income lies in getting accurate data on income itself, and in this connection the Mauritian experience was typical. The budget survey found expenditure on the average to be 8 percent above reported income. The usual solution is to use total expenditure as the explanatory variable. This total is readily available and not easily subject to gross misrepresentation. Furthermore, "while total expenditure may depend in a complicated way on income expectations and the like, the distribution of expenditure among various commodities depends only on the level of total expenditure" (56:81). Houthakker and Taylor (36:33) further justify the use of expenditure data:

> At least over short periods of time, consumers have more control over their expenditure than over their receipts of income, so that total expenditure is a better measure of the 'true' income of the consumer. It is an easy extension to interpret this argument as a variant of the permanent income hypothesis made popular in recent years by Modigliani and Brumberg (1954), Friedman (1957), and their followers.

Daily per capita total expenditure, by definition equal to the sum of per capita expenditures on various food and nonfood items, has thus been used as the independent variable of analysis. For the sake of convenience, we frequently refer to this total expenditure figure as "income".

Theoretical model

A conceptual model to best reflect Mauritian patterns of consumption should include consideration of location of residence, ethnic group, and size of household as well as income. Other economic and noneconomic

determinants that would be conceptually useful (prices, levels of assets, expectations, educational differences, tastes, preferences) are unfortunately not available. Thus, a conceptual relationship

$$Y_{ijt} = f(X, L, E, S, u),$$

where

Y_{ijt} = observed expenditure on the i^{th} commodity by the j^{th} household at time t,

X = income,
L = location of residence,
E = ethnic background,
S = size of household,
u = disturbance term,

} of the j^{th} household at time t

can be stated as a consumption function in the form

$$Y_{ijt} = a_{it} = a_i X_{jt} = u_{it},$$

where

Y_{ijt} = observed expenditure on the i^{th} commodity by the j^{th} household at time t, and

X_{jt} = observed total per capita expenditure by the j^{th} household at time t.

A preliminary regression analysis of the data for expenditure on rice and bread showed that the total variability of ungrouped data gave coefficients of determination (r^2) of 0.14 and less. Grouping of the data not only improves the r^2 by removing much of the within-group variability, but also allows for the control of the conceptually desirable and available qualitative factors. Stratification of the population into 224 mutually exclusive and relatively homogeneous strata on the basis of income, residence, ethnic origin, and size of household was carried out (table 17), and

Table 17. **Mauritius Family Budget Inquiry: stratification of households sampled***

Location of residence (2 groups)	Ethnic background (4 groups)	Total weekly expenditure (rupees) (7 groups)	Number of persons per household (4 groups)
Urban	General	0.00-19.99	1-3
Rural	population	20.00-39.99	4-6
	Hindu	40.00-59.99	7-9
	Muslim	60.00-79.99	over 10
	Chinese	80.00-99.99	
		100.00-119.99	
		over 150.00	

*Stratification schema after Malcolm J. Purvis (57:234).

the group means were used as the bases for future analysis. The r^2 were in the vicinity of .40; the testing for significant differences between groups was also facilitated.

Income distribution

Before looking more closely at the changes in dietary composition and food expenditure related to changes in income, a consideration of the income distribution in Mauritius is needed to place that variable in perspective. According to the national income accounts, average per capita income in 1962 was Rs. 1056 annually, or Rs. 20.31 on a weekly basis (42:13). The budget survey average is, of course, biased downward because of the exclusion of the higher income groups from the sample. The average per capita income of the sample was, however, Rs. 11.74 weekly (Rs. 610.48 annually). Table 18 shows the distribution of income among persons in the sample in absolute and percentage terms. The median income is lower than the mean, indicating a slightly skewed distribution.

Income and expenditure

Analysis of household expenditure data in simple tabular and graphic form shows quite clearly some of the main trends of the relationship between income and consumption. As income increases it is to be expected that the relative magnitude of food expenditures will decline; a certain level of sufficiency in food consumption is reached beyond which, out of every further increase, a higher percentage is devoted to other

Table 18. **Mauritius Family Budget Inquiry: personal "income" distribution***

Weekly per capita expenditure (rupees)	Urban		Rural		Average	
	No. persons	Per-cent	No. persons	Per-cent	No. persons	Per-cent
0.00-4.99	111	6.6	551	16.5	662	13.2
5.00-9.99	654	38.8	1,684	50.31	2,338	16.51
10.00-14.99	407	24.14	563	16.8	970	19.3
15.00-19.99	225	13.3	272	8.1	497	9.9
20.00-24.99	90	5.3	196	5.9	286	5.7
25.00-29.99	55	3.3	14	0.4	69	1.4
30.00-39.99	45	2.7	50	1.5	95	1.9
Over 40.00	100	5.9	15	0.4	115	2.3
Total‡	1,687	100.0	3,315	100.0	5,032	100.0
Mean income	11.71		10.22		11.71	

*Based on unpublished data from the Mauritius Family Budget Inquiry.
†Median falls in these groups.
‡Percentages may not add to 100.0, due to rounding.

Table 19. **Mauritius Family Budget Inquiry: expenditure on food as percentage of total expenditure***

Expenditure class (rupees capita weekly)	Rural	Urban	Average
	percent		
0.00-4.99	70.2	63.8	69.2
5.00-9.99	66.2	60.5	61.6
10.00-14.99	53.5	53.8	53.6
15.00-19.99	41.2	41.5	41.3
20.00-24.99	54.8	52.8	53.8
25.00-29.99	45.7	38.3	39.8
30.00-39.99	33.6	47.3	40.1
Over 40.00	46.4	25.7	28.4
"Income" elasticity of food expenditure†	.78	.72	.74

*Based on unpublished data from Mauritius Family Budget Inquiry.

†Derived below. Elasticity implies percentage change in food expenditure associated with a 1 percent change in total expenditure.

goods and services. However, as table 19 shows, food persists as an important expenditure item throughout the income range. In the poorest expenditure classes it is by far the paramount item, accounting for some 70 percent of all outlays; and not until the three highest classes are reached does it account for less than 50 percent.

Table 20. **Mauritius Family Budget Inquiry: percentages of total expenditure on various foodstuffs, highest and lowest expenditure class***

Foodstuff	Rural		Urban		Average	
	Lowest	Highest	Lowest	Highest	Lowest	Highest
	percent					
Cereals	40	35	35	22	40	27
Fish	6	6	9	9	6	7
Fats and oils	10	11	8	5	9	8
Dairy products	8	9	10	12	8	11
Meat	2	4	7	11	3	8
Eggs	1	-	-	2	1	1
Pulses	5	5	5	2	5	3
Vegetables	12	11	12	12	12	11
Fruits	1	4	2	7	1	6
Sugar	6	3	5	3	5	3
Alcoholic beverages	4	4	1	8	3	6

*Based on unpublished data from the Mauritius Family Budget Inquiry. Highest expenditure class = Over Rs. 150 weekly household expenditure. Lowest expenditure class = Less than Rs. 20 weekly household expenditure.

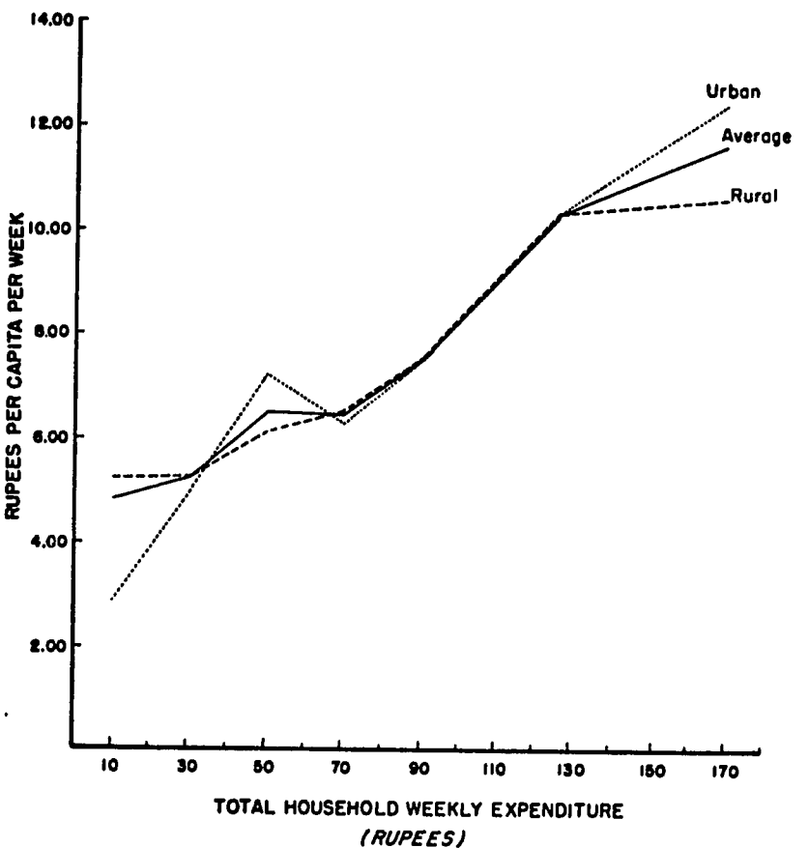


Figure 1. **Mauritius Family Budget Inquiry: per capita expenditure on all foodstuffs, by expenditure class.** (Based on unpublished data from the Mauritius Family Budget Inquiry. Positioning of data reflects expenditure class midpoints, except for the Rs. 150+ class, where Rs. 170 is employed.)

