# NUTRITION STATUS - RURAL AND URBAN KENYA

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# FOREWORD

The number of undernourished people in the world continues to rise both in absolute terms and as a share of world population. Estimates suggest that about 1,000 millions may not get enough food to meet their energy (calorie) requirements while 450 million of these, or a quarter of the population in the developing market economies, suffer from serious undernutrition. Hunger, the result of deprivation of food in adequate quantity, is one manifestation of the nutrition problem, though by far the most widespread. Raising the food intake of the over 450 million severely undernourished to the level of their nutritional requirements would involve the equivalent of 40-60 million tons of wheat per year. This amounts to no more than 3-5 percent of the present world cereal consumption, or 10-15 percent of the cereals now being fed to livestock in developed countries. These figures are just an indication of the present dimensions of hunger and undernutrition. To solve the problem, one needs to investigate the whole food and agriculture system. This would include consideration of many factors including population distribution and growth, food distribution and pricing, environment and health. The central issue here is the interaction between food production, distribution, consumption and economic policies to solve the hunger problem. The basic requirement is first to identify the population affected by the hunger problem. Within any one country, there are those who overeat and those who do not have access to an adequate quantity of food. A wide variety of social, political and economic factors are responsible for the skewness of the food consumption pattern in any one country as well as that at the international level.

The Food and Agricultural Program at IIASA investigates these issues. Kenya, a market economy has been chosen for an in-depth case study. The results are reported in two working papers. The first paper deals with the quantification of food consumption baskets in various income classes in rural and urban Kenya (Working Paper WP-80-13). The second treats nutritional analysis (Working Paper WP-80-14).

PREFACE

The paper presents a detailed nutritional analysis in the context of the food intake levels of various income groups in rural and urban Kenya. Nutritional surveys covering the majority of the population are not feasible and perhaps not necessary. The main contributions of this study are to provide an overall nutritional picture of Kenya and in particular identify the target groups within the overall population for whom in depth nutritional surveillance may be necessary.

# NUTRITIONAL ANALYSIS

## 1. NUTRITIONAL SITUATION OF THE RURAL POPULATION

Usually two harvests in one year are common in Kenya - the main harvest season being from June to July after the long rains and the minor harvest season in November to December after the short rains. The Integrated Rural Survey was conducted from November 1974 to October 1975 and thus, it includes both harvest seasons. The sample families were surveyed 13 times throughout that year with intervals of exactly 4 weeks, where the enumerator visited the household twice. Therefore, the survey includes the seasonal changes of the food availability; but it has to be kept in mind, that the data represent an agglomeration of the food consumed throughout the whole year. The intakes apply only to a household level.

The nutritional analysis of the food balance sheets derived from this survey was performed as described elsewhere (1) being based mainly on food composition table issued by FAO (2). FAO dietary recommendations (3) and the daily dietary allowances of the National Research Council (4) were mainly used for the interpretations. The requirements of the different groups are listed in Table 1.

It has to be stressed already at this point that the low protein requirement recommended by the FAO Committee (3) are only valid if enough energy is consumed. The very high calcium requirements are based on the American diet with its high meat consumptions; diets in developing countries being mainly vegetarian ones will require probably much lower amounts. However, no recommendations are available for this type of diet.

### 1.1 The Total Rural Population

The diet of the rural population is a very poor one without many variations. The main staple food is derived from cereals, in particular from maize; only small amounts of millet, wheat and rice are eaten. The preference for cereals is followed by starchy roots mainly cassava* and some potatoes. The consumption of beans is surprisingly low for a typical African diet. As expected, only very few fruits and vegetables are consumed. Also the intake of meat, eggs and fish is quite low, which, however, is a general phenomenon in Africa (1), (Table 2).

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* Cassava is used as a synonym for sweet potatoes, cassava roots and yams, and represents the "other starchy roots", [5].

Table 1. Estimation of the Dietary Requirements for the Various Population Groups in Kenya Assuming Two Different Activity Levels.

| Provinces | energy* (kcal) | protein [high quality] (g) | calcium (mg) | iron (mg) | vitamin A (I.U.) | thiamine (mg) | riboflavin (mg) | niacin (mg) | vitamin C (mg) |
|---|---|---|---|---|---|---|---|---|---|
| *I. Rural Population* | | | | | | | | | |
| A. Moderately Active | | | | | | | | | |
| Total Rural | 2220 | 27.8 | 800 | 14 | 4,500 | 1.11 | 1.33 | 14.65 | 45 |
| Central | 2220 | 27.8 | 800 | 14 | 4,500 | 1.11 | 1.33 | 14.65 | 45 |
| Coast | 2200 | 27.5 | 800 | 14 | 4,500 | 1.10 | 1.32 | 14.52 | 45 |
| Eastern | 2210 | 27.6 | 800 | 14 | 4,500 | 1.11 | 1.33 | 14.59 | 45 |
| Nyanza | 2260 | 28.3 | 800 | 14 | 4,500 | 1.13 | 1.36 | 14.92 | 45 |
| Rift Valley | 2220 | 27.8 | 800 | 14 | 4,500 | 1.11 | 1.33 | 14.65 | 45 |
| Western | 2210 | 27.6 | 800 | 14 | 4,500 | 1.11 | 1.33 | 14.65 | 45 |
| B Very Active | | | | | | | | | |
| Total Rural | 2400 | 27.8 | 800 | 14 | 4,500 | 1.20 | 1.44 | 15.84 | 45 |
| Central | 2410 | 27.8 | 800 | 14 | 4,500 | 1.21 | 1.45 | 15.91 | 45 |
| Coast | 2400 | 27.5 | 800 | 14 | 4,500 | 1.20 | 1.44 | 15.84 | 45 |
| Eastern | 2360 | 27.6 | 800 | 14 | 4,500 | 1.18 | 1.42 | 15.58 | 45 |
| Nyanza | 2420 | 28.3 | 800 | 14 | 4,500 | 1.21 | 1.45 | 15.97 | 45 |
| Rift valley | 2390 | 27.8 | 800 | 14 | 4,500 | 1.20 | 1.43 | 15.77 | 45 |
| Western | 2370 | 27.6 | 800 | 14 | 4,500 | 1.19 | 1.42 | 15.64 | 45 |
| *II. Urban Population* | | | | | | | | | |
| A. Light Activity | 2130 | 26.1 | 800 | 14 | 4,500 | 1.065 | 1.28 | 14.06 | 45 |
| B. Moderately Active | 2260 | 27.7 | 800 | 14 | 4,500 | 1.13 | 1.36 | 14.92 | 45 |

* included additional needs for pregnant and lactating (6 months) women and was calculated from the age structure of the particular population group.

Note: A more detailed description of the nutritional requirements is given by Frohberg, H.C. (1979), IIASA Research Report forthcoming.

Table 2. Diet Pattern of the Different Rural Income Classes in 1975.

| | energy (kcal) | protein | | fat (g) | calcium (mg) | iron (mg) | Vitamin A (I.U.) | thiamine (mg) | riboflavin (mg) | niacin (mg) | ascorbic acid (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | crude (g) | high quality (g) | | | | | | | | |
| Total | | | | | | | | | | | |
| cereals | 1358 | 36.3 | 15.4 | 13.2 | 44 | 6.5 | 1186 | 1.20 | 0.36 | 4.92 | - |
| starchy roots | 239 | 2.5 | 1.0 | 0.2 | 49 | 1.2 | - | 0.12 | 0.06 | 1.40 | 53.3 |
| pulses | 105 | 6.8 | 2.3 | 0.5 | 42 | 2.1 | 9 | 0.17 | 0.06 | 0.65 | 0.9 |
| fruits & vegetable | 70 | 1.4 | 0.5 | 0.2 | 33 | 0.8 | 1148 | 0.06 | 0.06 | 0.58 | 24.2 |
| Meat,egg &fish | 70 | 5.6 | 3.9 | 5.1 | 7 | 0.7 | 90 | 0.02 | 0.05 | 1.40 | - |
| milk | 84 | 4.2 | 2.6 | 4.6 | 156 | 0.1 | 175 | 0.04 | 0.23 | 0.15 | 1.4 |
| miscellaneous* | 144 | 0.2 | 0.1 | 3.2 | 15 | 0.4 | 21 | - | - | - | - |
| | 2069 | 57.0 | 25.8 | 27.1 | 348 | 11.8 | 2629 | 1.61 | 0.82 | 9.10 | 79.8 |
| Rural Poor | | | | | | | | | | | |
| cereals | 1061 | 28.5 | 13.2 | 10.3 | 47 | 4.9 | 888 | 0.89 | 0.29 | 3.68 | - |
| starchy roots | 220 | 2.0 | 0.8 | 0.2 | 48 | 1.0 | - | 0.09 | 0.05 | 1.01 | 51.9 |
| pulses | 58 | 3.8 | 1.3 | 0.3 | 23 | 1.1 | 5 | 0.09 | 0.03 | 0.36 | 0.5 |
| fruit & vegetable | 30 | 0.6 | 0.3 | 0.1 | 15 | 0.4 | 509 | 0.02 | 0.04 | 0.26 | 10.7 |
| meat,egg & fish | 56 | 4.4 | 2.6 | 4.0 | 5 | 0.6 | 69 | 0.01 | 0.03 | 1.12 | - |
| milk | 37 | 1.9 | 1.1 | 2.0 | 69 | 0.1 | 78 | 0.02 | 0.09 | 0.07 | 0.6 |
| miscellaneous* | 116 | 0.1 | 0.1 | 1.9 | 15 | 0.6 | 10 | - | - | 0.05 | - |
| | 1578 | 41.3 | 19.4 | 18.8 | 222 | 8.7 | 1559 | 1.12 | 0.53 | 6.54 | 63.7 |
| Rural Medium | | | | | | | | | | | |
| cereals | 1419 | 38.0 | 16.2 | 13.8 | 46 | 6.8 | 1236 | 1.26 | 0.38 | 5.16 | - |
| starchy roots | 249 | 2.6 | 1.0 | 0.3 | 50 | 1.3 | - | 0.12 | 0.06 | 1.49 | 55.0 |
| pulses | 116 | 7.5 | 2.6 | 0.6 | 46 | 2.3 | 10 | 0.18 | 0.06 | 0.71 | 1.0 |
| fruits & vegetable | 89 | 1.8 | 0.7 | 0.3 | 43 | 1.1 | 1482 | 0.07 | 0.08 | 0.75 | 31.3 |
| meat,egg &fish | 72 | 5.8 | 3.9 | 5.3 | 7 | 0.7 | 95 | 0.02 | 0.04 | 1.45 | - |
| milk | 92 | 4.6 | 2.8 | 3.1 | 181 | 0.1 | 192 | 0.04 | 0.25 | 0.16 | 1.5 |
| miscellaneous* | 151 | 0.3 | 0.1 | 3.5 | 14 | 0.4 | 21 | - | - | 0.06 | - |
| | 2188 | 60.5 | 27.3 | 28.8 | 387 | 12.7 | 3036 | 1.69 | 0.87 | 9.78 | 88.8 |
| Rural Rich | | | | | | | | | | | |
| cereals | 1786 | 47.6 | 19.3 | 17.4 | 48 | 9.4 | 1638 | 1.69 | 0.44 | 6.96 | - |
| starchy roots | 252 | 3.2 | 1.3 | 0.3 | 44 | 1.6 | - | 0.17 | 0.08 | 2.33 | 47.6 |
| pulses | 224 | 14.5 | 4.9 | 1.1 | 90 | 4.4 | 20 | 0.36 | 0.12 | 1.38 | 2.0 |
| fruit & vegetable | 114 | 2.2 | 0.8 | 0.4 | 53 | 1.3 | 1825 | 0.08 | 0.10 | 0.93 | 15.9 |
| meat, egg & fish | 107 | 8.6 | 5.9 | 7.9 | 8 | 1.2 | 138 | 0.02 | 0.07 | 2.16 | - |
| milk | 212 | 10.5 | 6.3 | 11.7 | 392 | 0.3 | 440 | 0.10 | 0.57 | 0.36 | 3.4 |
| miscellaneous* | 215 | 0.4 | 0.2 | 6.0 | 11 | 0.1 | 44 | - | - | 0.07 | - |
| | 2909 | 87.1 | 38.7 | 44.7 | 646 | 18.3 | 4105 | 2.42 | 1.38 | 14.19 | 92.2 |

