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URBAN FOOD CONSUMPTION PATTERNS AND NATIONAL FOOD POLICY IN LIBERIA

Report 4

SUBSTITUTES FOR RICE

March 1987

by

Stephen J. Hiemstra
Restaurant, Hotel, and Institutional Management Department
School of Consumer and Family Science
Purdue University

for

Nutrition Economics Group
Technical Assistance Division
Office of International Cooperation and Development
U.S. Department of Agriculture

A Report Prepared Under Cooperative
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Copies of this report are available from
Stephen J. Hiemstra, Professor,
Restaurant, Hotel, and Institutional Management Department,
School of Consumer and Family Science

155A Stone Hall,
West Lafayette, Indiana 47907
Phone 317/494-6844

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URBAN FOOD CONSUMPTION PATTERNS AND NATIONAL FOOD POLICY IN LIBERIA

Report 4 : SUBSTITUTES FOR RICE

EXECUTIVE SUMMARY

The primary purpose of this report is to examine the nature of the cross-demand relationships between rice and its close substitute foods in Liberia. A secondary purpose is to explore the nutrient contents of selected foods consumed in Liberia. Based on this information, the food impacts of certain agricultural policy alter-natives posed in Report 3 of this series of studies will be presented. The data for this study are taken from information reported in the household survey conducted in March 1986.

Importance of Rice and Substitutes

Rice constitutes the primary starchy food in Liberia, accounting for 58 percent of total expenditures on these foods in the survey. Other cereal products such as wheat flour, cassava, and starchy vegetables make up the remainder. In Monrovia, rice is of lesser importance than in the other six urban areas for which information is available. In these outlying areas, rice accounts for 62 to 90 percent of the total. Even so, bread and flour products are quite important in Monrovia.

The importance of rice is less in terms of poundages of food consumed than in

terms of expenditures, due to the relatively high price paid for rice in comparison with most of its close substitutes. In Mon-rovia, consumption of cassava totals about 8 pounds per capita per month compared with 21 pounds of rice. In Ganta, cassava and rice consumption are about equal. Consumption of cassava varies substan-tially among urban areas and among ethnic groups; little cassava is consumed in Lofa County, for example.

Demand Relationships

Statistical cross-demand relationships were not available for analysis in this study, due to the lack of available data on food price vari-ations. But, flexible income elasticities of demand were available for individual products or groups of products. Comparisons among them, particularly over income groups, give a basis for assessing the relative strengths of demand for substitute foods.

The income elasticities for both country and imported rice are quite low at 0.2 and 0.1, respectively. These elasticities vary from about 0.7 at the lowest income level to -2.9 and -1.4, respectively, at the highest level. They become negative at income levels above $600 to $700 per household per month. This means that at higher income levels, people purchase less rice and more substitute products than at lower incomes, in terms of incremental increases in income.

Rather surprisingly, these elasticities for rice are lower than for cassava, other cereals, and starchy vegetables. The income elasticity for total

cassava becomes negative at income levels above $1,100 per month, but not for processed cassava such as fufu. The mean elastic-ity for all cassava was 0.4, about double that for rice, and for processed cassava, the elasticity was nearly 0.6.

For other cereals and for starchy vegetables (as food groups), the income elasticities are very strong--greater than one--at all levels of income. This means that proportionately more of each of these food groups is purchased at progressively higher income levels. The strength of the demand for these products rivals that for meat and other animal products, other than fish.

The relatively weak demand for rice does not imply less absolute expenditures for rice after allowing for changes in household size. Data classified in terms of per capita income (in contrast to house-hold income classifications in Report 2) show that in Monrovia total rice spending increased from $4.46 per capita at the lowest income level to $5.62 at the highest level. The increase was even stronger in the other urban areas.

Nutrient Contents

Calorie and protein content calculations were made for all of the foods for which quantity data were available. The available data showed total consumption of 2,464 calories in Monrovia and an average of 2,449 calories per capita per day for the seven urban areas. The variation in consumption was quite high, ranging from 1,897 calories in Zorzor to 2,885 calories in Ganta. No allowance was made for inedible portions of foods purchased, nor for losses

or discard of food. An average of 28 percent of food spending was not accounted for in the calculations, because of the lack of quantity data from which to make the calculations.

Comparisons of calorie data with other sources is not precise because of data problems. Moreover, the averages combine members of a house-hold with strikingly different caloric requirements. Nevertheless, the March 1986 survey total of 2,449 calories compares with 2,270 calories reported for Liberia in the 1976/78 survey. In the U.S., 1977-78 data averaged 2,812 calories per capita per day for low-income households. FAO recommends a minimum of 2,200 calories per day.

Rice alone accounted for around one-half of all calories in the food consumed. All starchy food plus palm oil and vegetable oils accounted for about 80 percent of the total. Meat and fish accounted for another 12 percent.

Protein consumption totaled about 71 grams per capita per day in the food available for analysis. Buchanan and Zorzor had the lowest protein consumption levels at 54 and 57 grams, respectively. Fish accounted for the largest single share of protein in the diet with 45 percent of the total (Monrovia). However, rice contributed a substantial amount--31 percent of the total. Cassava leaves and potato greens are also good sources of protein.

Comparative data showed only 46 grams in the 1976/78 survey. U.S. data for 1977-78 reported an average of 99 grams from household data for low income households.

Impacts of Policy Alternatives

Considering food and nutritional impacts of certain income and policy alternatives, a long-term increase in real incomes in Liberia would have positive impacts on nutritional levels of the people. The nature of the demand elasticities suggests that consumption patterns in Liberia would gradually shift in the direction of the food consumption patterns in the U.S. This would mean larger consumption of grains other than rice and larger consumption of meat and fish.

A continuation of recent income declines would have some adverse impacts on nutrition of the country. Rice consumption, however, would decline rather slowly because of its relatively low income elasticity. A 3-percent annual decline in real income would be expected to reduce per capita rice consumption by about 0.5 percent per year. Larger percentage declines would occur for meat and other foods with high demand elasticities. Cassava purchases would decline more than for rice, but cassava consumption may increase for those with home production available. However, projections into the future would not be expected to show declines in total supplies of rice needed because the income impacts would be offset by needs of a growing population and increasing urbanization over time.

One problem with declining incomes is that of distribution of the decline among the population. If income declines are more rapid for the lower income people, the adverse impacts on nutrition will be concentrated on that sector

of the population.

If prices for rice were increased sufficiently to reduce rice imports enough to reach self-sufficiency, substantial adverse impacts on nutritional levels would be expected. Data are not precise. But, it seems likely that one-fourth of the current rice consumption would need to be replaced with cassava on somewhat less than a pound-for-pound basis. In that event, overall declines in consumption of both calories and protein in the range of 7 percent would take place due to the lower nutrient content of cassava. These declines would likely be much larger for the lower income segment of the population.

These declines could be reduced if other cereals were encouraged as a substitute for rice, because of their apparently relatively high demands. These products, principally wheat flour, are also imported. Consequently, their importation may not be encouraged if the objective is to be self-sufficient in all cereal products rather than just rice. On the other hand, Liberia may want to explore the availability of P.L. 480 shipments of wheat or flour from the U.S. in view of these food demands.

Free trade in agricultural products would increase rice consumption because of a reduction in price. The income effects of reduced rice prices would, however, soon spill over into increased purchases of foods with higher demand elasticities. This policy would have a particularly positive impact on nutritional levels in the long run as economic growth was resumed.

URBAN FOOD CONSUMPTION PATTERNS AND NATIONAL FOOD POLICY IN LIBERIA

Report 4: SUBSTITUTES FOR RICE

I. INTRODUCTION

The objective of this report is to explore the nature of the demand for rice relative to the demands for close substitute food products in Liberia. The data for this analysis will be drawn largely from Report 2, Part 1 of this series entitled, Results of the Survey (Hiemstra and Savadogo, 1986a), and Report 2, Part 2, entitled Statistical Analysis (Hiemstra and Savadogo, 1986b).

This report will present detailed consumption and expenditure patterns for various types of rice in relation to similar patterns for various types of cassava, cereals other than rice, and starchy vegetables. Comparisons will be made of selected statistical income-consumption relationships for these various food groups that have been developed earlier. Unfortunately, however, statistical cross-demand coefficients are not available for analysis because variations in consumer prices needed to compute such relationships were not available.