This relatively modest operation of the familiar Engelian relationship is common to developing countries. Here family size tends to be positively correlated with income, and here also is appreciable scope for purchasing more expensive foodstuffs. Figure 1 shows per capita food outlays in the higher expenditure classes to be roughly 3 times that in the lower, and figures 2 and 3 point up the broad nature of the dietary changes involved. Purchases of the cereals decline, while outlays on meat and fish, more desirable and more expensive foodstuffs, rise.

These changing relationships are observed in table 20 for other main food groups in the highest (over Rs. 150.00 weekly) and lowest (less than Rs. 20.00 weekly) expenditure classes. The contrasts shown there do not,

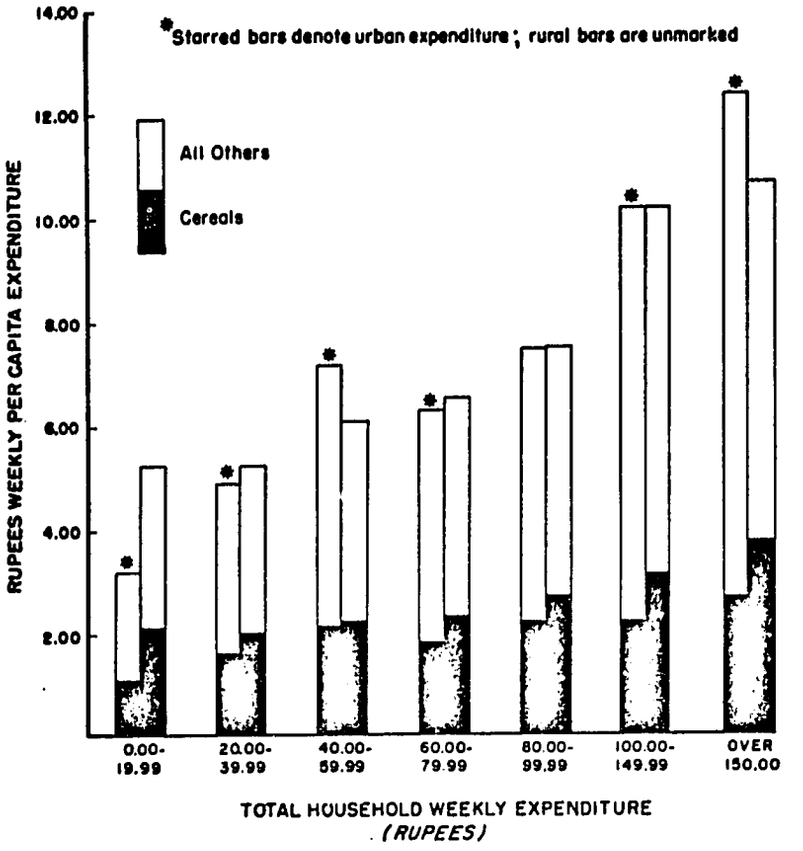


Figure 2. **Mauritius Family Budget Inquiry: per capita expenditure on cereals compared with expenditure on all food, by expenditure class. (Based on unpublished data from the Mauritius Family Budget Inquiry.)**

of course, imply a straight line function between the two extreme classes. In fact, the highest rural expenditure class tended to spend somewhat lesser amounts on many commodities than did the penultimate class. The data do, however, imply that expenditure elasticities for meat, fish, dairy products, fruit, and alcoholic beverages are positive and relatively close to unity, a fact borne out by the regression analysis below.

Before turning to this analysis, it is appropriate to note one final avenue of comparison that was explored. The experience in the West is that as income increases the dietaries of different ethnic groups tend to meld, and the greater homogeneity of urban diets in Mauritius suggests the tendency applies to the island as well. To test the strength of this tendency, a simple manipulation was applied to the expenditure data. The average spent on specific commodities by all ethnic groups in each

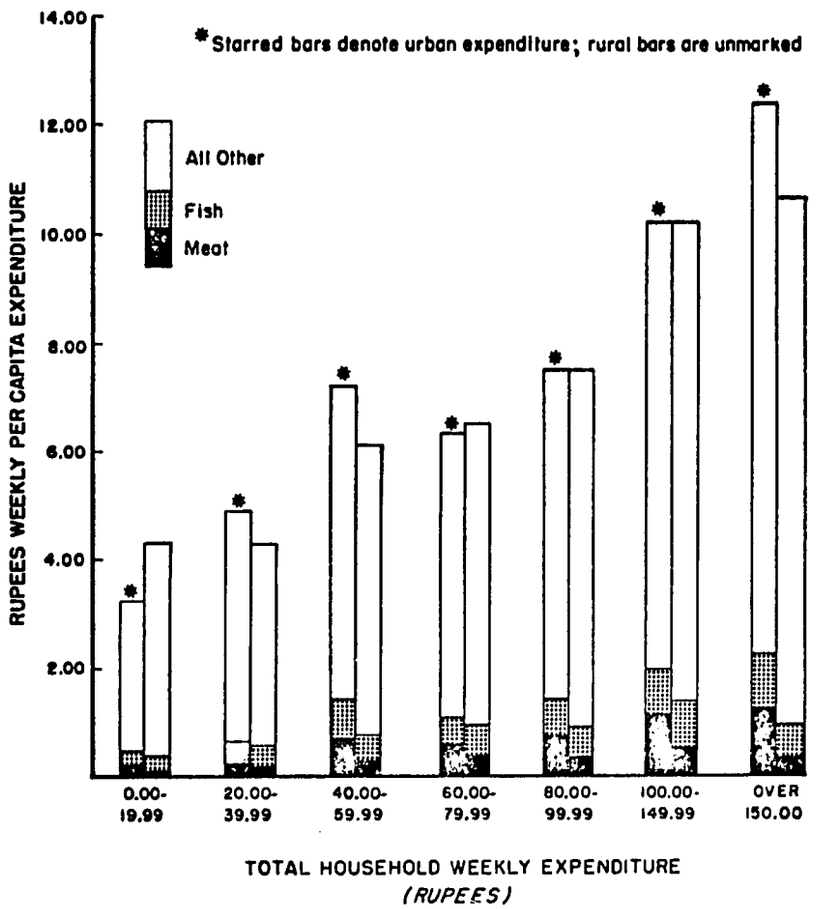


Figure 3. **Mauritius Family Budget Inquiry: per capita expenditure on meat and fish compared with expenditure on all food, by expenditure class. (Based on unpublished data from the Mauritius Family Budget Inquiry.)**

expenditure class was taken to equal 100; the expenditures of each ethnic group were then indexed according to this standard and the ranges of the index numbers within each ethnic group were calculated.[9] A decrease in range would indicate movement toward the common average. An increase would indicate the converse; that is, that with increased expenditure each ethnic group retained its unique dietary characteristics or emphasized them. Ranges between index numbers for per capita expenditure on 6 food items and commodity groups for selected expenditure classes are shown in the following comparisons:

[9]Rural and urban expenditures were grouped together to limit the tendency toward homogeneity that might be attributed to urbanization.

	Expenditure class			
	1	3	5	7
	(Rs. 0—19.99)	(40—59.99)	(80—99.99)	(Over 150)
All food	35	30	54	25
All cereals	44	11	74	19
Bread	18	21	60	35
Ration rice	41	49	126	19
All dairy products	54	83	82	16
All meat	147	196	92	176

It can be seen that neither case is entirely proved. The range between index numbers increased, remained the same, or fluctuated randomly with a rising level of expenditure. Why this puzzling result should occur is not readily apparent. It may be that we aggregated individual foodstuffs excessively. Or the problem may lie with our inability to take into account quality differentials. The line of inquiry is an interesting one and warrants further examination.

Statistical model

The mathematical form of the consumption function generally best suited to the analysis of food/income relationships (in terms of statistical fit) is the semilogarithmic function

$$Y_{ij} = a + bX_{ij} + u,$$

where

Y_{ij} = mean per capita weekly expenditure on the i^{th} commodity by the j^{th} household, and

X_{ij} = the logarithm of the mean per capita weekly total expenditure by the j^{th} household.