* miscellaneous = sugar, fats, nuts, spices, stimulants, alcoholic beverages

Source: M.M. Shah and H. Frohberg (5).

However, in total, not enough of all these commodities are available for the rural population to meet the caloric requirements; 86-93% of the required energy is supplied depending upon whether the rural population is considered very active or moderately active[1),2)] (Table 3). As mentioned earlier, the energy is mainly derived from cereals (56%) and from starchy roots (12%). Pulses contribute only to 5% of the energy, the commodity group fruits and vegetables as well as the group meat, eggs and fish to 3% each, and milk approximately to 4% of the total consumed energy. The rest is derived from sugar, fats, spices, stimulants and alcoholic beverages.

The protein content of the diet[3)] is almost identical with the energy content - it is too low for the rural population. This is especially critical because this estimation did not include any additional need for people with infectious diseases or people contaminated with parasites. Therefore, a high degree of kwashiorkor should be expected among the rural population, especially before the harvest season when food becomes even scarcer among the poorer people who cannot afford to spend more money for food.

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1) The work load of the rural population is very big, especially during the harvest season. Because of the seasonal changes, this cannot be assumed for the whole year, therefore, the activity level will be somewhere between moderately and very active. The total requirements also decrease because of a very high unemployment rate leading to a partially apathetic and sedentary type life in this particular group. On the other hand, the total requirements have to be increased because of the high incidence of infectious diseases and contamination with parasites, malabsorption of nutrients and of metabolic abnormalities. Children may also need additional energy for catch-up growth.

2) Food balance sheets are based on food at the retail level and not on food as consumed. Therefore, food losses should be taken into consideration when calculating the requirements. It was suggested by FAO to increase the requirements by 10% for wastage, (3) which means that a population is adequately nourished when 110% of the requirements are supplied.

3) Even if there is no correlation between energy and protein requirements, it can be assumed that the protein requirement of a healthy population is approximately 5% of the energy considering the population as moderately active. There is no higher use for protein if the population is very active. Therefore, the minimum requirements may be very close to the ones estimated for the moderately active population. The higher needs of people with infectious diseases and parasites and of pregnant women cannot be considered. It has to be kept in mind that each commodity is treated as a separate unit when the high quantity protein is **calculated.** However, it is well known that an interaction exists between the different items consumed at one time. That can upgrade the total quantity and quality of the protein.

Table 3. Food Consumption Pattern in Percent of the Nutritional Requirements for the Various Rural Income Classes

| | energy (%) | protein | | fat* (%) | calcium (%) | iron (%) | vitamin A (%) | thiamine (%) | riboflavin (%) | niacin (%) | vitamin C (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | crude (%) | high quality (%) | | | | | | | | |
| A. Moderately Active | | | | | | | | | | | |
| Total | 93 | 210 | 93 | 11 | 44 | 84 | 58 | 146 | 62 | 61 | 177 |
| Poor | 71 | 152 | 70 | 8 | 28 | 62 | 35 | 102 | 40 | 45 | 141 |
| Medium | 99 | 222 | 98 | 12 | 48 | 91 | 67 | 154 | 65 | 67 | 197 |
| Rich | 131 | 320 | 139 | 18 | 81 | 131 | 91 | 220 | 104 | 97 | 205 |
| B. Very Active | | | | | | | | | | | |
| Total | 86 | 210 | 93 | 10 | 44 | 84 | 58 | 134 | 57 | 57 | 177 |
| Poor | 66 | 152 | 70 | 7 | 28 | 62 | 35 | 93 | 37 | 41 | 141 |
| Medium | 91 | 222 | 98 | 11 | 48 | 91 | 67 | 141 | 60 | 62 | 197 |
| Rich | 121 | 320 | 139 | 17 | 81 | 131 | 91 | 202 | 96 | 90 | 205 |

* percent of total energy requirements

Calculated from Tables 1 and 2.

The fat consumption of the Kenyan rural population is as low as that of the whole continent (1). Hardly any fat is added to the meals and most of it is simply derived from the natural fat content of cereals, especially of maize which is relatively rich in fat. Since the content of essential fatty acids in these oils is quite high, the relatively low fat consumption should not cause any problem in this respect. However, it could impair the vitamin A absorption.

The thiamine content of the diet is of no concern, which is due to the high content of cereals in the diet. Also the losses should be relatively small since maize is generally home pounded without any major extraction[1]. Therefore, the diet should be considered as adequate in thiamine.

Because starchy roots,especially cassava, contribute a major portion to the diet, the vitamin C content of the diet is also of no concern. If cassava is omitted from the diet the amount of vitamin C derived from fruits and vegetables would be too low to fulfil the requirements even before preparation. It has to be kept in mind, that vitamin C is very heat sensitive and can be destroyed very rapidly. Furthermore, ascorbic acid is also destroyed while storing the crops. Therefore, even with the high vitamin C content of the food presently available, this vitamin can be in deficit if the food is not handled in the proper way.

The low fruit and vegetable consumption is also responsible for the exceptionally low vitamin A content of the diet which makes the population quite susceptible to eye and skin lesions and finally to xerophthalmia. The intake is near the minimum dietary level at which clinical symptoms will occur. The vitamin A content of the food may be even worsened by two factors:

a) The variety of maize consumed was considered to be yellow. However, if another variety is eaten, i.e. a white variety, it is very likely that it contains no vitamin A at all. Therefore, the vitamin A content of the food is at the upper limit of the possible amount.

b) The absorption and digestion of vitamin A - a fat soluble vitamin - may be impaired because of the low fat content of the diet. However, no evaluation of this consideration can be given because it cannot be quantified up to now.

The riboflavin intake needs serious attention due to the low consumption of milk and milk products, meat, eggs and fish. It is well below the requirements.

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1) It should be pointed out,that the amount of vitamins and minerals corresponds to the food on a retail level. The actual content of the consumed food may be much lower due to too long and inappropriate cooking habits which destroy and/or dilute the nutrients. However, the actual nutrient level cannot be evaluated. Therefore, the present examination of the Kenyian diet will refer to the maximum amount of a nutrient that people can receive with the diet.