In addition, this study will compute selected nutrient information from the per capita food consumption data developed in Report 2, Part 1. This information will be used to examine some on the nutritional implications for the policy alternatives that were posed in Report 3, Rice Self-Sufficiency in Liberia, (Hiemstra and Savadogo, 1987).

II. CONSUMPTION PATTERNS FOR STARCHY FOODS

A. Per Capita Expenditures

Rice is considered to be the preferred starchy food in Liberia, but it is far from being the only starchy food consumed. Data from the March 1986 household survey showed the following expenditures per capita among competing starchy foods:

	Dollars Per Month	Percent
Rice	$5.41	57.6
Other cereals	1.59	16.9
Cassava	1.24	13.2
Starchy vegetables	1.15	12.3
Total	$9.39	100.0

These data, which are averages for all urban areas in Liberia, show that rice accounts for only a little more than one-half the amount spent on this broad group of competing foods. These figures do not include bananas ($.15) which could also be regarded as a substitute for rice.

Prices for rice per pound generally exceed prices for other starchy foods. Fufu, a processed form of cassava, is the primary exception; it averaged about 40 cents per pound in March 1986, compared with rice at 23 to 30 cents. But, cassava tubers cost an average of only about 7 cents; plantains, 10 cents; sweetpotatoes, 11 cents; and eddoes about 15 cents per pound. This means that in terms of pounds (or calories) of starchy foods, rice is providing less than one-half of the total from this important food group in Liberia.

There also are some important differences among urban areas as to the importance of rice among starchy foods in Liberia. Following is a comparison showing spending per capita on rice as a percentage of total spending for all starchy foods (computed from table 35, Report 2, Part 1):

	Percent
Monrovia	53.5
Buchanan	62.6
Gbarnga	67.6
Ganta	61.6
Sanniquellie	70.5
Zorzor	84.4
Voinjama	90.4
Average	57.6

Zorzor and Voinjama are the urban areas that depend most heavily on rice alone as a starchy food. They purchase very little cassava and cereals other than rice. They also use fewer starchy vegetables than the other urban areas.

B. Income Relationships With Rice

Per capita spending in Report 2 (1) compared spending for various food groups over income categories defined in terms of household income, as is the ususal custom. These data showed that in three urban areas (Monrovia, Gbarnga, and Ganta) per capita spending for rice declined over income groups. For example, in Monrovia, per capita spending for total rice declined for $7.60 per person per month for households with incomes below $100 per month to $4.26 per capita for households with incomes exceeding $1,500 per month. However, in the remaining four urban areas, per capita spending increased over income groups.

Statistical demand analysis in Report 2 (2) showed a positive income elasticity at the mean income (.16). But, this elasticity declined sharply over income groups and became negative at income levels above $600 per month (table 1 and fig. 1).

In order to further analyze this relationship, the data from Report 2 (1) were retabulated in terms of per capita rather than household income groups. This was done because it was noted that there was a considerable increase in household size over income groups. The food expenditure data were arrayed in terms of deciles of per capita incomes.

These data show that rice expenditures per capita increase over income

Table 1. Income Elasticity of Demand for Starchy Foods, Animal Products, and Total Food, by Income Group, Based on AIDS Model, Urban Areas in Liberia, March 1986.

Income Group	Country Rice	Imported Rice	Total Rice	Cassava Tuber	Processed Cassava	Total Cassava
Mean	.21	.12	.16	.30	.56	.41
$ 0 - 99	.70	.64	.67	.42	.75	.59
100 - 199	.63	.50	.56	.58	.69	.62
200 - 299	.46	.34	.39	.45	.63	.52
300 - 399	.43	.15	.28	.37	.50	.42
400 - 499	.31	.03	.16	.09	.53	.29
500 - 599	.12	.14	.13	.53	.67	.58
600 - 699	-1.27	.17	-.08	.25	.72	.51
700 - 899	-.43	-.46	-.45	-.07	.23	.04
900 - 1,099	-1.65	-.20	-.50	.24	.37	.29
1,100 - 1,499	-2.16	-.91	-1.24	-.72	.26	-.23
1,500 +	-2.93	-1.42	-1.82	-1.30	.32	-.33

Income Group	Other Cereal	Other Starchy	Fish	Animal Products	Food at Home	Total Food,Bev
Mean	1.13	1.10	.49	1.25	.66	.67
$ 0 - 99	1.16	1.08	.70	1.42	.79	.80
100 - 199	1.13	1.09	.71	1.30	.76	.77
200 - 299	1.16	1.11	.63	1.27	.72	.73
300 - 399	1.16	1.08	.54	1.26	.68	.70
400 - 499	1.12	1.07	.53	1.21	.68	.70
500 - 599	1.14	1.11	.48	1.23	.65	.66
600 - 699	1.07	1.10	.38	1.22	.66	.69
700 - 899	1.15	1.12	.17	1.23	.54	.56
900 - 1,099	1.11	1.10	.22	1.25	.55	.57
1,100 - 1,499	1.12	1.11	.08	1.22	.50	.53
1,500 +	1.17	1.21	-.43	1.24	.36	.40

Source: Hiemstra and Savadogo, Statistical Analysis, Report 2, Part 2, table 2.