This functional form is applicable to commodities the consumption of which increases with income at a decreasing rate but which is never entirely saturated. As most commodities behave in this manner, the semilog form is usually used in preference to the log-log and log-inverse forms. The former is appropriate to items whose consumption remains far below the saturation level throughout the income range, while the latter is appropriate only to situations of actual hunger (cf. 56; 32; 57). The semilog form is also relatively simple computationally since only two parameters are involved. The income elasticity coefficient of the semilog form is equal to

$$\frac{b}{Y}$$

The results of regression analysis on the grouped data means are given in table 21. The estimates of income elasticity are based on the pooled strata mean expenditures. Pooled estimates are not weighted by the number of observations in each pool, but other investigators have found them to be reliable estimates of the "true elasticity" (cf. 56; 57:248–9).

Table 21. **Mauritius Family Budget Inquiry: consumption function coefficients for all strata pooled***

Commodity	Regression equations	r^2	SEb	Sy·x	Elasticity
Bread	$y = -.050 + .193x$	.53	.015	.137	.45
Urban	$y = .029 + .178x$	.17	.022	.112	.37
Rural	$y = -.106 + .199x$	.78	.019	.117	.51
Ordinary rice	$y = 1.053 - .038x$	.02	.061	.579	-.01**
Urban	$y = 1.313 - .210x$	.10	.096	.589	-.27
Rural	$y = .654 + .210x$	.07	.113	.516	.18**
Siam rice	$y = -.680 + .126x$	.28	.056	.501	1.11
Urban	$y = -.805 + .153x$	.33	.074	.483	1.30
Rural	$y = -.585 + .111x$	.25	.085	.525	1.02
All cereals	$y = -.324 + 1.010x$	.52	.080	.721	.17
Urban	$y = -.017 + .780x$	.61	.071	.460	.10
Rural	$y = -.838 + 1.347x$	.62	.126	.773	.56
Fresh fish	$y = -.111 + .296x$	.11	.029	.263	.92
Urban	$y = -.462 + .317x$	.32	.482	.296	1.06
Rural	$y = -.351 + .272x$	.53	.635	.231	.91
Dried fish	$y = -.011 + .058x$	.11	.013	.120	.11
Urban	$y = .009 + .042x$	.06	.018	.108	.36
Rural	$y = -.015 + .081x$	.23	.020	.097	.51
All fish	$y = .601 + .181x$	.53	.038	.339	.81
Urban	$y = -.632 + .491x$	.55	.051	.332	.80
Rural	$y = -.578 + .182x$	.51	.057	.350	.83
Beef	$y = -.227 + .178x$	.18	.031	.282	.83
Urban	$y = -.289 + .198x$	.24	.040	.263	.92
Rural	$y = -.169 + .159x$	.13	.050	.305	.75
Goat	$y = -.158 + .093x$	.09	.025	.222	1.29
Urban	$y = -.210 + .128x$	.10	.011	.288	1.17
Rural	$y = -.066 + .051x$	.11	.017	.107	.09
Hindu	$y = -.105 + .240x$	.27	.056	.311	1.30
All meat	$y = -.880 + .611x$	.52	.049	.139	.96
Urban	$y = -1.100 + .738x$	.61	.061	.117	.95
Rural	$y = -.579 + .413x$	.39	.067	.113	.92
Fats and oils	$y = -.233 + .307x$	.12	.030	.267	.58
Urban	$y = -.175 + .268x$	.39	.038	.250	.53
Rural	$y = -.322 + .363x$	.19	.045	.276	.66
Fresh milk	$y = -.107 + .321x$	.18	.028	.250	.83
Urban	$y = -.166 + .354x$	.13	.047	.306	.82
Rural	$y = -.328 + .276x$	.61	.027	.165	.83

Table 21. (continued)

Commodity	Regression equations	r^2	SEb	Sy·x	Elasticity†
Butter	y = - .350 + .209x	.51	.017	.153	1.25
Urban	y = - .371 + .214x	.49	.025	.161	1.23
Rural	y = - .332 + .204x	.53	.023	.142	1.29
All dairy products	y = - .848 + .642x	.63	.040	.363	.87
Urban	y = - .940 + .691x	.61	.060	.393	.84
Rural	y = - .853 + .650x	.61	.051	.318	.88
Eggs	y = - .252 + .142x	.28	.022	.194	1.43
Urban	y = - .156 + .093x	.21	.037	.239	1.41
Rural	y = - .313 + .159x	.25	.019	.119	1.37
Pulses	y = - .016 + .115x	.22	.018	.160	.43
Urban	y = .036 + .076x	.16	.020	.131	.33
Rural	y = - .105 + .173x	.37	.027	.167	.59
Vegetables	y = - .661 + .605x	.66	.036	.322	.72
Urban	y = - .883 + .709x	.70	.054	.351	.77
Rural	y = - .399 + .475x	.66	.041	.254	.61
Fruits	y = - .469 + .280x	.38	.029	.265	1.24
Urban	y = - .678 + .375x	.50	.048	.312	1.35
Rural	y = - .223 + .163x	.35	.027	.161	.97
White sugar	y = - .035 + .108x	.29	.014	.125	.17
Urban	y = - .077 + .106x	.33	.017	.114	.55
Rural	y = - .021 + .123x	.38	.019	.117	.45
Brown sugar	y = .050 - .001x	.0003	.006	.052	-.02**
Urban	y = .087 - .010x	.02	.009	.061	-.16**
Rural	y = .019 + .005x	.01	.005	.034	.16**
All sugar	y = .015 + .107x	.31	.013	.118	.38
Urban	y = .010 + .096x	.29	.017	.112	.38
Rural	y = - .002 + .128x	.11	.019	.114	.42
Rum	y = - .488 + .280x	.11	.066	.592	1.35
Urban	y = - .225 + .147x	.19	.031	.225	1.00
Rural	y = - .822 + .455x	.15	.131	.805	1.67
Alcoholic beverages	y = - 1.070 + .565x	.19	.095	.861	1.41
Urban	y = - .652 + .376x	.28	.069	.453	1.22
Rural	y = - 1.471 + .816x	.23	.182	1.121	1.67
All food	y = - 6.210 + 5.510x	.71	.272	2.455	.71
Urban	y = - 6.213 + 5.376x	.79	.320	2.096	.72
Rural	y = - 6.119 + 5.771x	.71	.150	2.767	.78

*Based on unpublished data from Mauritius Family Budget Inquiry.
**Not significant at .99 level. All other functions have significant coefficients.
†Computed at point of means; pooled strata basis.

In Mauritius, a rise in income is generally associated with increased purchases of trader's rice, butter, eggs, fruit, meat, fish, rum, and other alcoholic beverages. These trends are similar to those found in many

other budget investigations.[10] The substitution of trader's rice for ration rice and of fresh fish for dried fish as income increases is noteworthy and exemplifies a common finding—substitution of preferred products for cheaper commodities in the same food group. The relationship between pulses (an income elasticity of .43—indicating only a slight increase in purchases as income increases) and meat (income elasticity = .96) most probably also typifies a common pattern of substitution associated with increased income.

VI. Limitations of the Food Balance Sheet

To illustrate more concisely the variance from the "typical" national dietary found in the budget survey, the quantitative diet pattern of two expenditure classes in both rural and urban locations are compared to this national average in table 22. Expenditure classes 2 and 3 (families having total expenditures between 20 and 60 rupees weekly) are illustrated because they include a large proportion of both rural and urban sample populations. Falling within this range are 56 percent of the rural sample, and 32 percent of the urban population.

In a sense the five dietary patterns present "typical" pictures: two typify the average-income rural dweller; two represent a substantial segment of average-income urban residents; one depicts the average Mauritian without regard to either income distribution or location of residence. Whether there are significant differences among these patterns can be tested with various statistical measures (both parametric and nonparametric) as well as by simple inspection.

The food items listed account for roughly 95 percent of the calories of the "typical: national average" dietary. Projection of the income group figures on that basis results in estimated intakes[11] of 1712 and 1929 calories for the urban groups and 1974 and 2198 calories for the rural consumers, the national average being 2173. Judged against "requirements" of 2148 calories computed by the FAO system, most of the Mauritian population appears to have an income commensurate with only a marginally adequate intake of calories.

The consumption of trader's rice, oil, fresh milk, eggs, local fruit, and rum is significantly lower for the "average income" householder than for the "national average" person. The rural dweller with an average income consumes considerably less meat and fewer vegetables than does the "national average" consumer, while the urban average-income resident purchases both more meat and raw sugar and fewer cereals than does the "national average" Mauritian. While urban residents seem to consume substantially less than an "adequate" amount of calories, we have noted that this is doubtless a reflection of the less active nature of their exist-

[10]Except in Ghana. See 53:154.