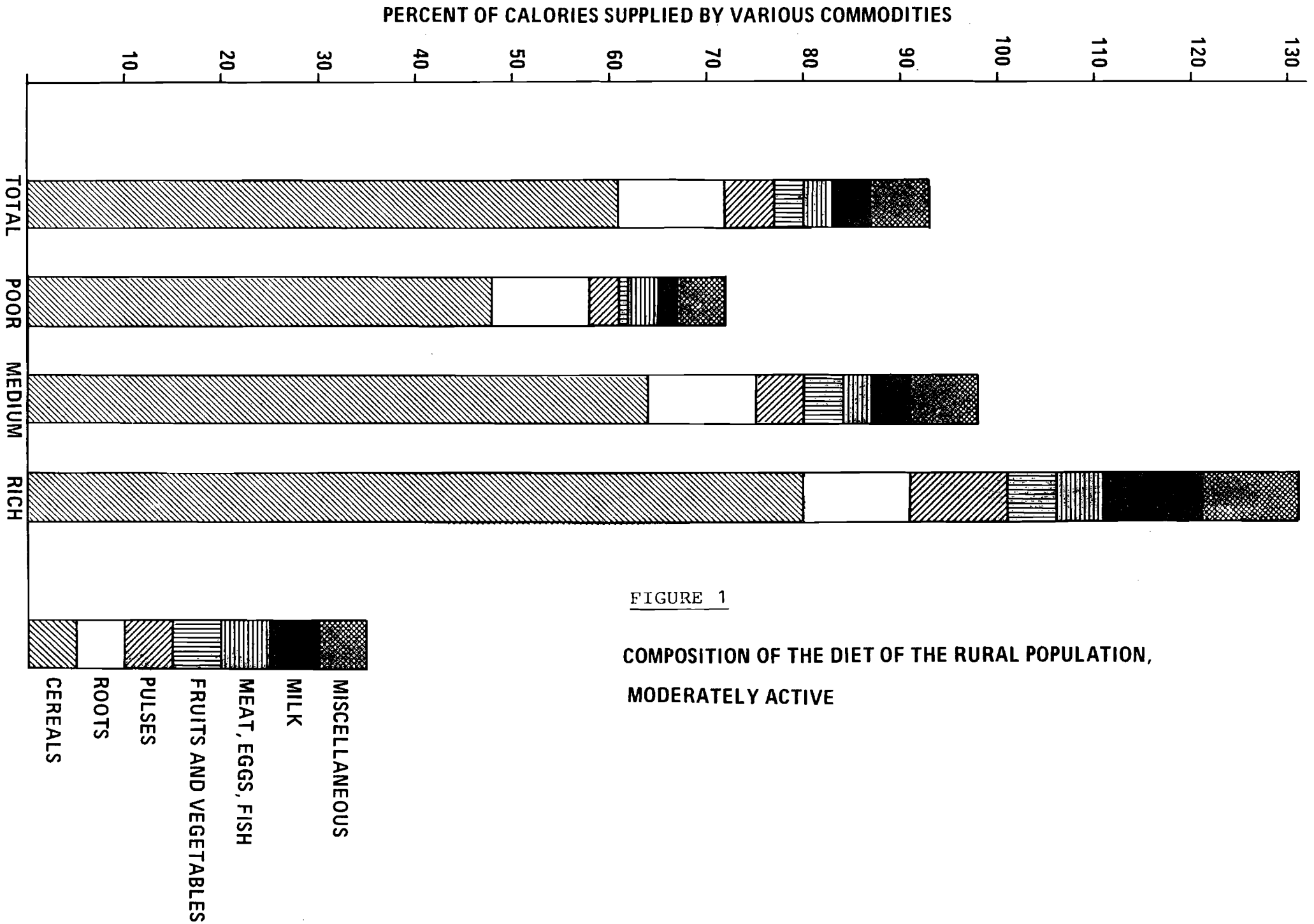



FIGURE 1

COMPOSITION OF THE DIET OF THE RURAL POPULATION,

MODERATELY ACTIVE

Considerably below the requirements is the niacin content of the diet, which is deduced from the low meat content of the diet and from the absence of nuts in the diet. It also cannot be expected that tryptophan is transferred into niacin because it is a limiting amino acid in the diet by itself (most of the protein comes from maize, and the limiting amino acids in maize are lysine and tryptophan).

The low niacin intake (4.1 mg/1000 kcal) is quite critical because it is below the minimum dietary level that will prevent clinical symptoms (below 4.4 mg/1000 kcal). A high incidence of dermatitis, stomatitis, diarrhea and mental depression can be expected among the rural population (and especially the poorer ones which will be seen later in this report), providing that they do not consume other niacin sources (i.e. nuts) as being represented in this survey.

The proportion of the requirements for calcium cannot be evaluated as strictly as the other nutrients, because it is not known how much of the mineral is consumed with drinking water and how much is really needed on a low animal protein diet. Since up to now no clinical evidence of calcium deficiencies could be found even when the intake was below 300 mg no immediate concern has to be given to this mineral.

## 1.2 The Rural Population divided into 4 Income Classes

Dividing the total rural population into 4 groups according to their income - poor, medium, rich, and very rich (which will not be covered in this report) - clearly demonstrates the different consumption pattern depending upon the amount of money spent on food (Figure 1). However, as indicated in Figure 1, the quality and variety of the food commodity classes purchased does not change dramatically with the increasing money spent for food, the differences in the diet will be more a matter of quantity.

The amount of cereals consumed increases sharply with having more money available to spend on food, whereas the consumption of starchy roots remains independent of the income (Figure 1). In addition, it is of interest that within one commodity group changes occur with increasing the food expenditures. The maize flour and millet consumption is shifting more towards wheat flour, bread and rice consumption which are the more expensive items. The poor man's starchy root is cassava whereas the rich class consumes more potatoes; the rich people obtain their required vitamin C by a much higher consumption of fruits and vegetables. The increase of beans consumed with increasing income influences positively the thiamine, riboflavin and niacin content of the upper class' diet. The dependency is the highest for milk consumption, 5 times more milk products are eaten in the rich income class as compared to the poor class. This high milk consumption explains the relatively high calcium content of the rich class's diet. It has to be pointed out that only the rich class consumes enough food to meet the energy and protein requirements (considering an additional 10% of the requirements

for losses) regardless whether the population is considered as moderately active or very active in respect to their requirements - these are 10% of the total rural population and 8% of the total Kenyian population.

All the variations in the diet pattern discussed before do not cause considerable variations in the relative caloric content derived from the protein, fat, sugar and starch of the food eaten by the poor and the rich classes. The general food pattern is still the same for all income groups (Figure 2). Basically, the rich class is only able to buy some additional fat, a fairly expensive item, whereas almost all the fat consumed by the poor class is dervied from the cereals. The animal protein intake is not more than slightly elevated when more money is spent for food, because it is not popular to eat much meat, fish and eggs among the rural population. The percentage of the vegetable protein in the diet does not change considerably with the income; 9-10% of the energy is derived form vegetable protein by all income classes. The consumption of refined sugar, another fairly expensive item, is proportional with the increase of fat, and refined sugar in the diet, the content of starch will decrease. It is worthwhile to stress more deeply that the percentage of supplied calories in the daily food intake derived from protein and especially from vegetable protein increases only slightly with increasing income, which is consistent with the observation throughout the whole world (6). Also developed countries do not consume a higher percentage of energy derived from total protein (calculated from (7)), the difference can be only found in the proportion of vegetable and animal proteins.

The income and food expenditures of different rural groups are listed in Table 4. On average, 75% of the income is spent for food, slightly more by the poor and slightly less by the rich part of the population. These spending practices are characteristic of low income countries throughout the whole world.

### 1.3 The rural population divided into 7 income classes.

The rural population is further subdivided into 7 income groups (R11-R17), where the poor group consists of R12, the medium group of R11, R13 and R14, and the rich group of R15-R17. Considering the amount of energy supplied in respect to the income, an exponential development with increasing income is observed which exactly behaves as a priori assumed (Figure 3). It can be deduced (providing no major change in the behaviour of the population) that an income of 650 KSh/year/caput (assuming constant prices) is enough to meet the energy requirements and the food losses for a moderatively active group of people. If the population is very active, they need about 100 KSh more per year to receive an adequate caloric diet. According to these standards, 28 or 13% respectively, of the rural population are able to purchase an adequate amount of food; R14 has to be considered as being the break-even group between the two extremata.

The rural population approaches only very slowly the stage, where people buy more expensive food as for example, fat, with increasing income - they are still quite strongly linked to their