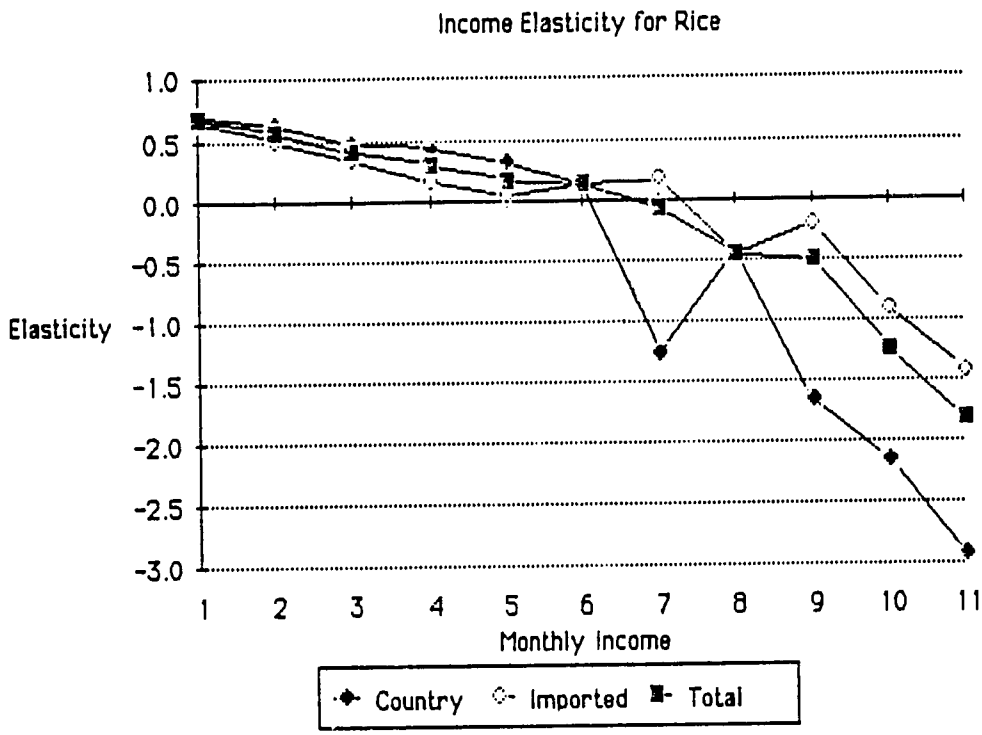

Figure 1

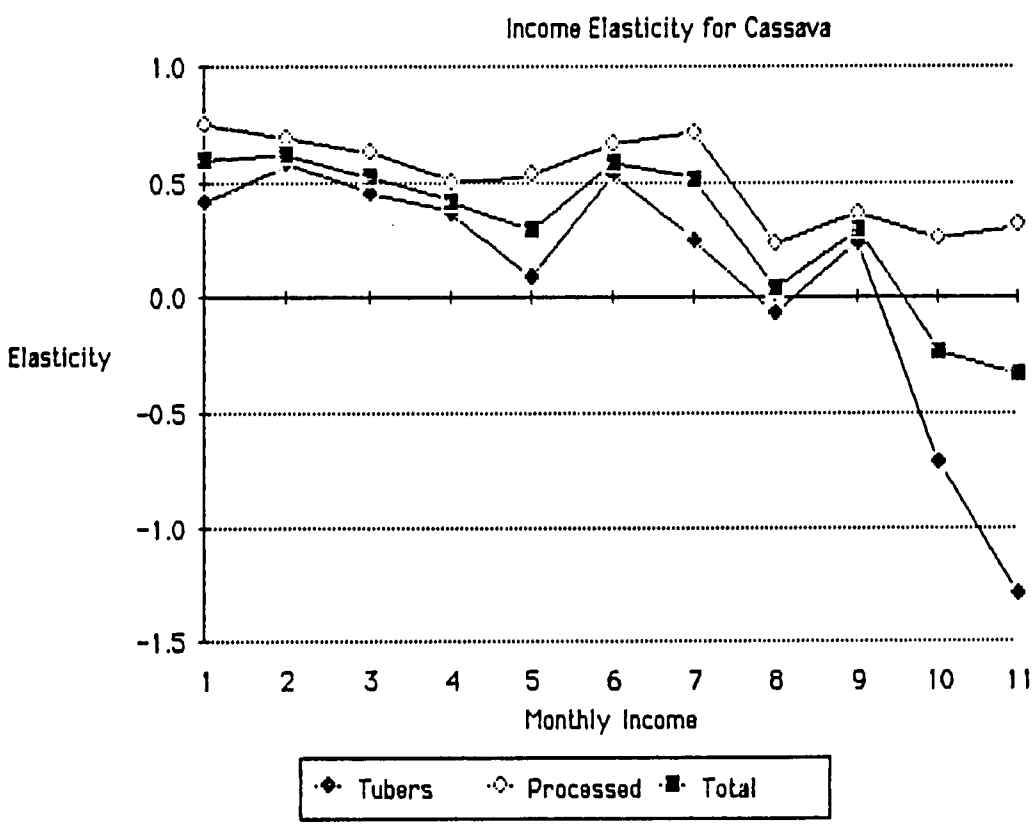

Figure 2

level when the income data are controlled for household size. Per capita rice expenditures in Monrovia increased from $4.46 per capita at the lowest per capita income level to $5.81 at the highest income level, an increase of 30 percent (table 2).

These data are not inconsistent with a declining income elasticity of demand for rice over income levels. The data show that as income increases, more rice is purchased in absolute terms, but the increase in purchases of rice is much less than the rate of increase in per capita incomes. Mean incomes of the income groups in table 2 increased from $14 per capita at the lowest level to $760 at the highest level. This is an increase of more than 50 fold. Meanwhile, per capita rice expenditures increased only 30 percent in Monrovia.

The strength of the demand for rice in Monrovia is not as strong as in the other urban areas for which data are available. Combining the data from the other six urban areas shows that rice expenditures increase by 75 percent over the income range compared with 30 percent in Monrovia. Furthermore, the demand for imported rice is not as strong as for country rice.

In the outlying urban areas, rice expenditures for country rice increased by 89 percent over the income range, compared with 60 percent for imported rice (table 3). Similar data for Monrovia are not as valid because of the very small amount of country rice available.

Table 2. Per Capita Monthly Expenditures for Starchy Foods, Animal Products, and Total Food, by Deciles of Per Capita Income, Monrovia, March 1986.

Income Group	Country Rice	Imported Rice	Total Rice	Cassava Tubers	Fufu	Gari	Total Cassava
$ 0 - 28	$.025	$4.433	$4.458	$.398	$.228	$.032	$.658
29 - 38	.000	3.905	3.905	.840	.493	.269	1.602
39 - 46	.000	4.981	4.981	.492	.290	.058	.840
47 - 56	.029	4.913	4.942	.901	.317	.130	1.349
57 - 66	.000	5.659	5.659	1.021	.436	.135	1.592
67 - 82	.445	4.793	5.238	.662	.500	.188	1.350
83 - 101	.013	6.551	6.564	.633	.478	.096	1.206
101 - 148	.373	4.693	5.065	.623	.449	.498	1.570
149 - 215	.178	5.828	6.006	.655	.733	.232	1.620
215 - 1,306	.197	5.618	5.815	1.641	.778	.414	2.833

Income Group	Other Cereal	Other Starchy	Total Starchy	Meat	Fish	Poultry, Milk	Total Food, Bev.
$ 0 - 28	$.327	$.379	$5.822	$.593	$2.195	$.194	$12.351
29 - 38	.544	.300	$6.351	1.395	2.671	.481	16.244
39 - 46	.886	.396	$7.103	1.813	3.424	1.160	19.837
47 - 56	1.579	1.381	$9.251	1.874	3.938	1.262	23.894
57 - 66	2.672	.974	$10.897	3.149	3.347	.828	27.920
67 - 82	2.352	1.103	$10.043	2.527	4.739	2.795	34.286
83 - 101	2.510	1.373	$11.653	3.706	3.947	2.890	36.226
101 - 148	3.243	1.822	$11.700	6.099	4.579	4.062	47.566
149 - 215	3.897	3.825	$15.348	7.046	6.092	5.621	56.321
215 - 1,306	3.631	2.056	$14.335	8.021	7.292	6.526	63.501

Table 3. Per Capita Monthly Expenditures for Starchy Foods, Animal Products, and Total Food, by Deciles of Per Capita Income, Six Urban Areas, March 1986.

Income Group	Country Rice	Imported Rice	Total Rice	Cassava Tubers	Fufu	Gari	Total Cassava
$ 0 - 28	$2.307	$2.222	$4.529	$.208	$.066	$.048	$.322
29 - 38	2.343	2.501	4.844	.364	.118	.045	.527
39 - 46	2.420	2.876	5.296	.267	.186	.022	.475
47 - 56	2.939	3.280	6.219	.471	.202	.086	.760
57 - 66	3.365	2.354	5.719	.443	.114	.025	.582
67 - 82	3.879	2.327	6.206	.652	.261	.090	1.003
83 - 101	4.789	2.286	7.075	.304	.173	.076	.553
101 - 148	5.176	2.257	7.433	.764	.237	.085	1.085
149 - 215	4.796	4.114	8.910	1.049	.567	.135	1.751
215 - 1,306	4.367	3.564	7.931	.836	.584	.244	1.664

Income Group	Other Cereal	Other Starchy	Total Starchy	Meat	Fish	Poultry, Milk	Total Food, Bev.
$ 0 - 28	$.084	$.226	$5.161	$.146	$1.409	$.074	$9.184
29 - 38	.221	.485	$6.077	.496	1.692	.373	12.277
39 - 46	.307	.531	$6.609	.553	2.692	.624	14.665
47 - 56	.825	.613	$8.417	1.238	2.676	1.042	19.009
57 - 66	.434	.845	$7.580	1.462	2.956	.884	19.351
67 - 82	.711	1.360	$9.280	2.135	3.108	1.363	23.047
83 - 101	.595	.889	$9.112	1.846	3.464	1.618	24.206
101 - 148	.789	2.290	$11.597	2.693	3.874	1.972	31.653
149 - 215	.960	1.954	$13.575	3.324	4.007	2.331	37.137
215 - 1,306	2.439	2.117	$14.151	5.502	5.097	6.696	49.256

However, the data support the same conclusion: imported rice spending increased 27 percent compared with 30 percent for total rice.

The statistical analysis in Report 2 (2) shows a slightly higher income elasticity of demand for country compared with imported rice (0.21 vs. 0.12) at the means. Even so, the elasticities for country rice become negative at a somewhat lower level of income than for imported rice and decline more rapidly at the upper income levels (table 1 and fig.1).