[11]The totals in table 22 plus 5 percent, minus 10 percent.

Table 22. **Mauritius Family Budget Inquiry: daily per capita purchases of selected foodstuffs—lower expenditure classes compared with national average***

Foodstuffs	Rural expenditure classes		Urban expenditure classes		Typical: national average
	2†	3‡	2†	3‡	
	calories				
Cereals					
Bread	136.2	160.1	186.2	210.1	194.2
Flour	157.4	203.8	38.7	76.8	164.0
Ration rice	972.2	1,056.5	803.4	864.8	890.5
Trader's rice	67.1	88.7	72.9	84.0	204.4
Fish					
Fresh fish	8.7	10.1	6.6	8.7	9.7
Dried fish	7.3	10.9	5.2	8.2	8.7
Meat					
Beef	3.6	5.9	5.0	15.5	8.4
Goat	0.7	1.8	0.1	0.7	2.3
Meat, n.e.s.	2.7	2.7	14.2	13.6	8.9
Oil	244.0	239.6	231.6	241.3	264.1
Fresh milk	53.0	55.6	45.8	42.4	79.5
Eggs	1.6	3.0	1.7	2.3	3.4
Legumes					
Lentils	55.0	57.4	46.0	49.8	53.8
Other pulses	56.1	70.7	48.6	55.8	64.7
Vegetables, fruits					
Potatoes	15.3	21.1	12.4	17.9	20.0
Pommes d'amour	4.4	3.8	4.5	5.8	5.2
Local fruit	1.9	3.1	2.3	3.3	4.6
Sugar					
White sugar	236.5	275.9	172.2	193.9	208.3
Raw sugar	48.8	37.9	103.9	134.1	52.9
Miscellaneous					
Rum	5.6	5.6	1.6	2.0	39.3
Total calories	2,078.1	2,314.2	1,802.9	2,031.0	2,286.9
Average weekly per capita expenditure on food (Rupees)	4.37	5.34	4.28	5.57	

*Based on unpublished data from Mauritius Family Budget Inquiry.
†Household expenditure = Rs. 20—39.99 weekly.
‡Household expenditure = Rs. 40—59.99 weekly.

ence. There are few overt signs of malnourishment in Mauritius, and no allowance for energy expenditure is made in the FAO formula.

Additional statistical tests point to both significant differences and similarities (table 23). Standard analysis of variance shows that there is statistical similarity between column means, but a nonparametric test for differences among columns within rows does show significant differences.[12] This is the analysis of variance using ranks, a test first suggested by Milton Friedman (30a:675–701). Thus while the total caloric contents of the five diets are similar, when the diets are compared row by row, or food item by food item, significant differences do occur.

The two-way analysis of variance also shows significant differences between the two rural-income groups and between the two urban groups, as well as between rural-income group 2 and the national average and

[12]These tests were all performed at the 5% level of significance.

Table 23. **Results of parametric and nonparametric analyses of variance, selected expenditure, and locational classes**

Variables	Test	Critical values	Test value	Decision
1. ALL: Urban 2 Urban 3 Rural 2 Rural 3 Typical	Two-way analysis of variance (parametric)	$F_{.95}$ (19,76)=1.84	51.57	reject
		$F_{.95}$ (4,76)=2.53	0.56	accept
2. ALL	Friedman's two-way analysis of variance*	$X^2_{.95}$ =9.45	22.46	reject
3. Rural 3; typical	"	$X^2_{.95}$ =3.85	0.8	accept
4. Urban 3; typical	"	"	5.0	reject
5. Urban 2; rural 2	"	"	0.8	accept
6. Rural 3; urban 3	"	"	1.8	accept
7. Rural 2; urban 3	"	"	0.8	accept
8. Rural 2; rural 3	"	"	7.2	reject
9. Rural 2; typical	"	"	9.8	reject
10. Urban 2; typical	"	"	12.8	reject
11. Urban 2; urban 3	"	"	12.8	reject

*Under Friedman's test, the statistic

$$X^2 = \frac{12}{np(p+1)} \sum_{j=1}^{p} \left(\sum_{i=1}^{n} r_{ij} \right)^2 - 3n(p+1)$$

has a X^2 distribution, with $p-1$ degrees of freedom, if the hypothesis that the true rank in each column is equal is true, where

r_{ij} = rank in the i^{th} row and the j^{th} column.

n = number of rows, and

p = number of columns.

(See 30a.)

between the urban-income group 2 and the national average. The upper-income groups in both locations are not significantly different from the national average pattern.

In short, according to this test income has a most significant effect on food consumption in Mauritius, while locational differences have less. Thus, the "national average" diet is not representative of the diets consumed by persons with incomes less than Rs. 40 weekly. Approximately 27 percent of the persons in the sample were in these lower income categories; this implies (through extrapolation) that approximately 162,000 Mauritians consumed less than the average amounts of calories noted in the balance sheet and budget survey results. If the average results are taken to indicate marginal sufficiency of calories—and they are probably the best criterion available—then the existence of a fairly substantial group of persons existing at slightly less than marginal levels is suggested.

It is also apparent that of the two lower-income groups, the urban residents consume even fewer calories and spend less per capita on food than do their rural neighbors. This is perhaps an expected differential: competition for the consumer's rupee in the towns is no doubt keener than in the rural village. If, in order to raise consumption levels, a policy of income supplementation or the institution of other programs which might result in income redistribution are made, consideration of this differential is important. Urban incomes will have to be raised to a level slightly above rural incomes in order to achieve the same impact on consumption.

Policy Implications

Within the past few years a kind of nutritionist has appeared that justifies its activities by making quantifications of the cost to society of inadequate dietaries. To an appreciable extent this is both a misdirected effort and an exercise in futility, since for undernourishment to have a cost to a society, full employment must be postulated, and with full employment, food problems are rare.

A number of value and policy judgements may, however, be legitimately attached to "the need for food"—properly measured. The failure of a food balance sheet or consumption survey to reveal an "adequate" amount of calories and protein has been widely used by FAO and others to conjure up visions of starving masses and empty rice bowls (53b:14–19). These assertions have commonly proved fallacious and have come to be viewed with skepticism by a public inured to pronouncements to the effect that it is shortly to be overtaken by pollution, sheer numbers, no gasoline, not to mention starvation. Nations have existed for thousands of years on what are now considered minimal diets.

However, a real "food need" does exist and will grow as long as population increases.

> If we continue to use the term 'food needs,' the term must be redefined to be economically relevant and operationally feasible. Economic relevance implies concepts such as demand, income, and price elasticities, and programs such as income supplementation and other assistance to weak economic groups. Operational feasibility places economic, political, and administrative limits on the amount of income supplementation, food subsidies, and direct distribution that are possible. The complex analysis required to meet such criteria does not lend itself to the same broad appeal as the more general objective of helping starving people or even poorly fed people—but it is more realistic (68:1080).

As a first step in this type of constructive analysis, data on the existing state of food consumption are necessary. Identification of problem areas within the nation as well as of the entire nation's problems are of vital importance. Even a low-income nation (such as Mauritius) can have real differences in income levels which, although the range of possible incomes is more limited than in high-income nations, may have substantial effects on food consumption. Other population groupings may also show distinctive and important characteristics, which must be correlated with the prevailing dietary patterns. In studying Mauritius, we have seen that economic, ethnic (in both social and religious contexts), and locational factors may be important determinants of food consumption patterns. Still other factors to be considered are the physical and geographical aspects of the nation, education levels, population growth rates, and political effects on trade and food supply patterns.

Over time, a series of food balance sheets, accurately done and correlated with changing conditions in income structure, trade and price patterns, population growth rates and age and sex structures, and other independent variables, would perhaps be a sufficient information basis. On a shorter-term and a more timely basis, however, there is a crucial need to pinpoint the divergences that may be generalized in the national average information. The demand side of the food supply situation can be disaggregated through the use of such techniques as consumption surveys and budget inquiries. That such techniques can pinpoint "weak economic groups" and help to define the "economic, political, and administrative limits" of a proposed operational program has been demonstrated in Mauritius. Food balance sheet figures are reasonably accurate and reliable as far as they go, but if too great a reliance is placed on them as policy guides, oversimplification to the extent of misidentification is possible and with it a hampering of economic growth and development.

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Appendix A. Construction of the Food Balance Sheet

Cereals

No grains for human consumption are produced on Mauritius at the present time, although cereals constitute the basis of the Mauritian diet. Some maize is grown as animal fodder; approximately 5000 metric tons of additional unmilled cereals are imported annually for this purpose.