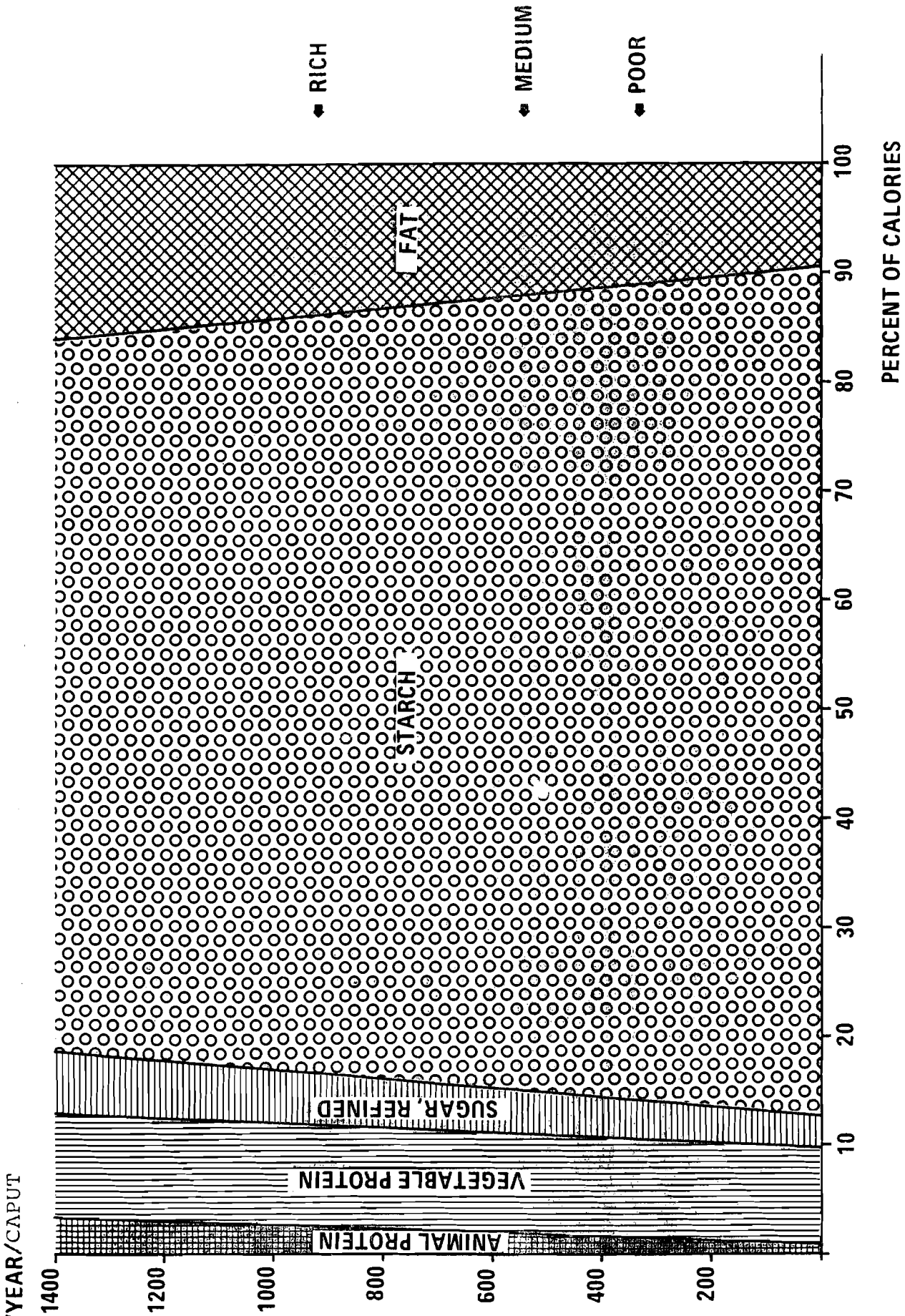
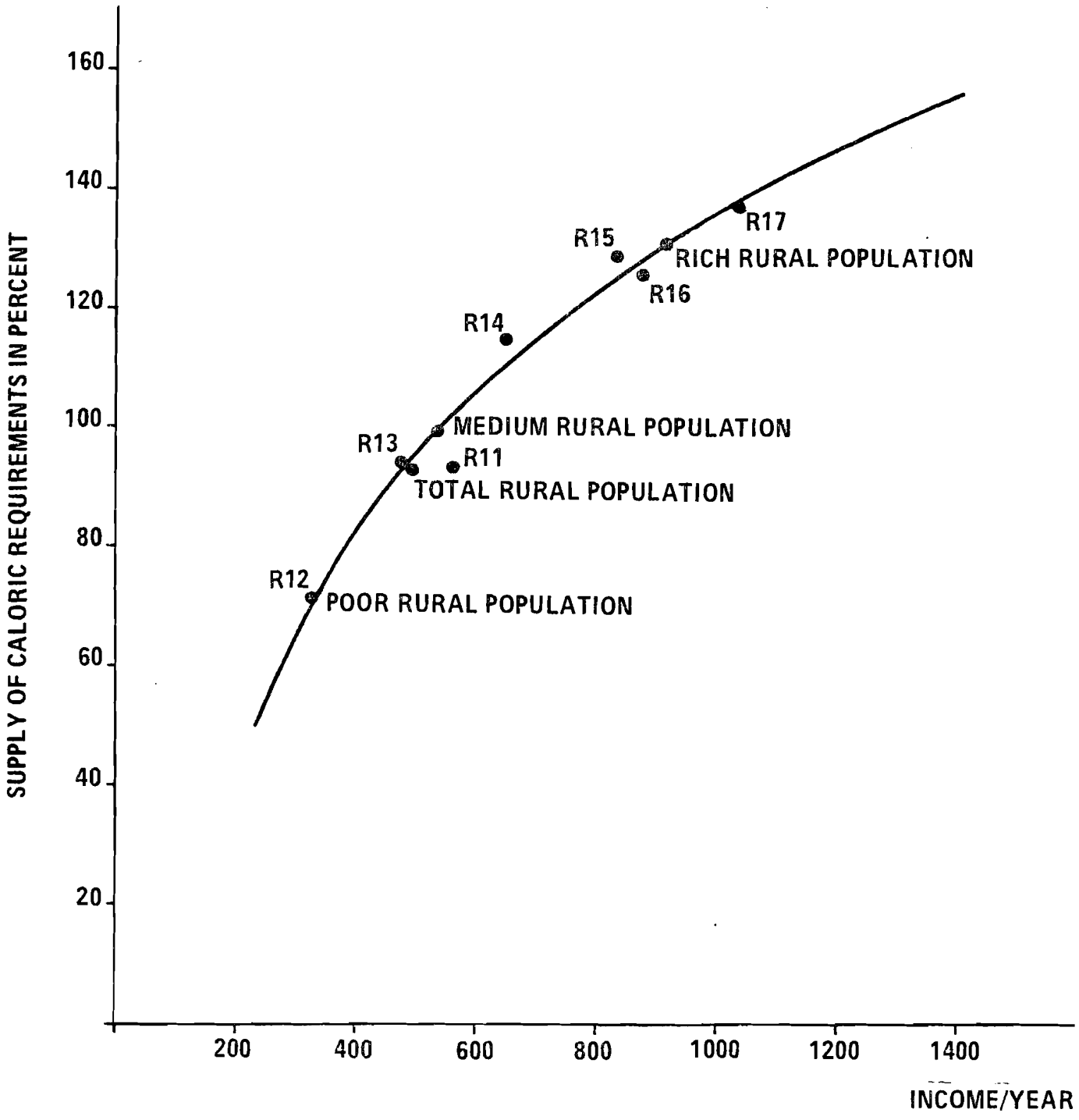



FIGURE 2 COMPOSITION OF THE DIET OF THE RURAL POPULATION (MODERATELY ACTIVE) DEPENDING ON THE FOOD EXPENDITURE

Table 4. Income and Population distribution of the Rural Population in year 1975

| Population group | Income/year (KSh) | Food expenditure/ year (KSh) | percent of total rural population | percent of total pop. | household size | percent of salary spent on food |
|---|---|---|---|---|---|---|
| Total rural pop. | 494.99 | 372.31 | 100 | 88 | 6.97 | 75 |
| Poor rural pop. | 326.04 | 251.54 | 34 | 30 | 7.45 | 77 |
| Medium rural pop. | 533.58 | 400.44 | 43 | 38 | 6.88 | 75 |
| Rich rural pop. | 911.71 | 665.05 | 10 | 8 | 5.98 | 73 |
| Rural population by income groups | | | | | | |
| R11 | 566.50 | 371.16 | 6 | 5 | 6.54 | 66 |
| R12 | 326.04 | 251.54 | 39 | 34 | 7.45 | 77 |
| R13 | 479.86 | 369.72 | 32 | 28 | 7.10 | 77 |
| R14 | 651.45 | 489.16 | 13 | 11 | 6.55 | 75 |
| R15 | 833.60 | 616.56 | 5 | 4 | 6.34 | 74 |
| R16 | 881.36 | 623.73 | 2 | 2 | 5.90 | 71 |
| R17 | 1035.18 | 755.54 | 4 | 3 | 5.60 | 73 |
| Rural population by provinces | | | | | | |
| Central | 643.60 | 448.63 | 16 | 15 | 6.95 | 70 |
| Coast | 390.42 | 325.00 | 7 | 6 | 8.04 | 83 |
| Eastern | 596.44 | 455.19 | 19 | 17 | 6.74 | 76 |
| Nyanza | 386.93 | 309.88 | 22 | 19 | 6.58 | 80 |
| Rift Valley | 456.19 | 341.41 | 22 | 20 | 7.51 | 75 |
| Western | 377.42 | 283.33 | 14 | 12 | 7.44 | 62 |




SOURCE: Shah M.M. and H. Frohberg [5].

FIGURE 3 SUPPLY OF CALORIC REQUIREMENTS OF RURAL POPULATION (MODERATELY ACTIVE) DEPENDING ON INCOME

Table 5. Diet Pattern of the Rural Population by Income Classes (absolute values)