C. Demand for Cassava

The demand for cassava in total is much stronger than it is for rice (table 1). This strong demand is shown in figure 2 to be associated primarily, but not entirely, with processed cassava. Processed cassava, fufu and gari, has a much higher income association than does cassava tubers. The mean income elasticities are 0.56 and 0.30, respectively. The elasticities for both products decline over income groups, but only for the tubers does the elasticity become negative. Even so, the demand for the tubers remains higher than for rice, as can be noted in comparing figures 1 and 2.

Despite their higher demand elasticities, per capita expenditures for all types of cassava products are much less than for rice, as noted above, at least during the survey period. In terms of poundages, the differences are much less in some of the urban areas studied, but there is a wide variation in use of cassava. In Ganta, which had the

highest use of cassava, per capita expenditures were about the same as for rice, 22 pounds each, as noted below (from Report 2, Part 1, table 62).

	Total Rice	Cassava Tubers	Fufu
		(pounds per capita)	
Monrovia	21.0	6.6	1.4
Buchanan	19.5	5.6	1.7
Gbarnga	20.0	11.2	1.1
Ganta	21.9	20.9	.7
Sanniquellie	24.5	10.8	.2
Zorzor	20.1	2.8	.1
Voinjama	28.2	.9	.2

There also are substantial differences among areas in the types of cassava used. Fufu is more prevalent in the coastal areas than in the interior. The tubers are much more prevalent in Nimba and Bong Counties.

The use of cassava varies substantially by ethnic group as well as geographically. In fact, it may be the ethnic differences that account for the geographic differences. Per capita expenditures for cassava vary nearly 10 fold, from $.22 to $2.12 per capita per month, between ethnic groups at the top and bottom in terms of rankings by expenditures for total cassava, as noted below:

Ethnic Group	Per Capita Expenditures for Cassava
Kissi	$.22
Lorma	.27
Mandingo	.31
Gbandi	.33
Sarpo	.34
Expatriates	.56
Kpelle	.85
Mano	.91
Vai	1.08
Other Liberians	1.18

Grebo	1.20
Belle	1.24
Gio	1.40
Kru	1.41
Krahn	1.45
Other Africans	1.50
Bassa	1.55
Mande	2.00
Gola	2.12

Following is a tabulation showing the principal ethnic group in each urban area, according to the survey. Data show percentages of total household heads [table F, Report 2 (1)]:

Urban Area	Ethnic Group	Percent of total
Monrovia	Kru	20
Buchanan	Bassa	68
Gbarnga	Kpelle	60
Ganta	Mano	39
Sanniquellie	Mano	50
Zorzor	Lorma	61
Voinjama	Mandingo	44

Monrovia is more of a "melting pot" of all ethnic groups than is any other urban area. The percentage of Bassa, at 18 percent, was almost as large as for Kru. One must recall, however, in interpreting these data that the sample in each outlying urban area was concentrated in three contiguous areas (Monrovia had six). Since people tend to live in clusters by ethnic groups, this sampling procedure may introduce a bias in the ethnic data.

D. Demand for Other Rice Substitutes

The income relationships for all other major substitute products are also all stronger than for rice. The data in table 2 show that per capita expenditures for both "cereals other than rice" and "other

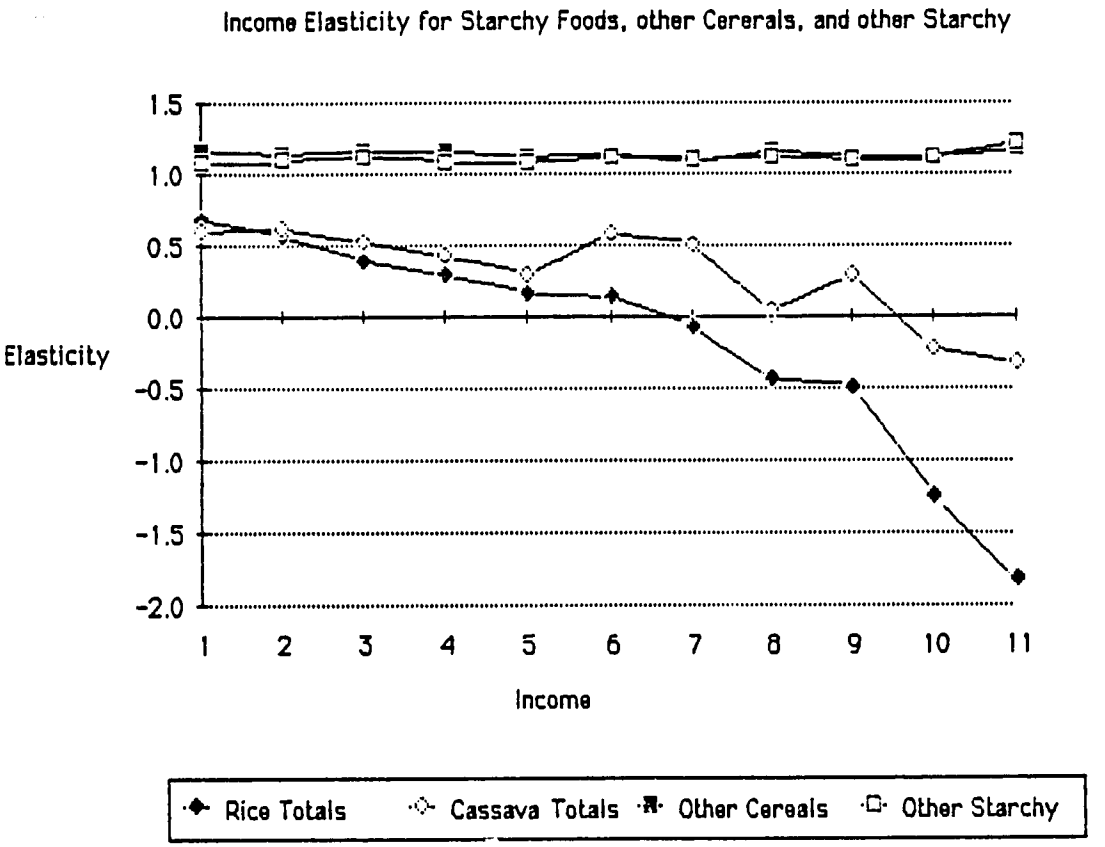

Figure 3

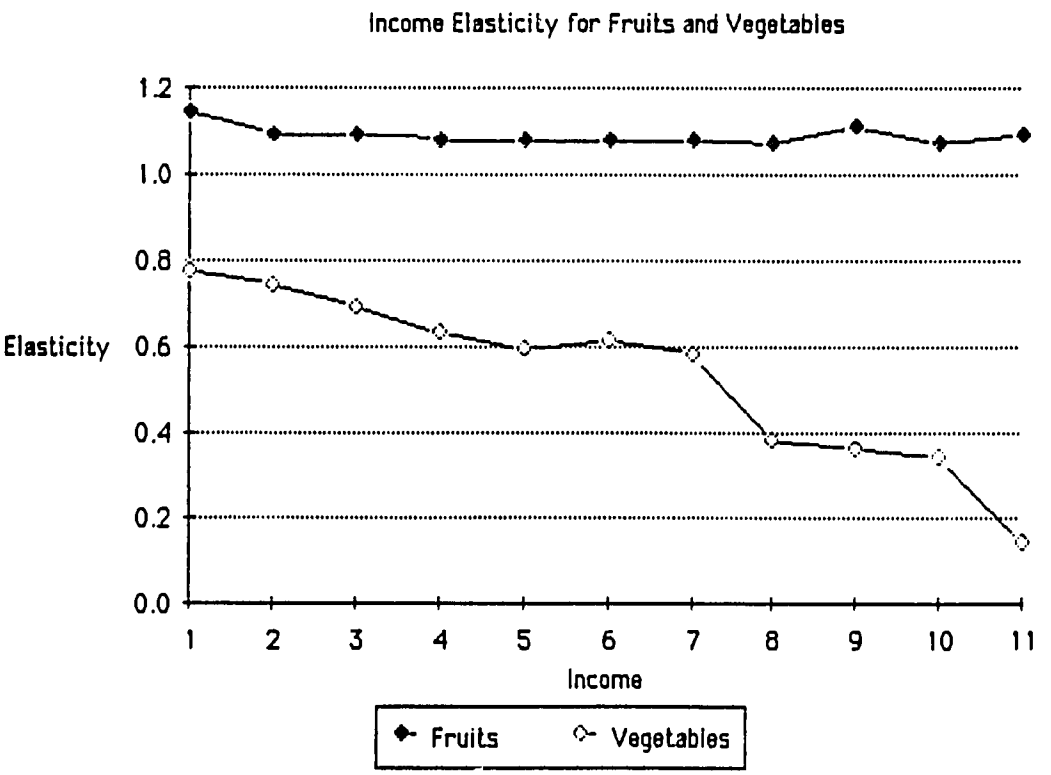

Figure 4

starchy foods" increase much more rapidly over income groups than does rice. Figure 3 compares the elasticities for each of the three major substitute groups with rice and clearly shows that rice has the least increase in consumption over increases in income. Both other cereals and other starchy foods have income elasticities that exceed one, which puts them in a class with fruits and animal products in terms of having high preferences over income groups (figures 4 and 5).