While Mauritius has traditionally imported staple cereals, the local production of rice and maize was encouraged during and immediately following World War II to alleviate food shortages. When normal trade resumed, however, the major sources of carbohydrate were once again wholly imported.

Rice and wheat flour arrive in Port Louis in a milled, ready-to-use form. Both are, to some extent, government-controlled products. A certain quantity and quality of the milled grains are contracted for by the Office

of the Controller of Supplies in the Ministry of Industry and Commerce, stored in government warehouses, and sold at fixed prices through normal market channels. The rest of the market, more or less the prestige trade, is supplied completely by licensed private importers.

Government, or "ration" rice is imported primarily from Burma, although this trade is conditional upon satisfactory price negotiation. In 1964, for example, it proved feasible to import 8000 tons of Thai rice for sale at the fixed price. Ration rice is always parboiled but is otherwise unenriched. The extraction rate generally ranges between 60 and 65 percent.

About 20 percent of the total rice imported is handled exclusively by private traders. Most of these imports are from Thailand; the remainder comes from the United States, Madagascar, India, Pakistan, and China. While the Thai rice is always parboiled, that from other sources is not. Extraction rates are approximately the same as for ration rice.

In the aggregate food balance sheet presented in table 2, a 2 percent waste figure has been applied to the gross import figures reported by the Department of Customs and Excise. This allowance for storage loss was judged by the Controller of Supplies to cover the maximum experienced during the 5-year period under consideration. A comparison of sack weights upon entering and leaving the warehouse indicates an average 1 percent difference at this level, with 2 percent being the maximum. The higher figure was applied to allow for other losses such as: storage after leaving the government warehouses and irregular losses from cyclone rains that flood the warehouses. Only about a quarter of the yearly turnover is in storage at any one time, so long-term storage losses and nutritional deterioration are minimized.

Wheat flour is imported primarily from Australia and France. All government-controlled flour is purchased from Australia with the following enrichment and milling specifications:

Niacin	7.25	milligrams per pound
Thiamin	1.09	milligrams per pound
Creta	1,075.00	milligrams per pound
Iron	30.00	milligrams per pound
Protein	8.5–10.0	percent
Ash	0.5	percent maximum
Extraction rate	72.0	percent

Price-controlled bread is made from imported wheat flour in about 90 commercial bakeries. Assuming the flour to be the most costly material, a comparison of total value of flour imports in 1964 with the total cost of materials reported by the bakeries in that year indicates that about 20 to 25 percent of the total quantity of flour imported is used for commercial bread-baking purposes. Private household consumption includes the preparation of unleavened breads.

Other cereal products imported and recorded in the balance sheet are the relatively minor quantities of groats and cereals, macaroni and vermicelli, bakery products, and other meals and flours of cereal (primarily cornflour). Export figures for these commodities as reported by the Department of Customs and Excise have been adjusted (as are all subsequent figures) for reexports to the dependencies of Mauritius and to nearby islands, mainly the Seychelles and Réunion.

Starchy roots

Irish potatoes, sweet potatoes, manioc, and *arouille*[1] are produced in some quantity on the island. Estimates of local production are made by the Department of Agriculture's Extension Division on the basis of reports filed by the district extension officers. Monthly estimates of the acreage of crops planted (including sugar interline crops) are made by the district officers while the crops are being planted. Monthly estimates of the average yield per *arpent*[2] are also made during the harvesting periods. These data are submitted to the Extension Division where they are aggregated on a yearly basis and adjusted when necessary. Monthly prices of various foodstuffs and the number of seed subsidy permits issued are used as cross-checks on the aggregated figures. Allowances for variations of district climatic conditions are also used as adjustment figures. The annual production totals are published in the reports of the Department of Agriculture.

Much of the Irish potato seed for commercial production is imported. According to figures on seed potatoes obtained by the Agricultural Marketing Board, approximately 650 tons were imported for seed purposes annually during the 5-year period under consideration. Since the establishment of this board in 1963, however, local production of potatoes has been encouraged considerably; imports of seed potatoes in 1963 and 1964 topped 830 tons per year.

Wastage on both imported and domestic table potatoes has been estimated on the basis of experience of the Marketing Board, importers, and local marketing intermediaries to be about 8 percent of ladings and harvest. This estimate has been applied to gross import and production figures.

It was impossible to separate imported sweet potatoes from the vegetable group with which they are included in the general import data. The amount is probably relatively small in any case. Local production is indicated separately.

Manioc and arouille present a problem of judgment, although the choice of alternatives proves to have little significant effect on the totals reflected in the food balance sheet. The balance sheet for Mauritius published by the FAO assumes that half of the reported local manioc production is used for the manufacture of laundry starch. This manufac-

[1] *Arouille* is a root similar to taro.

[2] An *arpent* is an archaic French measure of land equal to 1.043 acres.

turing is done on a household basis and is impossible to verify or check. Only one other relatively large-scale use is made of manioc; there is a small biscuit factory near Mahebourg which uses an estimated 50 tons of raw roots per year. Since this is a food use, it in no way affects the nutritional contribution of manioc. The starch use does, but if half of the amount is arbitrarily deducted for lack of better information, net food availability is reduced from 831 tons to 649 tons, average per capita availability from 1.219 kilograms to 0.952 kilograms, and average per capita calorie contribution from 3.3 to 2.6. Neither fat nor protein estimates are affected in any way, since the contribution of manioc to these values is negligible.

Included in the "flour and flakes of potatoes and vegetables" category are such products as arrowroot flour and sago. While these are not strictly starchy root products, the contribution to the diet is similar. They are widely used as baby foods.

Sugar and syrups

Data from the Mauritius Chamber of Agriculture have been used for the calculation of sugar availabilities. These data are based on the crop years 1960–1964; Department of Customs and Excise data are recorded on a calendar year basis. A "crop year" begins in June and ends the following June in Mauritius. Harvest of the crop, which marks the beginning of the period, generally terminates in December, while export of that particular crop extends until the next June. Thus, the calendar year system reflects the production of the year preceding the export figures.

For the period represented in the food balance sheet, use of Chamber of Agriculture figures for production and Customs figures for exports would indicate a net export balance, or negative domestic consumption. This false picture results from an unusual crop sequence. Sugar yield was excellent in 1959; large exports at the beginning of 1960 were made from stocks accumulated during the June to December harvest of 1959. But 1960 was an extremely poor year; two destructive cyclones hit the island in January and February. The amount of sugar harvested in 1960 does not begin to correspond with the amount exported in that year. Chamber of Agriculture statistics which actually extend until 1965 have been used for consistency between production and exports.

Refined sugar is produced for local consumption on the island in only three sugar mills—St. Antoine, Ferney, and Benares. Some of this sugar is exported to the dependencies, but since 1960, to no other countries. According to the Customs Report, some was exported to the Seychelles, Malaya, Nyasaland, and Singapore in that year; but since this probably came from 1959 stocks it is not considered.

There are a few candy and confectionery manufacturers on the island. The 1964 Census of Industrial Production includes them with the 25

establishments producing "biscuits and sugar confectionery". But since the main components of their product are local sugars, and all of it is locally consumed, no adjustment of sugar availability figures were required.

Pulses and nuts

Imported pulses include beans, dholls, emberics, gram, lentils, and peas from many countries, primarily Burma, India, Australia, and Madagascar. Import figures supposedly include an amount used for nonhuman feed. However, the Extension Division estimates that few legumes are actually used for cattle, since these products are relatively expensive feedstuffs.

Groundnuts are a prominent interline crop in Mauritius. The amount imported is classified as an oil seed in the Customs report; but since there are no oil-expressing facilities on the island, it is assumed that they are processed for human consumption. Other edible nuts are imported in small quantities, chiefly from Ceylon.

Coconuts available in Mauritius are of two types; ripe, mature nuts, which are largely imported from nearby countries (Kenya, Seychelles, Zanzibar), and unripe, green nuts, harvested locally for the use of the coconut milk. Some ripe nuts are, of course, harvested locally but since it is not possible to say what proportion are, a clear dichotomy has been assumed. The "official" weight of a ripe coconut, used by the Central Statistical Office, is 0.82 kilograms; the weight of a green coconut is here taken to be 0.50 kilograms. Estimates of local coconut production are available for only 4 years. Cyclones Alix and Carol, the famed pair of 1960, seriously damaged all tree crops. Coconuts, which are grown in great numbers along the seacoast, fared particularly badly. We have assumed that most of that year's crop was destroyed.