| | energy | protein | | fat | calcium | iron | vita-min A | thiamine | riboflavin | niacin | vitamin C |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | (kcal) | crude (g) | high quality (g) | (g) | (mg) | (mg) | (I.U.) | (mg) | (mg) | (mg) | (mg) |
| Rural 11 | | | | | | | | | | | |
| cereals | 1353 | 36.6 | 15.6 | 12.8 | 49 | 6.5 | 1091 | 1.15 | 0.36 | 4.89 | - |
| starchy roots | 251 | 2.5 | 0.9 | 0.3 | 53 | 1.3 | - | 0.12 | 0.05 | 1.34 | 57.3 |
| pulses | 64 | 4.2 | 1.4 | 0.3 | 26 | 1.3 | 6 | 0.10 | 0.03 | 0.39 | 0.6 |
| fruit & veg. | 58 | 1.2 | 0.4 | 0.2 | 28 | 0.7 | 992 | 0.05 | 0.05 | 0.51 | 21.0 |
| meat egg,fish | 65 | 5.3 | 3.7 | 4.8 | 6 | 0.7 | 85 | 0.02 | 0.04 | 1.27 | - |
| milk | 66 | 3.3 | 2.0 | 3.6 | 124 | 0.1 | 139 | 0.03 | 0.17 | 0.13 | 1.1 |
| miscellaneous* | 197 | 0.3 | 0.1 | 4.9 | 18 | 0.5 | 22 | - | - | 0.07 | - |
| Rural 12 | | | | | | | | | | | |
| cereals | 1061 | 28.5 | 13.2 | 10.3 | 47 | 4.9 | 888 | 0.89 | 0.29 | 3.68 | - |
| starchy roots | 220 | 2.0 | 0.8 | 0.2 | 48 | 1.0 | - | 0.09 | 0.05 | 1.01 | 51.9 |
| pulses | 58 | 3.8 | 1.3 | 0.3 | 23 | 1.1 | 5 | 0.09 | 0.03 | 0.36 | 0.5 |
| fruit & veg. | 30 | 0.6 | 0.3 | 0.1 | 15 | 0.4 | 509 | 0.02 | 0.04 | 0.26 | 10.7 |
| meat,egg.fish | 56 | 4.4 | 2.6 | 4.0 | 5 | 0.6 | 69 | 0.01 | 0.03 | 1.12 | - |
| milk * | 37 | 1.9 | 1.1 | 2.0 | 69 | 0.1 | 78 | 0.02 | 0.09 | 0.07 | 0.6 |
| miscellaneous | 116 | 0.1 | 0.1 | 1.9 | 15 | 0.6 | 10 | - | - | 0.05 | - |
| Rural 13 | | | | | | | | | | | |
| cereals | 1331 | 36.7 | 15.5 | 12.9 | 45 | 6.3 | 1139 | 1.15 | 0.35 | 4.78 | - |
| starchy roots | 262 | 2.7 | 1.0 | 0.3 | 54 | 1.3 | - | 0.13 | 0.06 | 1.49 | 59.0 |
| pulses | 111 | 7.2 | 2.4 | 0.6 | 45 | 2.2 | 10 | 0.18 | 0.06 | 0.68 | 1.0 |
| fruit & veg. | 86 | 1.7 | 0.7 | 0.3 | 42 | 1.1 | 1465 | 0.07 | 0.08 | 0.75 | 31.1 |
| meat,egg,fish | 67 | 5.2 | 3.5 | 4.9 | 7 | 0.7 | 85 | 0.02 | 0.03 | 1.33 | - |
| milk * | 88 | 4.4 | 2.6 | 4.9 | 163 | 0.1 | 183 | 0.04 | 0.24 | 0.15 | 1.4 |
| miscellaneous | 134 | 0.2 | 0.1 | 2.8 | 14 | 0.4 | 14 | - | - | 0.06 | - |
| Rural 14 | | | | | | | | | | | |
| cereals | 1615 | 43.1 | 17.6 | 16.1 | 42 | 10.0 | 1528 | 1.53 | 0.41 | 6.09 | - |
| starchy roots | 291 | 3.2 | 1.2 | 0.3 | 58 | 1.5 | - | 0.15 | 0.07 | 1.86 | 63.3 |
| pulses | 152 | 9.1 | 3.4 | 0.8 | 61 | 3.0 | 13 | 0.24 | 0.08 | 0.94 | 1.3 |
| fruit & veg. | 111 | 2.1 | 0.8 | 0.4 | 53 | 1.3 | 1813 | 0.08 | 0.10 | 0.92 | 38.7 |
| meat,egg,fish | 93 | 7.3 | 5.0 | 6.7 | 7 | 1.0 | 118 | 0.02 | 0.05 | 1.82 | - |
| milk * | 115 | 5.7 | 3.4 | 6.3 | 213 | 0.2 | 239 | 0.05 | 0.30 | 0.20 | 1.8 |
| miscellaneous | 171 | 0.3 | 0.2 | 4.8 | 13 | 0.3 | 28 | - | - | 0.07 | - |
| Rural 15 | | | | | | | | | | | |
| cereals | 1707 | 45.6 | 18.5 | 16.7 | 44 | 8.8 | 1567 | 1.63 | 0.42 | 6.59 | - |
| starchy roots | 316 | 4.2 | 1.5 | 0.4 | 56 | 1.9 | - | 0.21 | 0.09 | 2.79 | 61.2 |
| pulses | 267 | 17.3 | 5.9 | 1.3 | 107 | 5.2 | 23 | 0.42 | 0.14 | 1.64 | 2.3 |
| fruit & veg | 99 | 1.9 | 0.8 | 0.3 | 46 | 1.2 | 1592 | 0.08 | 0.10 | 0.83 | 34.5 |
| meat,egg,fish | 100 | 8.0 | 5.5 | 7.3 | 8 | 1.0 | 132 | 0.02 | 0.06 | 2.05 | - |
| milk * | 172 | 8.5 | 5.1 | 9.5 | 319 | 0.3 | 358 | 0.08 | 0.46 | 0.29 | 2.7 |
| miscellaneous | 207 | 0.3 | 0.2 | 6.1 | 11 | 0.1 | 35 | - | - | 0.02 | - |
| Rural 16 | | | | | | | | | | | |
| cereals | 1745 | 46.5 | 18.7 | 17.4 | 43 | 9.2 | 1673 | 1.68 | 0.43 | 6.71 | - |
| starchy roots | 185 | 2.6 | 0.9 | 0.2 | 31 | 1.2 | - | 0.13 | 0.06 | 1.78 | 34.5 |
| pulses | 198 | 12.8 | 4.4 | 1.0 | 79 | 3.9 | 17 | 0.31 | 0.10 | 1.22 | 1.7 |
| fruit & veg. | 101 | 1.9 | 0.8 | 0.7 | 47 | 1.2 | 1618 | 0.08 | 0.10 | 1.84 | 34.9 |
| meat,egg,fish | 77 | 6.0 | 4.1 | 5.6 | 7 | 0.8 | 92 | 0.02 | 0.04 | 1.52 | - |
| milk | 280 | 13.8 | 8.3 | 15.5 | 516 | 0.4 | 578 | 0.13 | 0.75 | 0.45 | 4.4 |
| miscellaneous * | 204 | 0.4 | 0.2 | 5.9 | 10 | 0.1 | 53 | - | - | 0.06 | - |
| Rural 17 | | | | | | | | | | | |
| cereals | 1920 | 50.8 | 20.8 | 21.9 | 52 | 9.8 | 1711 | 1.78 | 0.47 | 7.59 | - |
| starchy roots | 207 | 3.0 | 1.1 | 0.2 | 34 | 1.3 | - | 0.15 | 0.06 | 2.06 | 37.5 |
| pulses | 184 | 11.9 | 4.0 | 0.9 | 74 | 3.6 | 16 | 0.29 | 0.10 | 1.13 | 1.6 |
| fruit & veg. | 140 | 2.7 | 1.1 | 0.4 | 64 | 1.6 | 2256 | 0.11 | 0.12 | 1.15 | 48.6 |
| meat,egg,fish | 137 | 11.0 | 7.5 | 10.1 | 11 | 1.5 | 172 | 0.03 | 0.09 | 2.72 | - |
| milk | 221 | 11.0 | 6.6 | 12.2 | 411 | 0.3 | 461 | 0.11 | 0.59 | 0.37 | 3.5 |
| miscellaneous * | 228 | 0.4 | 0.2 | 5.8 | 11 | 0.1 | 53 | - | - | 0.08 | - |

* miscellaneous = sugar, fats, nuts, spices, stimulants, alcoholic beverages

SOURCE: M.M. Shah and H. Frohberg [5]

Table 6. Diet Pattern of the Rural Population by Income Classes in 1975

| Income Group | Energy (kcal) | protein crude (g) | protein high quality (g) | fat (g) | calcium (mg) | iron (mg) | vitamin A (I.U.) | thiamin (mg) | riboflavin (mg) | niacin (mg) | vitamin C (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A. Absolute Values | | | | | | | | | | | |
| R 11 | 2055 | 53.0 | 24.1 | 26.9 | 304 | 11.1 | 2335 | 1.47 | 0.70 | 8.65 | 80.0 |
| R 12 | 1578 | 41.3 | 19.4 | 18.8 | 222 | 8.7 | 1559 | 1.12 | 0.53 | 6.54 | 63.7 |
| R 13 | 2077 | 57.0 | 25.8 | 26.5 | 370 | 12.1 | 2896 | 1.59 | 0.82 | 9.24 | 92.5 |
| R 14 | 2545 | 71.6 | 31.6 | 35.3 | 447 | 15.6 | 3739 | 2.07 | 1.01 | 11.91 | 105.1 |
| R 15 | 2867 | 85.9 | 37.2 | 41.5 | 591 | 18.5 | 3707 | 2.44 | 1.27 | 14.26 | 100.7 |
| R 16 | 2788 | 84.1 | 37.4 | 45.9 | 733 | 16.8 | 4031 | 2.35 | 1.48 | 12.58 | 75.5 |
| R 17 | 3036 | 90.7 | 41.3 | 48.0 | 657 | 18.2 | 4669 | 2.47 | 1.43 | 15.10 | 91.2 |
| B. Relative Values (in percent of requirements) - moderately Active | | | | | | | | | | | |
| R 11 | 93 | 195 | 87 | 11 | 38 | 79 | 52 | 132 | 53 | 59 | 178 |
| R 12 | 71 | 152 | 70 | 8 | 28 | 62 | 35 | 101 | 41 | 45 | 136 |
| R 13 | 94 | 210 | 93 | 11 | 46 | 86 | 64 | 143 | 62 | 63 | 206 |
| R 14 | 115 | 263 | 114 | 14 | 36 | 111 | 83 | 186 | 76 | 81 | 234 |
| R 15 | 129 | 316 | 134 | 17 | 74 | 132 | 82 | 200 | 95 | 97 | 224 |
| R 16 | 126 | 309 | 135 | 19 | 92 | 120 | 90 | 218 | 111 | 86 | 168 |
| R 17 | 137 | 333 | 149 | 19 | 82 | 130 | 104 | 223 | 108 | 103 | 203 |
| C. Relative Values (in percent of requirements) - very active | | | | | | | | | | | |
| R 11 | 86 | 195 | 87 | 10 | 38 | 79 | 52 | 123 | 49 | 55 | 178 |
| R 12 | 66 | 152 | 70 | 7 | 28 | 62 | 35 | 93 | 38 | 41 | 136 |
| R 13 | 87 | 210 | 93 | 10 | 46 | 86 | 64 | 133 | 60 | 58 | 206 |
| R 14 | 106 | 263 | 114 | 13 | 56 | 111 | 83 | 173 | 70 | 75 | 234 |
| R 15 | 120 | 316 | 134 | 16 | 74 | 132 | 82 | 203 | 88 | 90 | 224 |
| R 16 | 116 | 309 | 135 | 17 | 92 | 120 | 90 | 196 | 103 | 79 | 168 |
| R 17 | 127 | 333 | 149 | 18 | 82 | 130 | 104 | 206 | 99 | 95 | 203 |

Calculated from Tables 55 and 59.

traditional food pattern (Table 5 and 6 ). Only the richest group (R17) has an adequate supply of all examined minerals and vitamins; however, their diet cannot be classified as an excellent one either, because they are way above their caloric requirements. As a consequence, the food losses in this income group may be higher than in the average. These people also may develop a tendency towards obesity. Their consumption of cereals is relatively too high, whereas they still eat too little fruit and vegetables, milk products and nuts in order to have a "well balanced" diet, because otherwise the major nutrients would also be above the requirements.

It should actually be assumed that the more money people of the same cultural and regional background spend on food, the better the quality of their diet should become. However, that may be only true within certain limitations, and surely will not hold for all countries, especially not for the developed ones. This statement is also justified only with some restrictions for the rural population in Kenya (Figure 4). As already mentioned, the caloric content of the diet increases proportionally with the amount of money spent on food, however the composition of the purchased food changes only minimally in proportion with the caloric content. This expresses strongly that people do not buy different food commodity groups while spending more money on it, they simply purchasemore food of the same variety. This allows some generalizations about the diet of the rural population. Providing enough money is spent on food (more than 500 KSh/capita on 1975 prices), a sufficient amount of calories (the requirements of a moderately active group of people and the food losses) is obtained. This diet will be sufficient in protein, thiamine, vitamin C, and in iron; the latter one is still in the limitation of the error at this point of the curve. However, deficiencies in riboflavin, niacin, vitamin A and calcium will occur. If the most limited nutrients - niacin and vitamin A (calcium is not the most limited one because of reasons mentioned already earlier) - are considered as the essential factors of a sufficient diet, approximately 750 KSh/person would be needed. However, this diet would be too rich in energy [by 30-40%] and if all food is eaten as assumed, the whole population would become obese. On the other hand, if a sufficient amount of thiamine is the limiting factor, only approximately 300 KSh would have to be spent; however, the diet would be sufficient only in thiamine and vitamin C, all the other nutrients would be too low, some of them even below the minimum dietary level that would prevent clinical symptoms. This indicates that the average diet of the rural population is not a balanced one. Therefore, a typical diet adequate in calories and protein should contain approximately 6-7% less cereals or about 30% less starchy roots[1]. It should be increased by 50% in the total vegetable and fruit consumption. In addition, about 20-30g of nuts should be eaten per capita per day in order to obtain an adequate niacin intake. Some nuts are probably eaten anyhow which simply have not been elaborated on in this survey; in the provisional food balance sheets given by the FAO for the same

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1) From a nutritional point of view, it may be much better to decrease the starchy root consumption than the cereal consumption since the nutritive value of the latter commodity is higher.