In a broad sense, all foods are substitutes for rice. Income elasticities for the average of all food products declines over income groups from 0.8 at the lowest income to 0.4 at the highest income level and averages .67 (figure 6). These levels much exceed demand levels for rice, particularly at the higher income levels when the demand for rice is strongly negative but for total food remains much above zero.

Cereals other than rice are purchased in larger quantities in Liberia than perhaps is popularly understood. Following are per capita expenditures per month by item:

	Dollars Per Month
Bread and Flour	$1.14
Cornmeal	.25
Noodles and Pasta	.06
Other Cereals	.13

In all cases, Monrovia is the area with the highest expenditures for these products and Buchanan is second, but they are available in all urban areas. Bread and flour products, particularly, were purchased

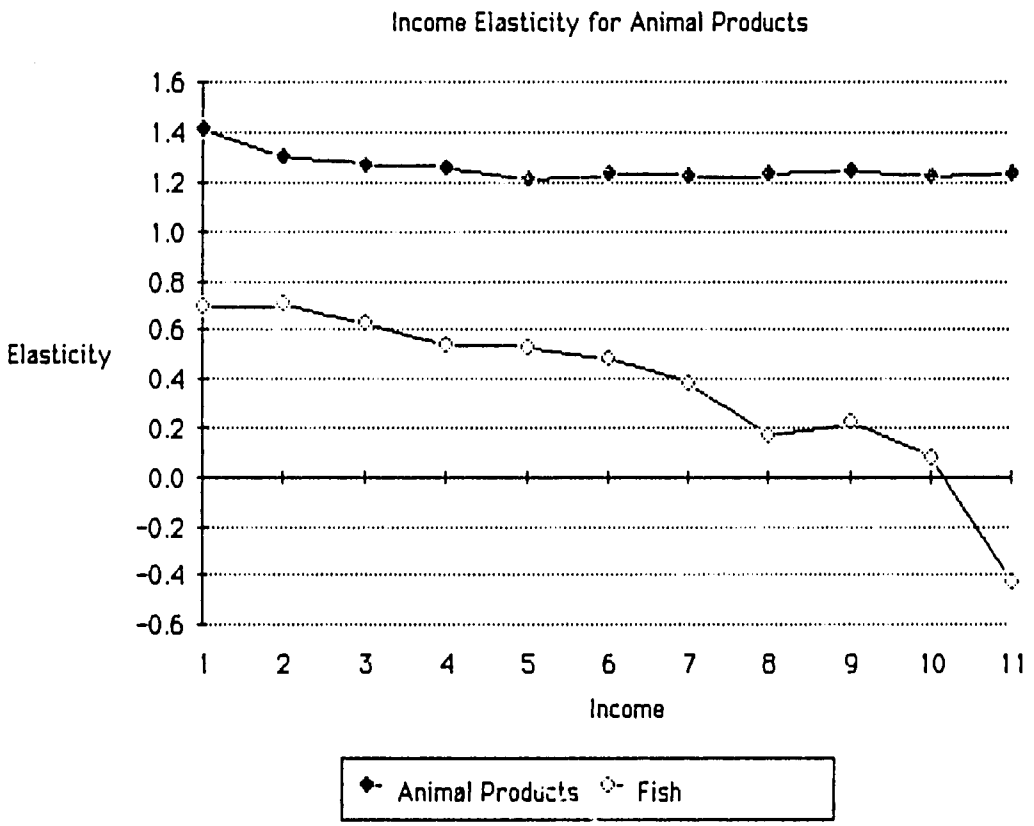

Figure 5

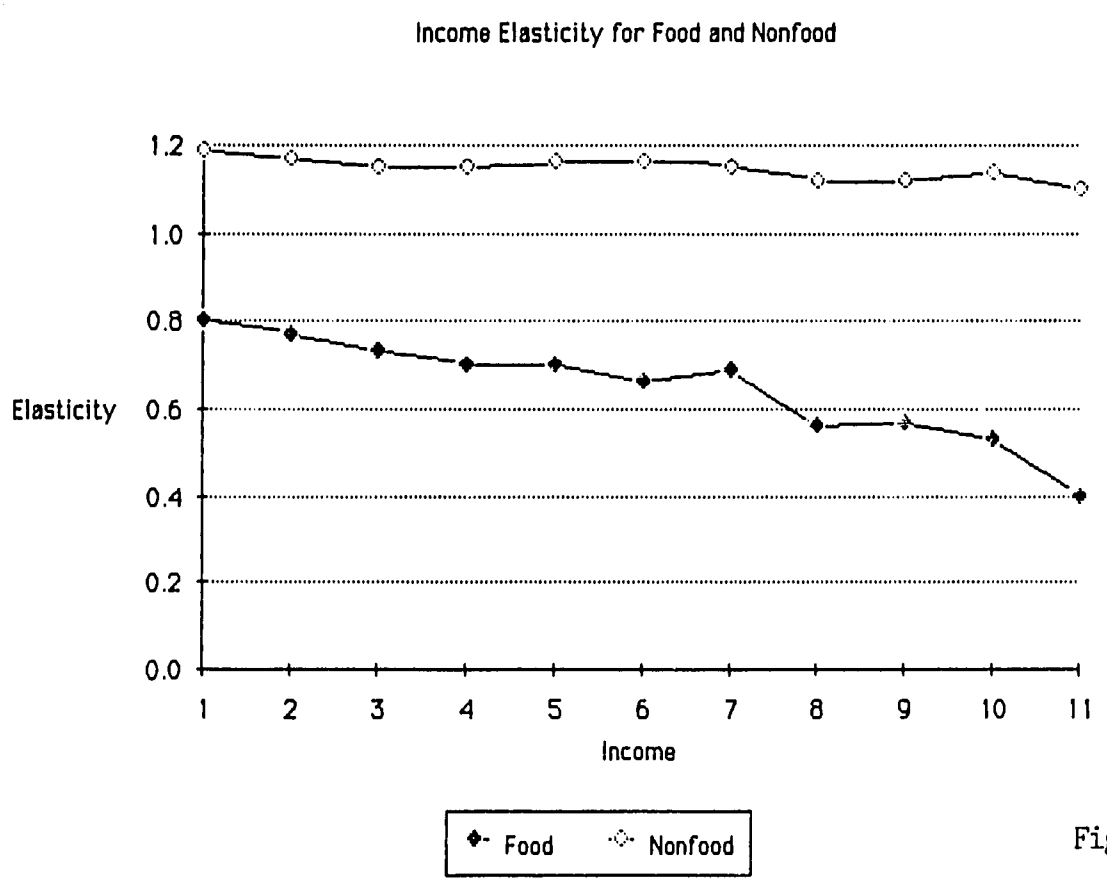

Figure 6

widely in all areas except for Voinjama. Following are percentages of households purchasing bread or flour products in March 1986:

	Percent of Households Purchasing
Monrovia	81.8
Buchanan	75.4
Gbarnga	53.8
Sanniquellie	46.1
Zorzor	50.0
Voinjama	.8

Cornmeal was purchased by more households in Buchanan than elsewhere.

III. NUTRIENTS IN PURCHASED FOODS

A. Procedures Used

The average per capita consumption of food products reported in Report 2, Part 1, is reported in this section in terms of their caloric and protein contents. Only those products for which pounds of food are available could be used in these computations (from table 62). Most of the major products are included, but foods for which prices were not collected in the survey could not be used.