Vegetables

The tonnage estimates of local vegetable production in the food balance sheet are those of the Extension Division. They were calculated in the same manner as was discussed with regard to potatoes. Again, the data refer primarily to commercial production. Green maize, beans and peas, eggplant, tomato, ginger, "creepers" (chayote, squashes, pumpkins), and "mixed vegetables" (okra, onions, chillies, and many varieties of leaves) are grown locally and sold in markets or by itinerant vendors.

Household gardens are not common, so the figures of commercial production used are probably not far below the actual. Of the households participating in the Family Budget Inquiry, only 5 percent of the urban households and only 16 percent of those in rural areas stated that they had any kitchen garden area.

A 10 percent waste figure has been applied to the fresh vegetable items because of their perishable nature.

Fruit

Imported fruit is visible everywhere in Mauritius; apples and oranges are popular, though relatively expensive, items. Most of these and other fresh fruits are imported from South Africa and Australia. A substantial quantity of dried fruit (raisins, currants, and others) is also imported. Some of the dried raisins are used for the commercial preparation of a "country liquor" known as Mauritius fruit wine. It is impossible to estimate just what proportion of imported fruit is used for this purpose.

Local production of fruit is more difficult to quantify. Department of Agriculture figures include only the commercial production of bananas and pineapples, and of these, only the pineapple estimate includes the majority of local production. Since the banana estimate does not take into consideration the production of the few banana trees which border many houseyards, there may be a substantial quantity unaccounted for.

Some citrus fruits are grown on the island. In the district of Pamplemousses there are a few small, long-established orchards, but the total output is very small. The Department of Agriculture has done extensive work with orange cultivation and sells some of the experimental orchard production, but this too is a negligible amount. Other fruits grown locally, but not included for lack of data, are jackfruits, papayas, guavas, masson, mangoes, and lemons.

The annual yield of local fruit is subject to the whims of the cyclones. So many banana plants near bearing were destroyed in 1960 that the Department of Agriculture figures for that year include only pineapple. The threat of future devastating cyclones has reduced incentives for the establishment of large-scale orchards.

The fruit juices included in the food balance sheet are chiefly in syrup form—orange squash, lemon squash, and the like. Note that the amount of juice is recorded in thousands of litres.

Meat

The quantities of meat listed in the balance sheet have been derived in a number of ways. Local production and the carcass weights of cattle imported on the hoof have been calculated from abattoir records. There are six government abattoirs on the island; three in urban areas handle the bulk (about 80%) of the meat slaughtered. Each carcass is weighed as it leaves the abattoir; all animals must legally (with a few exceptions pointed out below) be slaughtered in the abattoirs. Imported animals must spend a specified length of time in quarantine and pass a health inspection before slaughter. This accounts for a slight disparity between the number reported as imported by the Department of Customs and Excise and the number reported killed.

Beef is raised locally and imported both on the hoof and frozen. Figures for local production are only those reported by the abattoir; in fact, a number of cattle are killed outside of the abattoirs in March or April

by official permit for a Muslim religious festival. Figures for imported beef are a combination of frozen weights and the fresh carcass weights of abattoir-slaughtered imported animals.

Local beef comes from either small producers of milk or from herds that are raised for meat. The slaughter of local cattle is subject to restrictions of weight and age; official weight is 85 kilograms and female cows cannot be slaughtered before they have 8 teeth. Herd cattle during the food balance sheet period accounted for between 5 and 11 percent of total local slaughtered weight.

Pork is raised locally as well as imported as frozen meat. There is at least one company in Port Louis that manufactures sausages, presumably using a large proportion of local pork. But the meat they use is slaughtered at Roche Bois abattoir and thus included in the fresh pork figures.

Goat production and slaughter are more difficult to quantify. Legally, goats are slaughtered either at abattoirs or at home after a permit has been issued by the local sanitary office. In fact, a great deal of "canefield" slaughter takes place. Goat meat is in high demand and there is reason to believe that the reported figures are understated. Local production figures have been increased by 10 percent to allow for this extra-legal source. This percentage figure was the minimum estimate of a number of sanitary office officials and Veterinary Department officials. Another 5 percent has been added to account for slaughter by permit. This figure is an estimate based on the number of permits issued by 4 sanitary offices—1 urban and 3 rural. In 1964, permits to slaughter 600 goats were issued at these four offices. Since there are some 20 sanitary offices on the island, all of which issue such permits, it is estimated that at least 1000 animals per year are slaughtered under permit. At 9 kilograms each, the carcass weight average in the abattoirs in 1964, the 9 tons of goat meat killed on home premises is approximately 5 percent of the 226.2 tons of goat otherwise available annually.

Most of the sheep slaughtered locally are imported live from Rodrigues and Australia. The carcass weights of these animals are listed as "local production" since abattoir records do not distinguish sheep by origin. The amount of imported mutton noted in the food balance sheet is frozen or chilled.

Venison is the by-product of a Mauritian sport, *la chasse*. The deer killed are sold to various cold stores and the meat distributed through them. The figure for tonnage per year was reported by the president of the *Société des Chasseurs*.

Poultry availability is subject to speculation. The 1964 Census of Agriculture carried out by the Veterinary Department was considered unsuccessful in producing a true estimate of fowl numbers. Furthermore, it has nothing to say about how many of these animals are consumed by the households that raise them. For food balance sheet purposes, the veterinary census figures were taken to be the minimum numbers, and 30 percent of this poultry population was estimated killed each year.

This percentage of offtake was based on the following:

1) The livestock census lists the total number of birds as 438,777. Of these, 85 percent are chickens, 21 percent of which are males and 79 percent, females.

2) Most males, old hens, and culls are probably consumed by the family or sold at one time or another during the year. Other fowl are presumably kept primarily for eating purposes, since duck and pigeon eggs are not commonly eaten. Thus, 15 percent are males and culls, 15 percent other.

Taking 30 percent of the gross figure of 439,000, we get 132,000 fowl eaten per year. Using an average weight per bird of 1 kilogram (which underestimates the weight of turkeys, overestimates that of doves and pigeons, and is reasonably accurate for ducks and chickens), the figure of 132 tons of poultry meat per year is derived. The small tonnage of poultry meat sold through the Poultry Centre of the Veterinary Department is included in the balance sheet figures.

Offals are not included in local abattoir statistics; they are included in the "other meats" category of imports. It proved impossible to obtain an estimate of the weight of offals that reach the *basse boucherie* in the markets.

Processed meat items include bacon, salami, corned beef, corned mutton, and other sausages. As mentioned above, the local preparation of these items uses meat already included as fresh meat.

Eggs

Estimates of egg production are as subject to error as are estimates of poultry numbers. The number of laying hens has been judged by various informed persons to range from 200,000 to nearly a million; the number of eggs per hen per year to range from 60 to 80. We chose to follow the estimate prepared by A.S.M. Hall in his work before the Marketing Board was established. He estimated that in 1962 there were about 350,000 laying hens producing 70 eggs each per year. This number is slightly larger than that used as the basis for poultry meat estimates, but is probably more accurate than the minimal figure given above. Added to the estimated private production is the number of eggs sold from the Poultry Centre in Reduit and the Poultry Unit in Curepipe.

Sample weighing in several markets indicated that 50 grams was the minimum average weight of one egg; the tonnage is calculated on this basis.

Fish

All fresh fish in Mauritius are legally landed at one of 18 controlled landing stations supervised by the Fisheries Department. In fact, there is some illegal landing of under-sized fish, which may be more than 10 percent of the yearly catch. However, this figure is difficult to substantiate and has thus not been applied to the production data.

Almost half of the fresh fish reported as "imported" were from the island of St. Brandon, a dependency, and were caught in Mauritian-owned boats. South Africa contributed the bulk of imports from outside the island and its dependencies.

Salted, smoked, and dried fish are mainly of three types: *poisson salé snoek* from South Africa, *poisson salé blanc* from the dependencies, and *bombli* from India.[3] The marked popularity for these kinds, which are sold at relatively cheap prices, has perhaps inhibited any experiments with drying local fish. It is also said that local fish are not so well suited to the process. Consequently, no processed fish are produced on Mauritius.

The local production of crustacea and molluscs refers only to lobsters. Fresh octopi are listed separately; crabs, clams, and oysters are not included at all, as data are unavailable, and it is expected that the quantities consumed are small. Imports of crustacea and molluscs, however, refer chiefly to dried octopus *(ourite sèche)* which originates in India. Smaller quantities of crustacea (mostly shrimps) are imported from China, Madagascar, and Pakistan. Some fresh and frozen crustacea are imported (mainly from Hong Kong) but amount to less than 5 percent of the total.

It was possible to separate the dried octopus that is imported from the dependencies (using Department of Agriculture data) from other crustacea and molluscs. This quantity is listed as "octopi" with the fresh catches of Mauritius.