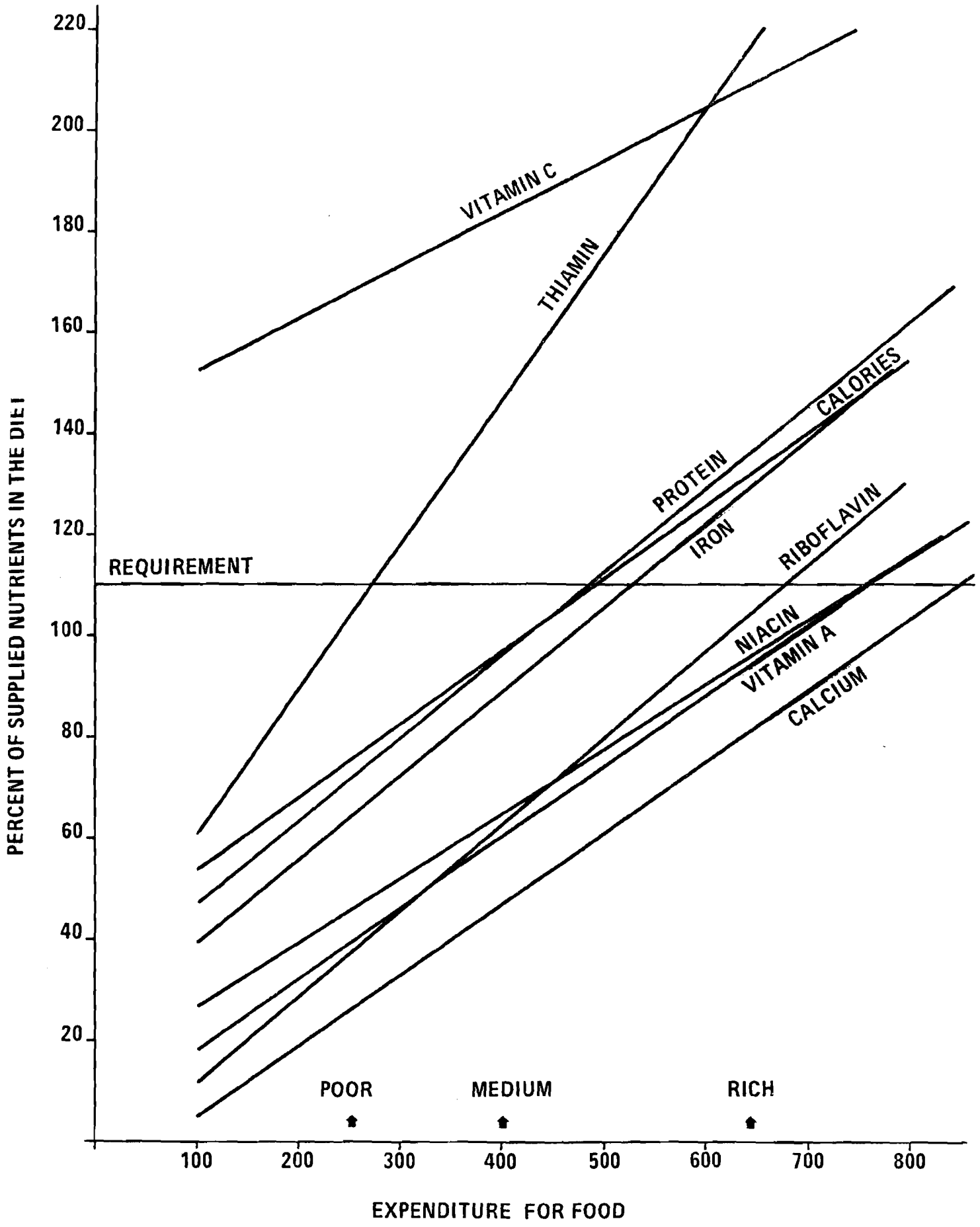


FIGURE 4 DEPENDENCE OF THE QUALITY OF THE DIET UPON FOOD EXPENDITURE FOR RURAL POPULATION (MODERATELY ACTIVE)

period (8), 11.6 g nuts and oilseeds are eaten by the total Kenyian population per capita per day. Thus, the niacin content of the diet may actually be of no concern; however, it will need further investigation not only from the view of the food analysis, but also from a clinical point of view. More serious is the low vegetable and fruit consumption - it will need more education of the people to show the importance of these items in the diet in order to make them grow more of this commodity for home consumption.

### 1.4 The Rural Population Divided by Provinces

In a further study, the rural population was divided by provinces in order to establish the most critical area from a nutritional point of view. Two different assumptions were made when calculating the consumption baskets in these provinces:

Set 1: The same food prices were applied in all provinces. They are the same ones as used to calculate the food balance sheets of the rural population divided by income classes.

Set 2: Different prices were applied in the different provinces.

These two groups were evaluated separately; however, they will be considered as one group further on, because the differences between both groups are within the error limit of the nutritional analysis. Slightly different requirements have to be considered for the essential nutrients in the various provinces because of differences in the population stucture (Table 1 ).

#### 1.4.1 Western Province

The per capita income in the Western Province is the lowest in comparison to all other provinces (Table 4 ). In addition, their preference for food (especially of high quality food) must be relatively low, because they spend only 62% of their income on food whereas the national total of the rural population for food expenditure can be found around 75%. Therefore, as can be predicted by Figure 4, their diet is an insufficient one, the most insufficient one of all the provinces. Indeed, the energy and protein intake of the whole province (not divided into income groups!) is almost as low as the one of the poor income class discussed in [5] (Table 7 and 8). Therefore, it can be expected that the diet of the poor class in this province is even below the one of the national rural poor class. The energy and protein intake is far below the acceptable range which is mainly due to their comparatively low cereal and starchy root consumption; the other food commodities are also below the consumption level of the rural population (Table 9 , Figure 5). Consequently, their diet is insufficient in all essential nutrients except thiamine and vitamin C which are still in a tolerable range at the retail level, but even which may become critical after preparation of the food. The amount of protein in the diet is too low, which is partly due to the relatively low cereal consumption as well as to the low intake of pulses and milk products; on the other hand, the consumption of meat is fairly high in comparison to the other provinces. The same

Table 7. Dietary Intake of the Various Rural Provinces (absolute values) in 1975.

| Province | energy (kcal) | protein | | fat (g) | calcium (mg) | iron (mg) | vita-min A (I.U.) | thiamine (mg) | ribo-flavin (mg) | niacin (mg) | vita-min C (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | crude (g) | high quality (g) | | | | | | | | |
| Set 1 | | | | | | | | | | | |
| Central | 2236 | 59.8 | 26.9 | 30.0 | 440 | 12.9 | 3010 | 1.67 | 0.93 | 9.90 | 99.4 |
| Coast | 1964 | 48.6 | 22.5 | 21.1 | 224 | 9.8 | 2027 | 1.34 | 0.59 | 7.99 | 95.8 |
| Eastern | 2386 | 67.8 | 28.3 | 27.0 | 475 | 15.9 | 3079 | 1.91 | 0.97 | 11.66 | 129.1 |
| Nyanza | 1864 | 50.8 | 23.8 | 26.0 | 246 | 10.3 | 2487 | 1.40 | 0.66 | 8.20 | 60.0 |
| Rift Valley | 2013 | 56.3 | 26.7 | 33.9 | 536 | 9.5 | 2352 | 1.56 | 1.07 | 7.09 | 46.2 |
| Western | 1686 | 45.7 | 21.3 | 22.4 | 188 | 9.0 | 2100 | 1.27 | 0.54 | 6.87 | 50.0 |
| Set 2 | | | | | | | | | | | |
| Central | 2376 | 63.9 | 28.6 | 30.9 | 424 | 13.8 | 3136 | 1.82 | 0.96 | 10.53 | 100.0 |
| Coast | 2060 | 51.3 | 23.6 | 21.9 | 217 | 10.4 | 1978 | 1.45 | 0.60 | 8.27 | 91.8 |
| Eastern | 2449 | 70.1 | 29.9 | 28.1 | 482 | 16.2 | 3176 | 1.95 | 1.00 | 11.38 | 125.4 |
| Nyanza | 1837 | 50.1 | 23.7 | 26.5 | 253 | 9.9 | 2331 | 1.38 | 0.66 | 8.06 | 55.5 |
| Rift Valley | 1941 | 53.4 | 25.2 | 31.2 | 462 | 8.7 | 2205 | 1.49 | 0.95 | 6.36 | 45.5 |
| Western | 1684 | 45.6 | 21.5 | 22.6 | 195 | 9.1 | 2096 | 1.25 | 0.55 | 6.89 | 50.0 |

SOURCE: M.M. Shah and H. Frohberg [5].