Omitted foods include all of the "other cereals" such as bread and flour, cornmeal, and noodles, and all of the "other foods," which include sugar, salt, coffee, tea, and soft drinks. White potatoes, beniseed, lamb and goat, poultry, eggs, milk, maggi cubes, avocados, and foods purchased and used away from home were also omitted. Quantity data for beer were estimated on the basis of value of purchases reported but cane juice and palm wine were omitted.

In total, monthly household food and beverage purchases of $48.31 out of the total of $173.38, or 28 percent of the total in terms of average dollar values for the seven urban areas, could not be included in the computations due to the lack of quantity data (tables 3 to 14, Report 2, Part 1). It is hard to assess the importance of these foods in terms of their nutrients, because they tended to be specialized products.

These computations were made without regard for inedible portions of food products, due to the lack of information on appropriate factors to use in converting food products from their form as purchased to the form as eaten. Loss of nutrients due to removal of inedible portions of products is less of a problem for most crop products, for example rice, than it is for animal products. Nevertheless, failing to allow for inedible food portions results in an unknown upward bias in the resulting data because the nutrient composition data are on an edible weight basis.

Similarly, no allowance was made in the data to allow for loss of food or nutrients that might result from food processing or marketing, food used for pets, losses during food preparation, or discard of food scrapes. There is little basis for making these kinds of adjustments, however, it should be recognized that some losses likely occur. In the United States, 5 percent is deducted for food losses by low income people in the computation of the Thrifty Food Plan (for purpose of

determining food stamp allotments) (U.S. Department of Agriculture, 1975). As much as 30 percent of food loss is allowed by USDA in the computation of the "liberal food plan" for the highest income consumers (Peterkin, 1974).

Food losses in Liberia would likely be less than in the U.S., even for it's low-income consumers, for several reasons. Relatively lower income levels would induce people to more careful with use of food. Also, the types of food commonly eaten, particularly rice, would have relatively little loss. In addition, large households would likely have less food leftover from their meals. On the other hand, the lack of refrigeration would increase the spoilage of certain kinds of food.

Nutrient composition data were taken from the study by Heather Warrack-Goldman, The Nutrition of Children in a Coastal African (Liberia) Food Economy (1979). They had been compiled from a number of sources but primarily from Food and Agriculture Organization's Food Composition Tables, Minerals and Vitamins for International Use, (1954). Consequently, the composition data are rather old but likely the best available in terms of foods appropriate to Liberia.

B. Findings

1. Calories. The estimated number of calories per capita per day ranged from a low of 1,897 in Zorzor to 2,885 in Ganta (table 4). This is a surprisingly wide range considering that they are urban area averages. Monrovia consumed an average of 2,464 calories per day,

Table 4. Estimated Calories Per Capita Per Day in Food Products Purchased in Urban Areas in Liberia, March 1986.

Urban Areas	Country Rice	Imported Rice	Concess. Rice	Total Rice	Cassava Tubers	Fufu	Total Cassava
	(calories per day)						
Monrovia	21	1,107	33	1,160	111	40	150
Buchanan	179	891	9	1,079	93	50	142
Gbarnga	469	634	0	1,104	186	30	216
Ganta	919	263	21	1,203	348	20	369
Sanniquellie	1,006	343	0	1,349	181	4	185
Zorzor	525	584	0	1,109	46	2	48
Voinjama	1,260	292	0	1,552	14	4	19

Urban Areas	Farina	Sweet Potatoes	Eddoes	Plantains	Total Starchy	Beans, Dry	Beef	Pork, Pig Feet
	(calories per day)							
Monrovia	19	8	18	24	1,380	18	14	123
Buchanan	15	11	33	29	1,310	7	9	44
Gbarnga		7	89	39	1,455	35	4	52
Ganta		17	50	163	1,802	31	4	26
Sanniquellie		74	37	58	1,702	9	6	28
Zorzor		5	17	33	1,213	12	6	8
Voinjama		4	35	31	1,641	43	0	14

Urban Areas	Bush Meat	Fish	Palm Oil, Kernal	Vege. Oil	Pumpkin	Bitter-balls	Cassava Leaves	Potato Leaves
	(calories per day)							
Monrovia	9	160	453	138	1	6	30	24
Buchanan	4	98	325	31		5	63	15
Gbarnga	10	119	571	39		14	43	42
Ganta	27	217	530	44		27	53	53
Sanniquel	7	128	506	72		9	132	39
Zorzor	10	113	375	17		6	64	25
Voinjama	14	172	695	11		6	90	57

Urban Areas	Okra	Tomatoes	Peppers	Citrus Fruit	Pine-apples*	Bananas	Beer	Total Food, Bev.
	(calories per day)							
Monrovia	3	2	11	4	2	7	77	2,464
Buchanan	1	2	12	5	2	13	19	1,964
Gbarnga	3	2	34		1	8	27	2,459
Ganta	1	5	28		0	9	26	2,885
Sanniquel	2	1	10		1	9	25	2,686
Zorzor	1	1	11		1	13	21	1,897
Voinjama	0	4	25		2	23	64	2,859

Source: Based on quantity data from Hiemstra and Savadogo, Report 2 (1), table 62, except for added data on beer.

Note: Blanks indicate that no information was available.

*Includes paw paw and plums.

Table 5. Percentages of Total Calories Per Capita Per Day in Various Food Products Purchased in Urban Areas in Liberia, March 1986.

Urban Areas	Country Rice	Imported Rice	Concess. Rice	Total Rice	Cassava Tubers	Fufu	Total Cassava
	(percent of total)						
Monrovia	.8	44.9	1.3	47.1	4.5	1.6	6.1
Buchanan	9.1	45.4	.4	54.9	4.7	2.5	7.2
Gbarnga	19.1	25.8	.0	44.9	7.6	1.2	8.8
Ganta	31.8	9.1	.7	41.7	12.1	.7	12.8
Sanniquellie	37.5	12.8	.0	50.2	6.7	.2	6.9
Zorzor	27.7	30.8	.0	58.5	2.4	.1	2.6
Voinjama	44 1	10.2	.0	54.3	.5	.2	.7

Urban Areas	Farina	Sweet Potatoes	Eddoes	Plantains	Total Starchy	Beans, Dry	Beef	Pork, Pig Feet
	(percent of total)							
Monrovia	.8	.3	.7	1.0	56.0	.7	.6	5.0
Buchanan	.8	.6	1.7	1.5	66.7	.3	.4	2.3
Gbarnga	.0	.3	3.6	1.6	59.2	1.4	.2	2.1
Ganta	.0	.6	1.7	5.7	62.5	1.1	.1	.9
Sanniquel	.0	2.7	1.4	2.2	63.4	.3	.2	1.0
Zorzor	.0	.3	.9	1.8	63.9	.6	.3	.4
Voinjama	.0	.1	1.2	1.1	57.4	1.5	.0	.5

Urban Areas	Bush Meat	Fish	Palm Oil, Kernal	Vege. Oil	Pumpkin	Bitter-balls	Cassava Leaves	Potato Leaves
	(percent of total)							
Monrovia	.4	6.5	18.4	5.6	.0	.2	1.2	1.0
Buchanan	.2	5.0	16.5	1.6	.0	.2	3.2	.8
Gbarnga	.4	4.8	23.2	1.6	.0	.6	1.8	1.7
Ganta	1.0	7.5	18.4	1.5	.0	.9	1.8	1.8
Sanniquel	.3	4.8	18.9	2.7	.0	.3	4.9	1.4
Zorzor	.5	6.0	19.8	.9	.0	.3	3.4	1.3
Voinjama	.5	6.0	24.3	.4	.0	.2	3.1	2.0

Urban Areas	Okra	Tomatoes	Peppers	Citrus Fruit	Pine-apples*	Bananas	Beer	Total Food, Bev.
	(percent of total)							
Monrovia	.1	.1	.5	.2	.1	.3	3.1	100.0
Buchanan	.0	.1	.6	.2	.1	.6	1.0	100.0
Gbarnga	.1	.1	1.4	.0	.0	.3	1.1	100.0
Ganta	.0	.2	1.0	.0	.0	.3	.9	100.0
Sanniquel	.1	.0	.4	.0	.0	.3	.9	100.0
Zorzor	.0	.0	.6	.0	.1	.7	1.1	100.0
Voinjama	.0	.1	.9	.0	.1	.8	2.2	100.0

Source: Based on data in table 4.