Tinned fish are popular items because of their superior storage qualities. Sardines are sold in most boutiques[4] by the piece as sandwich fillings. Most small boutiques also handle at least two different-sized tins of pilchards (both in tomato and in oil sauce) as well as sardines and salmon. Tinned fish come mainly from South Africa, Morocco, and Japan.

Milk and milk products

The quantity of fresh milk production has been a point of debate in Mauritius for a number of years because it has occasionally been shown that more milk is consumed than is produced, the discrepancy being explained by the fact that milk is often diluted before sale. For this reason, our estimate of local production is based on the number of cows and on an estimate of milk production per cow per year derived by A.S.M. Hall and corroborated by several Veterinary Department officials. In 1964, according to the livestock census, there were slightly more than 20,000 female cows over the age of 2 years. At an assumed 900 litres of milk per year per cow, an estimate of 18,000 tons of milk per year was derived.

Figures reported by the Department of Customs and Excise on tinned milk are not differentiated with regard to sweetness. Here, it has been

[3] *Poisson salé* is the Mauritian term for all salted, smoked, and/or dried fish; *bombli* is the local name for dried bummalo (Bombay duck).

[4] A "boutique" is a small retail store.

assumed that most of such milk is both condensed and sweetened rather than evaporated and unsweetened.

It is not possible to separate the amount of skim dried milk from the quantity of full-cream dried milk. Data on UNICEF milk received by the Departments of Social Welfare and Education suggest that almost one-quarter of the total amount of imported dried milk was skim milk. The nutritional calculations were made on this assumption.

A negligible amount of cheese is produced in Mauritius. Some milk foods (e.g., ice cream) are also made locally, but imported components, included with "milk foods", are used. Butter availability is listed with the "fats and oils" group.

Fats and oils

There have been no oil-expressing plants in Mauritius since the middle 1950s when some oil was manufactured with copra imported from the dependencies. Coconut oil in the 1960–1964 period was used less for cooking than as a hair-dressing. We have not included it as a food item.

It is possible that oil consumption is somewhat overstated in the balance sheet because it is impossible to estimate accurately the exact quantities of oil that were reexported to the dependencies. It is recorded by the Department of Customs and Excise only by value; the substantial size of this amount (slightly more than Rs. 130,000 annually) indicates that perhaps the total quantity available in Mauritius is less than stated.

Some margarine and butter are processed on the island, but the amount eludes quantification because most processing is done in the home. The Census of Industrial Production lists two large producers of dairy products. One is the Mauritius Dairy Company, Ltd., which deals primarily in pasteurized milk (Purlait). It was established in 1962 and had not yet built up a large market for its other products, including butter, by 1964. The other firm is primarily a manufacturer of yoghurt and cottage cheese.

Alcohol for consumption

With the establishment of the Phoenix Brewery in 1963, Mauritian capacity for the production of alcoholic beverages increased considerably. While rum production (based on the molasses by-product of the sugar industry) remained just about stable over the 5-year period, the quantity of Mauritius fruit wine delivered for home consumption dropped markedly in 1963. Consequently, while capacity increased, consumption remained about constant.

There may be an element of double-counting in the computation of calories derived from fruit wine, since imported raisins and other fruit are used in the manufacturing process. But this is not a serious overstatement, since all of the imported dried fruit contributes only .001 percent of total calories.

All amounts of locally produced alcoholic beverages are taken from the reports of the Department of Customs and Excise. The "quantities released for home consumption" annually have been used rather than total annual gross production figures.

Appendix B. Nutrient Conversion Factors

Item	Calories	Grams protein (per 100 grams)	Grams fat	Information source
Cereals				
Rice	359	7.1	1.1	FAO, #11, p. 10.
Wheat flour	349	9.8	1.3	FAO, #8, p. 10.
Groats/cereals	385	13.0	7.5	FAO, #18, p. 11.
Macaroni	367	11.0	1.1	FAO, #33, p. 11.
Bakery products	496	6.5	22.0	McCance, average of #24 and #28, p. 25.
Meal/flour, n.e.s.	363	8.4	1.2	FAO, #21, p. 11.
Cereal preparations, n.e.s.	358	9.8	1.5	McCance, average of #24 and #28, p. 25.
Starchy roots				
Potatoes	70	1.7	0.1	FAO, #34, p. 12.
Sweet potatoes	97	1.1	0.3	FAO, #36, p. 12.
Manioc	109	0.9	0.2	FAO, #37, p. 12.
Arouille	86	1.5	0.2	FAO, #40, p. 12.
Potato flours and flakes	340	0.2	-	Platt, average of #32 and #41.
Sugars				
Raw sugar	351	1.0	-	FAO, #45, p. 13.
Refined sugar	387	-	-	FAO, #44, p. 13.
Candy	350	-	-	Average of #470 in McCance, p. 93, and #608, Hdbk. 8, p. 21.
Pulses and nuts				
Pulses	340	22.0	1.8	FAO, average of #63, p. 14.
Groundnuts (in shell)	388	18.2	30.7	FAO, #52, p. 13.
Edible nuts	262	7.0	25.0	FAO, #68, p. 15.
Ripe coconuts	161	1.9	15.6	FAO, #64, p. 15.
Young coconuts	61	1.4	5.1	FAO, #65, p. 15.

Appendix B table continued

Item	Calories (per 100 grams)	Grams protein (per 100 grams)	Grams fat (per 100 grams)	Source
Vegetables				
Tomatoes	19	1.1	0.3	FAO, #72, p. 15.
Green & leafy vegs.	20	1.9	0.2	FAO, average of #106a and #106b, p. 17.
Fresh and frozen	22	1.4	0.2	FAO, #116, p. 18.
Tinned	60	3.0	0.3	Hdbk. 8, average of #1523, p. 44, #2295, and #2296, p. 62.
Fruits				
Citrus fruits	32	0.6	0.1	FAO, #123, p. 18.
Apples	49	0.3	0.3	FAO, #125, p. 18.
Other fresh fruit	41	0.5	0.7	FAO, #162, p. 20.
Dried fruit	267	2.8	0.6	FAO, #169, p. 20.
Preserved fruit	65	0.4	-	McCance, #351, p. 79.
Prepared fruit	261	0.3	-	McCance, average of #183 and #189, p. 93.
Juice	135	0.3	-	McCance, #518, p. 97.
Meats				
Beef	225	14.7	18.0	FAO, #174, p. 21.
Pork	396	10.4	39.0	FAO, #190, p. 22.
Goat	128	14.0	7.0	FAO, #198, p. 22.
Mutton	241	11.9	21.1	FAO, #191, p. 22.
Venison	101	18.0	3.0	FAO, #202, p. 22.
Poultry	129	12.0	8.6	FAO, #207, p. 23.
Other meat	130	18.0	5.5	Platt, average of #205-207, pp. 21-25.
Dried meat	509	60.0	28.0	FAO, #213, p. 23.
Tinned meat	231	22.3	15.0	McCance, #121, p. 35.
Eggs				
Eggs	144	11.0	10.4	FAO, #215, p. 23.
Fish				
Fresh fish	62	8.8	2.7	FAO, #227, p. 24.
Salted, smoked, etc.	178	27.0	7.0	FAO, #233, p. 24.
Crustacea, molluscs	25	4.1	0.5	FAO, #230, p. 24.
Tinned fish	220	20.0	15.0	McCance, average of #256, p. 61, and #267, 268 on p. 63.
Octopus (fresh only)	78	15.3	-	Hdbk. 8, #1100, p. 41

Appendix B table continued

Item	Calories	Grams protein (per 100 grams)	Grams fat	Source
Milk				
Cows', fresh	60	3.3	3.0	FAO, #251, p. 25.
Condensed, sweetened	336	8.2	10.0	FAO, #263, p. 26.
Dried, full cream	506	26.0	30.0	FAO, #266, p. 26.
Dried, skimmed	360	36.0	1.0	FAO, #267, p. 26.
Cheese	299	18.0	24.0	FAO, #271, p. 26.
Milk food	384	13.2	6.3	McCance, #519, p. 97.
Fats and oils				
Oil (all kinds)	884	-	100.0	FAO, #277, p. 27.
Margarine	720	0.6	81.0	FAO, #279, p. 27.
Ghee	879	-	100.0	FAO, #282, p. 27.
Butter	716	0.6	81.0	FAO, #281, p. 27.
Alcoholic beverages				
Beer	28	-	-	McCance, #526, p. 99.
Wine	110	-	-	McCance, #536-542 averaged, p. 99.
Cider	40	-	-	McCance, average of #533 and #534, p. 99.
Spirits (70% proof)	222	-	-	McCance, #547, p. 99.

Sources:

FAO, *Food composition tables—minerals and vitamins—for international use.* Nutritional Studies No. 11, 1954.