Table 8. Dietary Intake of the Various Rural Provinces Relative to the Nutritional Requirements.

| Province | energy (%) | protein | | fat* (%) | calcium (%) | iron (%) | vita-min A (%) | thiamin (%) | ribo-flavin (%) | niacin (%) | vita-min C (%) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | crude (%) | high quality (%) | | | | | | | | |
| I. Set 1 | | | | | | | | | | | |
| A. Moderately Active | | | | | | | | | | | |
| Central | 101 | 220 | 97 | 12 | 55 | 92 | 67 | 150 | 70 | 68 | 221 |
| Coast | 89 | 180 | 81 | 9 | 28 | 70 | 45 | 122 | 45 | 55 | 213 |
| Eastern | 108 | 250 | 102 | 11 | 59 | 114 | 68 | 172 | 73 | 80 | 287 |
| Nyanza | 82 | 183 | 84 | 10 | 31 | 74 | 55 | 124 | 49 | 55 | 133 |
| Rift Valley | 91 | 207 | 96 | 14 | 67 | 68 | 52 | 141 | 80 | 48 | 103 |
| Western | 76 | 169 | 77 | 9 | 24 | 64 | 47 | 114 | 41 | 47 | 111 |
| B. Very Active | | | | | | | | | | | |
| Central | 93 | 220 | 97 | 11 | 55 | 92 | 67 | 138 | 65 | 62 | 221 |
| Coast | 82 | 180 | 81 | 8 | 28 | 70 | 45 | 112 | 41 | 50 | 213 |
| Eastern | 101 | 250 | 102 | 10 | 59 | 114 | 68 | 162 | 68 | 75 | 287 |
| Nyanza | 77 | 183 | 84 | 10 | 31 | 74 | 55 | 116 | 46 | 51 | 133 |
| Rift Valley | 84 | 202 | 96 | 13 | 67 | 68 | 52 | 130 | 75 | 45 | 103 |
| Western | 71 | 169 | 77 | 9 | 24 | 64 | 47 | 107 | 38 | 44 | 111 |
| II. Set 2 | | | | | | | | | | | |
| A. Moderately Active | | | | | | | | | | | |
| Central | 108 | 235 | 103 | 13 | 53 | 99 | 70 | 164 | 72 | 72 | 222 |
| Coast | 94 | 190 | 85 | 9 | 27 | 74 | 44 | 132 | 45 | 57 | 204 |
| Eastern | 111 | 259 | 108 | 11 | 60 | 116 | 71 | 176 | 75 | 78 | 279 |
| Nyanza | 81 | 181 | 79 | 11 | 32 | 71 | 52 | 122 | 49 | 54 | 123 |
| Rift Valley | 87 | 196 | 91 | 13 | 58 | 62 | 49 | 134 | 71 | 43 | 101 |
| Western | 76 | 168 | 77 | 9 | 24 | 65 | 47 | 113 | 41 | 47 | 111 |
| B. Very Active | | | | | | | | | | | |
| Central | 99 | 235 | 103 | 12 | 53 | 99 | 70 | 150 | 66 | 66 | 222 |
| Coast | 86 | 190 | 85 | 8 | 27 | 74 | 44 | 121 | 42 | 52 | 204 |
| Eastern | 104 | 259 | 108 | 11 | 60 | 116 | 71 | 165 | 70 | 73 | 279 |
| Nzanza | 76 | 181 | 79 | 10 | 32 | 71 | 52 | 114 | 46 | 50 | 123 |
| Rift Valley | 81 | 196 | 91 | 12 | 58 | 62 | 49 | 124 | 66 | 40 | 101 |
| Western | 71 | 168 | 77 | 9 | 24 | 65 | 47 | 105 | 39 | 44 | 111 |

* percent of total energy requirements

Calculated from Table 7 and Table 1.

TABLE 9: DIETARY PATTERNS OF THE RURAL POPULATION OF THE VARIOUS PROVINCES

1. Set 1
2. Set 2

| | calories (kcal) | | protein (g) crude | | protein (g) high quality | | fat (g) | | calcium (mg) | | iron (mg) | | vitamin A (I.U.) | | Thiamine (mg) | | riboflavin (mg) | | niacin (mg) | | vitamin C (mg) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 |
| **Central** | | | | | | | | | | | | | | | | | | | | | | |
| Cereals | 1328 | 1455 | 35.5 | 38.9 | 15.5 | 16.8 | 12.7 | 14.1 | 48 | 50 | 6.2 | 6.8 | 1088 | 1232 | 1.14 | 1.26 | 0.35 | 0.39 | 4.71 | 5.18 | - | - |
| Starchy roots | 306 | 311 | 35.7 | 3.8 | 1.3 | 1.4 | 0.3 | 0.3 | 58 | 58 | 1.8 | 1.8 | - | - | 0.18 | 0.19 | 0.08 | 0.08 | 2.30 | 2.38 | 63.3 | 63.8 |
| Pulses | 137 | 154 | 8.9 | 10.0 | 3.0 | 3.4 | 0.7 | 0.8 | 55 | 62 | 2.7 | 3.0 | 12 | 14 | 0.22 | 0.24 | 0.07 | 0.08 | 0.84 | 0.95 | 1.2 | 1.4 |
| Vegetables & Fruits | 94 | 74 | 1.8 | 1.8 | 0.8 | 0.8 | 0.3 | 0.3 | 44 | 44 | 1.1 | 1.1 | 1581 | 1569 | 0.07 | 0.07 | 0.09 | 0.09 | 0.79 | 0.79 | 33.1 | 33.1 |
| Meat,Eggs,Fish | 52 | 51 | 4.1 | 4.0 | 2.7 | 2.9 | 3.9 | 3.8 | 4 | 4 | 0.5 | 0.5 | 82 | 78 | 0.02 | 0.01 | 0.04 | 0.04 | 0.91 | 0.99 | - | - |
| Milk | 112 | 104 | 5.6 | 5.2 | 3.4 | 3.1 | 6.2 | 5.7 | 209 | 194 | 0.2 | 0.2 | 233 | 217 | 0.05 | 0.05 | 0.30 | 0.28 | 0.20 | 0.19 | 1.8 | 1.7 |
| Miscellaneous* | 208 | 208 | 0.3 | 0.3 | 0.2 | 0.2 | 6.0 | 6.0 | 12 | 12 | 0.4 | 0.4 | 26 | 26 | - | - | - | - | 0.05 | 0.05 | - | - |
| **Coast** | | | | | | | | | | | | | | | | | | | | | | |
| Cereals | 1365 | 1476 | 36.9 | 39.8 | 15.9 | 17.1 | 12.4 | 13.6 | 56 | 58 | 6.5 | 7.0 | 1066 | 1091 | 1.13 | 1.24 | 0.36 | 0.39 | 4.93 | 5.34 | - | - |
| Starchy Roots | 306 | 306 | 2.5 | 2.5 | 1.0 | 1.0 | 0.3 | 0.3 | 70 | 70 | 1.4 | 1.4 | - | - | 0.11 | 0.11 | 0.06 | 0.06 | 1.11 | 1.11 | 75.2 | 75.2 |
| Pulses | 11 | 18 | 0.7 | 1.2 | 0.3 | 0.4 | 0.1 | 0.1 | 5 | 7 | 0.2 | 0.3 | 1 | 2 | 0.02 | 0.03 | 0.01 | 0.01 | 0.07 | 0.11 | 0.1 | 0.2 |
| Vegetables & Fruits | 62 | 47 | 1.1 | 0.9 | 0.4 | 0.4 | 0.2 | 0.1 | 26 | 21 | 0.6 | 0.5 | 905 | 739 | 0.05 | 0.04 | 0.05 | 0.04 | 0.49 | 0.38 | 20.1 | 16.0 |
| Meat, Eggs,Fish | 68 | 65 | 5.9 | 5.6 | 4.0 | 3.9 | 4.8 | 4.6 | 6 | 6 | 0.6 | 0.7 | 90 | 88 | 0.02 | 0.02 | 0.05 | 0.05 | 1.29 | 1.23 | - | - |
| Milk | 25 | 22 | 1.3 | 1.1 | 0.8 | 0.7 | 1.3 | 1.2 | 49 | 43 | - | - | 54 | 47 | 0.01 | 0.01 | 0.06 | 0.05 | 0.06 | 0.06 | 0.4 | 0.4 |
| Miscellaneous* | 126 | 126 | 0.2 | 0.2 | 0.1 | 0.1 | 2.1 | 2.1 | 12 | 12 | 0.5 | 0.5 | 11 | 11 | - | - | - | - | 0.04 | 0.04 | - | - |
| **Eastern** | | | | | | | | | | | | | | | | | | | | | | |
| Cereals | 1344 | 1426 | 36.2 | 38.4 | 15.5 | 16.4 | 12.6 | 13.5 | 49 | 51 | 6.4 | 6.8 | 1062 | 1148 | 1.14 | 1.22 | 0.35 | 0.37 | 4.88 | 5.17 | - | - |
| Starchy Roots | 429 | 395 | 5.0 | 4.3 | 1.8 | 1.6 | 0.5 | 0.4 | 90 | 79 | 2.4 | 2.1 | - | - | 0.24 | 0.20 | 0.11 | 0.10 | 3.12 | 2.55 | 89.6 | 85.8 |
| Pulses | 245 | 253 | 15.9 | 16.4 | 5.4 | 5.6 | 1.2 | 1.3 | 99 | 102 | 4.8 | 5.0 | 22 | 22 | 0.39 | 0.40 | 0.13 | 0.13 | 1.51 | 1.56 | 2.2 | 2.2 |
| Vegetables & Fruits | 101 | 101 | 2.0 | 2.0 | 0.8 | 0.8 | 0.3 | 0.3 | 49 | 49 | 1.3 | 1.3 | 1704 | 1704 | 0.08 | 0.08 | 0.10 | 0.10 | 0.86 | 0.86 | 35.8 | 35.8 |
| Meat,Eggs,Fish | 52 | 50 | 4.0 | 3.9 | 2.1 | 2.6 | 3.7 | 3.6 | 4 | 4 | 0.5 | 0.5 | 76 | 72 | 0.02 | 0.01 | 0.04 | 0.04 | 1.03 | 0.97 | - | - |
| Milk | 90 | 97 | 4.4 | 4.8 | 2.6 | 2.8 | 4.9 | 5.3 | 166 | 179 | 0.1 | 0.1 | 186 | 201 | 0.04 | 0.04 | 0.24 | 0.26 | 0.16 | 0.17 | 1.5 | 1.6 |
| Miscellaneous* | 127 | 127 | 0.3 | 0.3 | 0.1 | 0.1 | 3.7 | 3.7 | 18 | 18 | 0.4 | 0.4 | 29 | 29 | - | - | - | - | 0.10 | 0.10 | - | - |
| **Nyanza** | | | | | | | | | | | | | | | | | | | | | | |
| Cereals | 1334 | 1322 | 35.6 | 35.3 | 15.0 | 14.8 | 13.3 | 13.2 | 39 | 36 | 6.5 | 6.5 | 1246 | 1243 | 1.21 | 1.21 | 0.35 | 0.34 | 4.86 | 4.84 | - | - |
| Starchy Roots | 150 | 150 | 1.2 | 1.2 | 0.5 | 0.5 | 0.1 | 0.1 | 34 | 34 | 0.7 | 0.7 | - | - | 0.05 | 0.05 | 0.03 | 0.03 | 0.55 | 0.55 | 36.8 | 36.8 |
| Pulses | 26 | 16 | 1.7 | 1.1 | 0.6 | 0.4 | 0.1 | 0.1 | 10 | 7 | 0.5 | 0.3 | 2 | 1 | 0.04 | 0.03 | 0.01 | 0.01 | 0.16 | 0.10 | 0.2 | 0.1 |
| Vegetables & Fruits | 68 | 50 | 1.2 | 1.0 | 0.4 | 0.4 | 0.2 | 0.2 | 29 | 23 | 0.7 | 0.6 | 1005 | 822 | 0.05 | 0.04 | 0.06 | 0.04 | 0.54 | 0.42 | 22.1 | 17.5 |
| Meat,Eggs,Fish | 99 | 100 | 8.0 | 8.0 | 5.4 | 5.4 | 7.1 | 7.2 | 8 | 8 | 1.1 | 1.0 | 104 | 110 | 0.01 | 0.02 | 0.06 | 0.06 | 1.94 | 1.98 | - | - |
| Milk | 58 | 69 | 2.9 | 3.4 | 1.8 | 2.1 | 3.2 | 3.8 | 109 | 128 | 0.1 | 0.1 | 121 | 142 | 0.03 | 0.03 | 0.15 | 0.18 | 0.10 | 0.11 | 0.9 | 1.1 |
| Miscellaneous* | 129 | 129 | 0.2 | 0.2 | 0.1 | 0.1 | 2.0 | 2.0 | 17 | 17 | 0.7 | 0.7 | 13 | 12 | - | - | - | - | 0.05 | 0.05 | - | - |
| **Rift Valley** | | | | | | | | | | | | | | | | | | | | | | |
| Cereals | 1410 | 1382 | 37.3 | 36.6 | 15.4 | 15.1 | 14.8 | 14.4 | 28 | 29 | 7.4 | 6.9 | 1519 | 1458 | 1.36 | 1.31 | 0.35 | 0.35 | 5.21 | 5.09 | - | - |
| Starchy Roots | 151 | 151 | 1.2 | 1.2 | 0.5 | 0.5 | 0.1 | 0.1 | 34 | 34 | 0.7 | 0.7 | - | - | 0.05 | 0.05 | 0.03 | 0.03 | 0.05 | 0.05 | 36.9 | 36.9 |
| Pulses | 6 | 4 | 0.4 | 0.2 | 0.1 | 0.1 | - | - | 2 | 1 | 0.1 | - | 1 | - | 0.01 | 0.01 | - | - | 0.04 | 0.02 | 0.1 | - |
| Vegetables & Fruits | 15 | 15 | 0.3 | 0.3 | 0.1 | 0.1 | 0.1 | 0.1 | 7 | 7 | 0.1 | 0.1 | 248 | 248 | 0.01 | 0.01 | 0.01 | 0.01 | 0.13 | 0.13 | 5.4 | 5.4 |
| Meat,Eggs,Fish | 62 | 60 | 4.8 | 4.7 | 3.3 | 3.2 | 4.6 | 4.4 | 5 | 3 | 0.6 | 0.3 | 74 | 69 | 0.02 | 0.01 | 0.03 | 0.01 | 1.23 | 0.70 | - | - |
| Milk | 243 | 204 | 12.0 | 10.1 | 7.2 | 6.1 | 13.5 | 11.3 | 449 | 377 | 0.4 | 0.3 | 502 | 422 | 0.11 | 0.11 | 0.65 | 0.55 | 0.39 | 0.33 | 3.8 | 3.2 |
| Miscellaneous* | 125 | 127 | 0.2 | 0.2 | 0.1 | 0.1 | 0.8 | 0.8 | 11 | 11 | 0.4 | 0.4 | 8 | 8 | - | - | - | - | 0.04 | 0.04 | - | - |
| **Western** | | | | | | | | | | | | | | | | | | | | | | |
| Cereals | 1205 | 1203 | 32.2 | 32.1 | 13.8 | 13.9 | 11.9 | 11.9 | 37 | 37 | 5.7 | 5.7 | 1099 | 1085 | 1.07 | 1.05 | 0.31 | 0.32 | 4.31 | 4.28 | - | - |
| Starchy Roots | 132 | 132 | 1.1 | 1.1 | 0.4 | 0.4 | 0.1 | 0.1 | 30 | 30 | 0.6 | 0.6 | - | - | 0.05 | 0.05 | 0.02 | 0.02 | 0.05 | 0.05 | 32.3 | 32.3 |
| Pulses | 48 | 42 | 3.1 | 2.7 | 1.1 | 0.9 | 0.2 | 0.2 | 19 | 17 | 0.9 | 0.8 | 4 | 4 | 0.08 | 0.07 | 0.03 | 0.02 | 0.30 | 0.26 | 0.4 | 0.4 |
| Vegetables & Fruits | 47 | 47 | 1.0 | 1.0 | 0.4 | 0.4 | 0.2 | 0.2 | 22 | 22 | 0.6 | 0.6 | 797 | 797 | 0.04 | 0.04 | 0.04 | 0.04 | 0.40 | 0.40 | 16.7 | 16.7 |
| Meat,Eggs,Fish | 84 | 85 | 6.6 | 6.6 | 4.4 | 4.6 | 6.2 | 6.1 | 6 | 6 | 0.9 | 0.9 | 116 | 117 | 0.02 | 0.02 | 0.05 | 0.05 | 1.70 | 1.72 | - | - |
| Milk | 34 | 38 | 1.7 | 1.9 | 1.1 | 1.2 | 1.8 | 2.1 | 63 | 72 | - | 0.1 | 72 | 81 | 0.01 | 0.02 | 0.09 | 0.10 | 0.07 | 0.07 | 0.6 | 0.6 |
| Miscellaneous* | 115 | 115 | 0.3 | 0.3 | 0.1 | 0.1 | 1.9 | 1.9 | 11 | 11 | 0.4 | 0.4 | 12 | 12 | | | | | 0.04 | 0.04 | - | - |