*Includes paw paw and plums.

which was close to the weighted average of 2,449 calories for the seven urban areas. The data represent average consumption for the entire households with no regard for any variations in composition of individuals within a household.

Both Buchanan and Zorzor had average consumption levels that fell well below the 2,200 calorie level that is often regarded as a minimum for healthy living (FAO). Even averages that exceed this level likely have some households below the 2,200 level. However, there is no adequate measure of the amount of dispersion in relation to needs. The data relate to a data collection period of 7 days which may not be representative of longer term food consumption for a given household. Furthermore, it must be recalled that 28 percent of average food expenditures are not represented in the calorie computations, so a 1,900 calorie level should not be regarded as unduely low.

Rice alone accounted for around one-half of all calories in the food purchased (table 5). All starchy foods plus palm oil accounted for about three-fourths of the total calories measured. These two foods accounted for only about 40 percent of total food spending which shows that they are both concentrated sources of calories.

Data from the 1976-78 survey in Liberia showed per capita consumption of 2,270 calories in urban areas and 2,151 in rural areas (Pay-Bayee, Tun, and Yetley, 1983). Of this amount, 1,067 calories were from rice or 47 percent of the total, in urban areas. Oil accounted for another

31 percent of the total, which exceeded consumption in the 1986 survey. Comparison with these earlier data would suggest some increase in overall caloric consumption over the past decade, however, data collection and calculation methods of the two studies may differ significantly and therefore make such a conclusion tentative. Pay-Bayee, Tun, and Yetley compared their findings with an FAO recommendation of 2,200 calories per day in concluding that consumption levels appeared adequate.

A comparison of calories consumed in Liberia with those consumed in other countries is difficult to make with any precision, in view of the number of omitted foods and the lack of information on inedible portions and food waste and loss. Nevertheless, U.S. data from the low income segment of the 1977-78 nationwide household survey (the latest data available) yielded average consumption of 2,812 calories per day when measuring data from the entire households, as was done in Liberia (U.S. Department of Agriculture, 1981).

The U.S. results were quite different when based on data collected from selected individuals within households. On that basis, consumption averaged only 1,826 calories per day from the 1977-78 survey (U.S. Department of Agriculture, 1984). These striking differences between data based on average household use and individual intake data presumably are due to the differing types of data that are collected in each case. The intake data are more refined in terms of relating to physical intakes of representative persons in specified sex-age

groups and they omit various nutrient losses discussed above with respect to the Liberian data. However, USDA has never published a reconciliation of the above two sets of data.

USDA also publishes another set of data that can be used as a general comparison, but the methodology differs considerably because they are not based on household surveys. USDA's per capita consumption data, which are based on supply and utilization data converted to their retail-weight equivalents (so-called disappearance data), are converted to their nutrient equivalents and published by the Economic Research Service. These data show average consumption of 3,450 calories per capita per day for 1984 (U.S. Department of Agriculture, 1985). These data contain no deduction for waste or losses of food but are adjusted to omit inedible portions.

A comparison of the share of calories coming from different food groups based on the USDA's individual intake data shows that only 25.8 percent comes from all grain products and another 4.2 percent from fats and oils. This is in marked contrast with the 56.0 percent of calories coming from all starchy foods and another 24.0 percent coming from palm and other vegetable oils in Monrovia (table 5). A total of 28.4 percent of calories in the U.S came from meat, poultry, and fish, compared with 12.5 percent in Monrovia from meat and fish (poultry data are missing).

2. Protein. Protein in the available foods purchased in the March 1986 urban survey totaled about 72 grams per day, in Monrovia (table 6). The weighted average for the seven urban areas was 70.8 grams. As in the case of calories, a substantially amount of variation existed among the urban areas surveyed even though Monrovia was close to the average. Zorzor and Buchanan had the lowest protein consumption at 57 and 54 grams, repectively.

Comparative data from USDA's 1977-78 survey showed 68 grams from the individual intake data for the average of all individuals and 99 grams from the household data for low income households. USDA's disappearance data show 102 grams of protein consumed per capita per day in 1984.

Fish accounted for the largest single share of protein in the diet, with 45 percent of the total in Monrovia (table 7). However, rice contributed a substantial amount of protein to the total, 31 percent in Monrovia and up to 38 percent in Buchanan. Meat and beans are relatively high sources of protein, but consumption levels are too low to be major sources of total protein consumption. Cassava leaves and potato greens are also good protein sources in some areas, particularly in Sanniquellie.

Meat, poultry, and fish contributed 49 percent of total protein in U.S. diets in 1977-78, according to the survey of individuals. Grain products contributed only 18 percent compared with 31 percent in

Table 6. Estimated Protein Per Capita Per Day in Food Products Purchased in Urban Areas in Liberia, March 1986.

Urban Areas	Country Rice	Imported Rice	Concess. Rice	Total Rice	Cassava Tubers	Fufu	Total Cassava
	(grams per day)						
Monrovia	.4	21.2	.6	22.2	.9	.2	1.1
Buchanan	3.4	17.1	.2	20.6	.7	.2	1.0
Gbarnga	8.8	12.2	.0	21.0	1.5	.1	1.6
Ganta	17.2	5.0	.4	22.7	2.8	.1	2.9
Sanniquellie	18.9	6.6	.0	25.4	1.4	.0	1.5
Zorzor	9.9	11.2	.0	21.0	.4	.0	.4
Voinjama	23.6	5.6	.0	29.2	.1	.0	.1

Urban Areas	Farina	Sweet Potatoes	Eddoes	Plantains	Total Starchy	Beans, Dry	Beef	Pork, Pig Feet
	(grams per day)							
Monrovia	.1	.1	.3	.2	24.0	1.4	1.1	5.7
Buchanan	.0	.2	.6	.3	22.6	.5	.7	2.0
Gbarnga		.1	1.6	.3	24.6	2.6	.3	2.4
Ganta		.3	.9	1.4	28.1	2.3	.3	1.2
Sanniquellie		1.2	.6	.5	29.3	.7	.4	1.3
Zorzor		.1	.3	.3	22.1	.9	.5	.4
Voinjama		.1	.6	.3	30.3	3.2	.0	.6

Urban Areas	Bush Meat	Fish	Palm Oil, Kernal	Vege. Oil	Pumpkin	Bitter-balls	Cassava Leaves	Potato Leaves
	(grams per day)							
Monrovia	1.6	32.0	.0	.0	.0	.2	2.3	2.3
Buchanan	.7	19.6	.0	.0		.2	4.9	1.4
Gbarnga	1.7	23.9	.0	.0		.6	3.3	4.0
Ganta	4.7	43.5	.0	.0		1.1	4.0	5.0
Sanniquel	1.2	25.7	.0	.0		.4	10.1	3.7
Zorzor	1.8	22.7	.0	.0		.2	4.9	2.4
Voinjama	2.4	34.5	.0	.0		.3	6.9	5.3

Urban Areas	Okra	Tomatoes	Peppers	Citrus Fruit	Pine-apples*	Bananas	Beer	Total Food, Bev.
	(grams per day)							
Monrovia	.2	.1	.5	.1	.0	.1	.00	71.6
Buchanan	.1	.1	.5	.1	.0	.2	.00	53.6
Gbarnga	.2	.1	1.5		.0	.1	.00	65.3
Ganta	.1	.2	1.2		.0	.2	.00	92.0
Sanniquel	.1	.0	.4		.0	.2	.00	73.5
Zorzor	.0	.0	.5		.0	.2	.00	56.7
Voinjama	.0	.2	1.1		.0	.4	.00	85.3

Source: Based on quantity data from Hiemstra and Savadogo, Report 2 (1), table 62, except for added data on beer.

Note: Blanks indicate that no information was available.

*Includes paw paw and plums.

Table 7. Percentages of Protein Per Capita Per Day in Food Products Purchased in Urban Areas in Liberia, March 1986.