R. A. McCance and E. M. Widdowson, *The composition of foods* (London, 1960).

B. S. Platt, *Tables of representative values commonly used in tropical countries* (London, 1962).

B. K. Watt and A. L. Merrill, *Composition of foods* (USDA, Agricultural Handbook 8, 1963).

Appendix C. Calculation of Recommended Nutrient Allowances

Recommended Calorie Allowances for Mauritius Based on the FAO Formula, 1962*

(Reference weights: male, 60 kg.; female, 50 kg.; environmental temperature, 22.5°C)

Age group	Mauritius population		Reference allowance		Adjusted for age		Adjustment for temperature		Mauritius: number of persons		Total recommended daily allowance	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
	percent		calories		calories		calories				1000 calories	
0-1	3.11		1,120						23,159		26,271	
1-3	9.70		1,300						66,112		85,946	
4-6	9.72		1,700						66,266		112,652	
7-9	8.93		2,100						60,866		127,819	
10-12	8.76		2,500						59,729		149,323	
13-15	3.40	3.42	3,100	2,600					23,202	23,373	71,926	60,770
16-19	3.51	3.51	3,396	2,232			3,184	2,093	23,932	23,887	76,199	19,995
20-29	6.69	6.73	3,019	2,146	3,019	2,146	2,830	2,012	45,588	45,897	129,011	92,345
30-39	6.11	5.79	3,019	2,146	2,928	2,081	2,745	1,951	41,633	39,445	114,283	76,957
40-49	4.65	4.16	3,019	2,146	2,837	2,017	2,660	1,891	31,665	28,385	84,229	53,676
50-59	3.13	2.91	3,019	2,146	2,611	1,856	2,448	1,740	21,336	19,817	52,231	34,482
60-69	1.64	1.95	3,019	2,146	2,385	1,695	2,236	1,589	11,119	13,286	24,929	21,111
70+	0.63	1.22	3,019	2,146	2,083	1,481	1,953	1,388	1,292	8,300	8,382	11,520
									681,619		1,464,063	
											2,148 calories per capita per day	

*Data from FAO, *Calorie requirements* (Nutr. Studies No. 15, 1965), pp. 35–46; Mauritius, Cent. Stat. Off., *1962 census of Mauritius and its dependencies, vol. 1* (1963), pp. 8–10; and Mauritius, Meteor. Dept., *Annual report 1962* (1963), p. 10.

Recommended Protein Allowances for Mauritius Based on the FAO Formula, 1962*

(Reference weights: male, 60 kg.; female, 50 kg.)

	Population	Average body weight	Allowance per kg. body weight per day	Reference allowance per capita per day	Total recommended daily reference allowance
		kg.	gr.	gr.	kg.
Infants, 0–1 years					
not breast fed	15,638	9	1.70	15.30	239
Children, 1–3 years					
not breast fed	66,112	12	1.06	12.72	811
Children, 1–6	66,266	18	0.97	17.16	1,157
7–9	60,866	27	0.92	21.81	1,512
10–12	59,729	35	0.86	30.10	1,798
Adolescents					
male, 13–15	23,202	49	0.81	11.16	955
16–19	23,932	60	0.77	16.20	1,106
female, 13–15	23,373	46	0.81	38.61	903
16–19	23,887	50	0.77	38.50	920
Adults					
male	155,663	60	0.71	42.60	6,631
female	155,130	50	0.71	35.50	5,507
Allowance for pregnancy (25,805 women)	12,903			6.00	77
Allowance for lactation (7,820 women)	7,821			15.00	117
Total	681,619				21,763**

(**Equals 32 gr. reference protein person day; equivalent, at NPU' of 65, of 49 gr. protein).

*Data from Mauritius, Cent. Stat. Off., *1962 census of Mauritius and its dependencies, vol. 1* (1963), pp. 8–10; and FAO, *Protein requirements* (Nutr. Meet. Rept. Series No. 37, 1965), p. 51.

Appendix D. Food Codes—Mauritius Family Budget Inquiry

10. Bread, Flour, Cereals
- 100 pain moule, pain maison
- 101 farine
- 102 maize flour, oatmeal
- 103 riz ordinaire
- 104 riz Siam
- 105 macaroni, vermicelli
- 106 other cereals
- 107 biscuit, gateaux
- 108 packaged baby cereals
- 109 other

11. Meat
- 110 beef
- 111 veal
- 112 mutton
- 113 lamb
- 114 pork
- 115 cabri, bouc, goat
- 116 cerf
- 117 foie, kidney, etc.
- 118 offal, tripes, os
- 119 meat, unspecified

12. Fish, Poultry
- 120 poisson frais
- 121 poisson salé
- 122 tinned fish (saumon, sardines)
- 123 crustacea
- 124 ourite fraiche
- 125 poultry, fresh or frozen
- 126 other poultry

13. Oils and Fats (except butter)
- 130 huile olive, huile salade
- 131 huile ordinaire, huile cuisine
- 132 margarine
- 133 ghee, mantegue
- 134 cooking fats
- 135 huile, unspecified

14. Dairy Products
- 140 lait frais
- 141 lait condense
- 142 lait en poudre
- 143 milk, sweetened
- 144 beurre
- 145 fromage (hard, in slices)
- 146 fromage (soft)
- 147 fromage, unspecified
- 148 oeufs

15. Pulses, Dried Vegetables
- 150 lentilles
- 151 dholl embrevade
- 152 dholl gram, dholl petit pois
- 153 mais, concassee
- 154 petit pois, gros pois
- 155 haricots
- 156 emberiques
- 157 other

16. Vegetables
- 160 pommes de terre
- 161 leafy, green and yellow
- 162 root vegetables
- 163 pommes d'amour
- 164 other vegetables (fresh)
- 165 other preserved vegetables
- 169 vegetables, unspecified

17. Fruit
- 170 citrus fruits
- 171 other fresh and frozen fruit
- 172 tinned fruit
- 173 dried fruit (raisins, etc.)
- 174 pistaches
- 175 other nuts

18. Sugar and Confectionery
- 180 sucre blanc
- 181 honey, molasses
- 182 jam, marmalade, confitures
- 183 chocolat
- 184 sweets

19. Other Foods
- 190 soups, packaged or tinned
- 191 sauces, vinaigres
- 192 sel
- 193 poivre
- 194 moutarde
- 195 prepared spices
- 196 fresh spices—girofle, thym, cotomili, etc.
- 199 other condiments

20. Alcoholic Drinks
- 200 beer, ale, porter
- 201 vin
- 202 cider
- 203 rhum
- 204 other spirits—whiskey, eau de vie, etc.
- 209 spirits, unspecified

21. Meals and Rafraichissements

210	repas
211	tiffins, gajacs
212	thé (served in glasses)
213	pain et beurre
221	bombli
222	sardines
271	pommes
280	sucre roux

23. Nonalcoholic Drinks

230	thé (en paquet)
231	café (en poudre)
232	cocoa, drinking chocolate
233	milk drinks, Ovaltine, etc.
234	soft drinks

Appendix E. Persons Contacted in Mauritius

While many persons in Mauritius and the island itself combined to make our research both pleasant and interesting, the following persons were especially informative on the subjects of food and economics.

Department of Agriculture
- Mr. M.D. ffrench-Mullin, Director
- Mr. Antoine Darne, Deputy Director
- Mr. B.D.N. Roy, Acting Deputy Director
- Mr. K. Lutchmeenaraidoo, Senior Agricultural Officer
- Dr. Sydney Moutia, Senior Agricultural Officer
- Mr. Mohamud Sooltangos, Agricultural Officer
- Mr. H. Fougeres, Fisheries Advisor
- Mr. Claude Delaitre, Acting Senior Veterinary Officer
- Mr. L.R. Pascal, Senior Stock Inspector

Central Statistical Office
- Mr. L.E. Honore, Director
- Mr. Rassou, Assistant Statistician
- Mr. H. Ithier, Machine Room Supervisor

Department of Health
- Dr. B. Teelock, Principal Medical Officer
- Dr. H. Ghoorah, Medical Officer

Marketing Board
- Mr. M. Milliken

Others
- Mr. G.W. Adolphe, Supplies Control Officer
- Mr. Aboo Bakar, Export/Import Merchant
- Mr. Philippe Chevreau, United Dairies, Ltd.
- Mr. J. Domen, Government Planning Unit
- Mr. A. d'Emmerez
- Mr. J.E. Felix, Government Printer
- Mr. Jean Francois, Librarian, Mauritius Institute
- Mr. K. Hazareesingh, Secretary to the Premier
- Mr. J.H. Julien
- Miss Vandermere, FAO Nutrition Advisor