Urban Areas	Country Rice	Imported Rice	Concess. Rice	Total Rice	Cassava Tubers	Fufu	Total Cassava
	(percent of total)						
Monrovia	.5	29.6	.9	31.0	1.2	.3	1.5
Buchanan	6.3	31.9	.3	38.4	1.4	.4	1.8
Gbarnga	13.5	18.6	.0	32.1	2.3	.2	2.5
Ganta	18.7	5.5	.4	24.6	3.0	.1	3.1
Sanniquellie	25.7	8.9	.0	34.6	2.0	.0	2.0
Zorzor	17.4	19.7	.0	37.1	.7	.0	.7
Voinjama	27.7	6.6	.0	34.3	.1	.0	.2

Urban Areas	Farina	Sweet Potatoes	Eddoes	Plantains	Total Starchy	Beans, Dry	Beef	Pork, Pig Feet
	(percent of total)							
Monrovia	.1	.2	.5	.3	33.5	1.9	1.5	7.9
Buchanan	.1	.3	1.1	.5	42.3	.9	1.3	3.8
Gbarnga	.0	.2	2.4	.5	37.7	4.0	.4	3.7
Ganta	.0	.3	1.0	1.5	30.6	2.5	.3	1.3
Sanniquel	.0	1.7	.9	.7	39.8	.9	.6	1.7
Zorzor	.0	.1	.5	.5	39.0	1.6	.8	.6
Voinjama	.0	.1	.7	.3	35.6	3.7	.0	.7

Urban Areas	Bush Meat	Fish	Palm Oil, Kernal	Vege. Oil	Pumpkin	Bitter-balls	Cassava Leaves	Potato Leaves
	(percent of total)							
Monrovia	2.3	44.7	.0	.0	.0	.3	3.2	3.2
Buchanan	1.3	36.5	.0	.0	.0	.4	9.1	2.6
Gbarnga	2.6	36.6	.0	.0	.0	.9	5.1	6.1
Ganta	5.2	47.3	.0	.0	.0	1.2	4.4	5.4
Sanniquel	1.7	35.0	.0	.0	.0	.5	13.8	5.0
Zorzor	3.2	40.1	.0	.0	.0	.4	8.7	4.2
Voinjama	2.8	40.4	.0	.0	.0	.3	8.1	6.2

Urban Areas	Okra	Tomatoes	Peppers	Citrus Fruit	Pine-apples*	Bananas	Beer	Total Food, Bev.
	(percent of total)							
Monrovia	.2	.1	.7	.1	.0	.2	.0	100.0
Buchanan	.1	.2	.9	.1	.0	.4	.0	100.0
Gbarnga	.2	.1	2.3	.0	.0	.2	.0	100.0
Ganta	.1	.2	1.3	.0	.0	.2	.0	100.0
Sanniquel	.2	.1	.6	.0	.0	.2	.0	100.0
Zorzor	.1	.0	.8	.0	.0	.4	.0	100.0
Voinjama	.0	.2	1.3	.0	.0	.5	.0	100.0

Source: Based on data in table 6.
*Includes paw paw and plums.

Monrovia for rice alone. Milk products contributed 18 percent of total protein in the U.S.--the same share as for all grains.

The 1986 survey showed a substantially higher consumption of protein than did the 1976-78 survey in Liberia. The earlier survey indicated that 46 grams of protein were consumed per day compared with the average of 71 grams in 1986. In the earlier survey, rice contributed 46 percent of the total and meat only 31 percent.

IV. POLICY ALTERNATIVES

This section will examine some of the nutritional and cross-demand implications of selected food policy alternatives considered in Report 3 (Hiemstra and Savadogo, 1986c).

Alternative I: Improving Income Trends Over Time.

A long-term increase in real incomes in Liberia would have positive impacts on nutritional levels of the people. The nature of the demand elasticities suggests that consumption patterns in Liberia would gradually shift in the direction of the food consumption patterns in the U.S. noted above. This means larger consumption of grains other than rice and larger consumption of meat and fish.

Shifts from rice to other cereals would have no adverse effect on calorie or protein consumption. Wheat flour has about the same caloric content as rice (103 calories per ounce for each) and a higher

protein content than does rice (3.1 compared with 2.0 grams per ounce, respectively). In addition, more meat would add to protein consumption.

Alternative II: Continuation of Recent Income Declines.

Declining food consumption in response to declining incomes is bound to have some adverse impacts on nutrition of the country. The relatively low income elasticity of demand for rice is favorable in retaining rice consumption under these circumstances. Report 3 indicated a decline of only about 0.5 percent per year or 1.2 pounds per capita per year in response to a 3 percent rate of real decline in income. Larger declines would occur for meat and other foods with high demand elasticities. Even cassava purchases would decline more than for rice according to these data. However, cassava consumption may increase if it is available from home production.

Total caloric consumption would decline about in line with rice. Protein consumption would drop at a somewhat higher rate, due to declining meat consumption. But, the elasticitiy of demand for fish is not as high as for meat, so total protein consumption would drop more slowly than the rate of income decline.

One problem with declining incomes is that of distribution of the decline among the population. If income declines are more rapid for the lower income people, as is likely, the adverse impacts on nutrition will be concentrated on that sector of the population.

Alternative III: Self-sufficiency for Rice.

If rice prices were increased sufficiently to reduce rice imports enough to reach self-sufficiency, around 25 percent, substantial impacts on nutritional levels would be expected unless steps were taken to cushion the impacts on the low-income sector of the economy.

In the absense of price cross-elasticity data, estimates cannot be precise. However, if one-fourth of the rice consumed were replaced by cassava, pound-for-pound, total consumption of calories in Monrovia would drop by 5.2 percent and total consumption of protein would drop by 5.9 percent, on the average. In fact, the declines would be greater, because of the adverse income impacts of such a price increase.

The overall declines in both calories and protein would likely be in the range of 7 percent. The declines would be greater and, perhaps more onerous, in most of the other urban areas because of the higher levels of rice consumption and less use of cassava.

These adverse nutritional impacts could be reduced to the extent that consumption of other cereals were encouraged as a substitute for rice. However, since these other cereals are also imported, attaining rice self-sufficiency at the expense of increased outside dependency on other cereals may seem like a hollow accomplishment. However, if for example, Liberia could qualify for P.L. 480 shipments of wheat or

wheat flour from the U.S., they would reduce the need for commercial purchases of rice accordingly, and at no reduction in nutritional levels.

Alternative IV: Free Trade in Agricultural Products.

Reducing market prices for rice to world levels would increase consumption. Consumption increases would be the largest for rice, but the income effects of reduced rice prices would soon spill over into increased purchases of foods with higher demand elasticities. This policy would have a particularly positive impact on nutritional levels in the long run as economic growth was resumed. At that point the nutritional impacts would be similar to those discussed under Alternative I.

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Table A. Nutrient Composition of Foods Used in Liberia.

Food Item :	Calories	Protein
	(calories per ounce)	(grams per ounce)
Rice, Country	102.84	1.93
Rice, Imported	103.13	1.99
Cassava, Tubers	31.32	.25
Cassava, Fufu	53.97	.26
Farina	99.72	.28
Sweet Potato	27.16	.45
Eddoe	24.34	.43
Plantain	25.31	.22
Beans, Dry	96.02	7.13
Beef	54.54	4.19
Pork	92.61	4.26
Bush Meat	29.55	5.11
Fish*	51.55	10.34
Palm Oil	248.58	.00
Vegetable Oil	251.14	.00
Pumpkin	5.03	.22
Bitterball	8.24	.34
Cassava Leaf	25.85	1.99
Potato Greens	13.92	1.31
Lettuce	5.68	.34
Okra	8.28	.48
Peppers, Hot	26.70	1.16
Tomato	6.25	.28
Citrus (orange)	8.55	.12
Banana	17.00	.29
Pineapple	8.95	.08
Beer	7.95	.00

Note: Nutrient contents relate to edible portions of food.
*Data for fish represent the average of fresh and dry.
Source: Warrack-Goldman, H., The Nutrition of Children in a Coastal African (Liberian) Food Economy, Graduate School of Cornell University, Ph.D Thesis, January 1979.