* Miscellaneous = sugar, fats, nuts, stimulants, alcoholic beverages

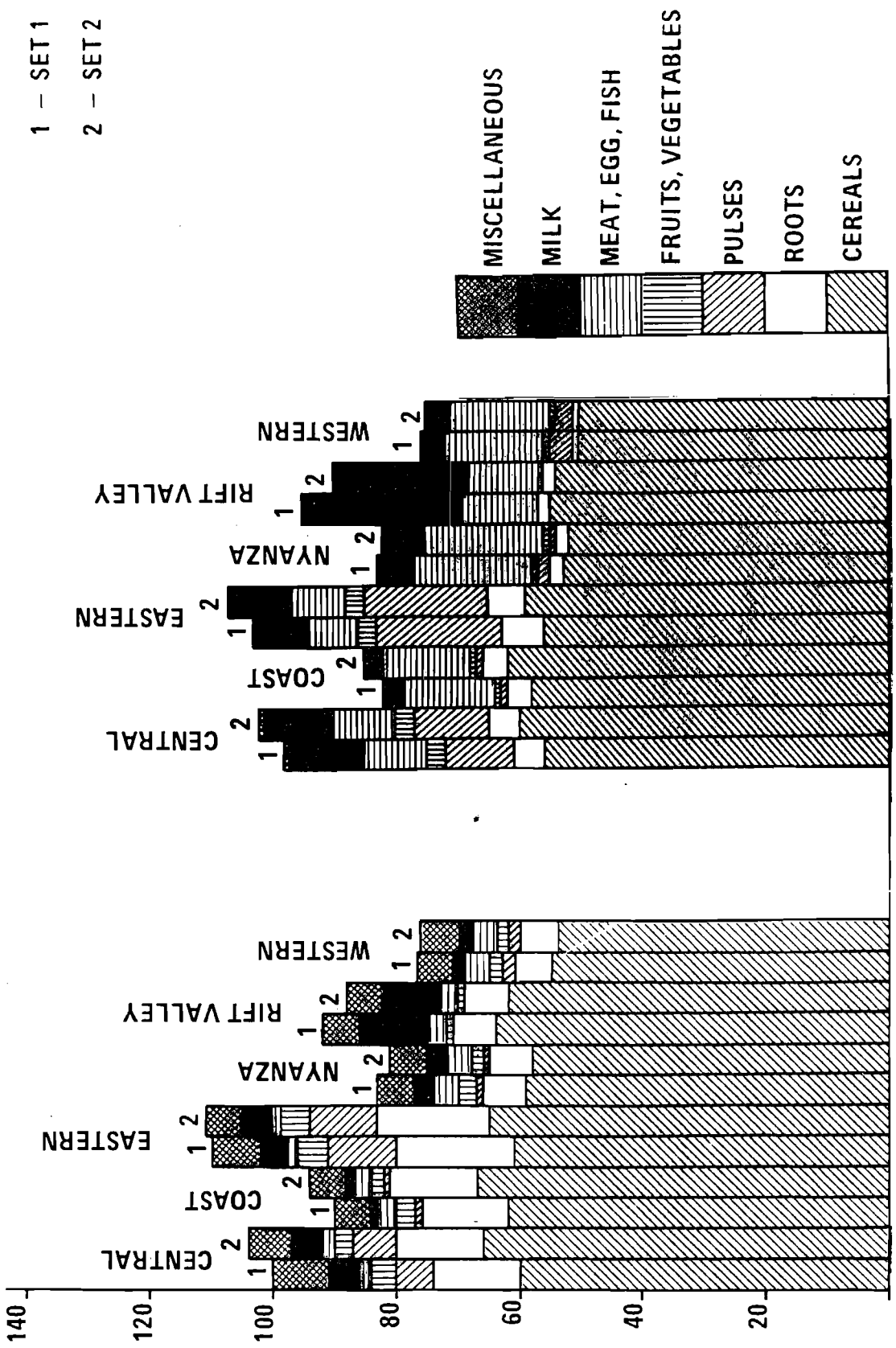


Figure 5a **CONTRIBUTION OF THE DIET TO VARIOUS REQUIRED NUTRIENTS IN SEVERAL PROVINCES**

(moderate activity level)

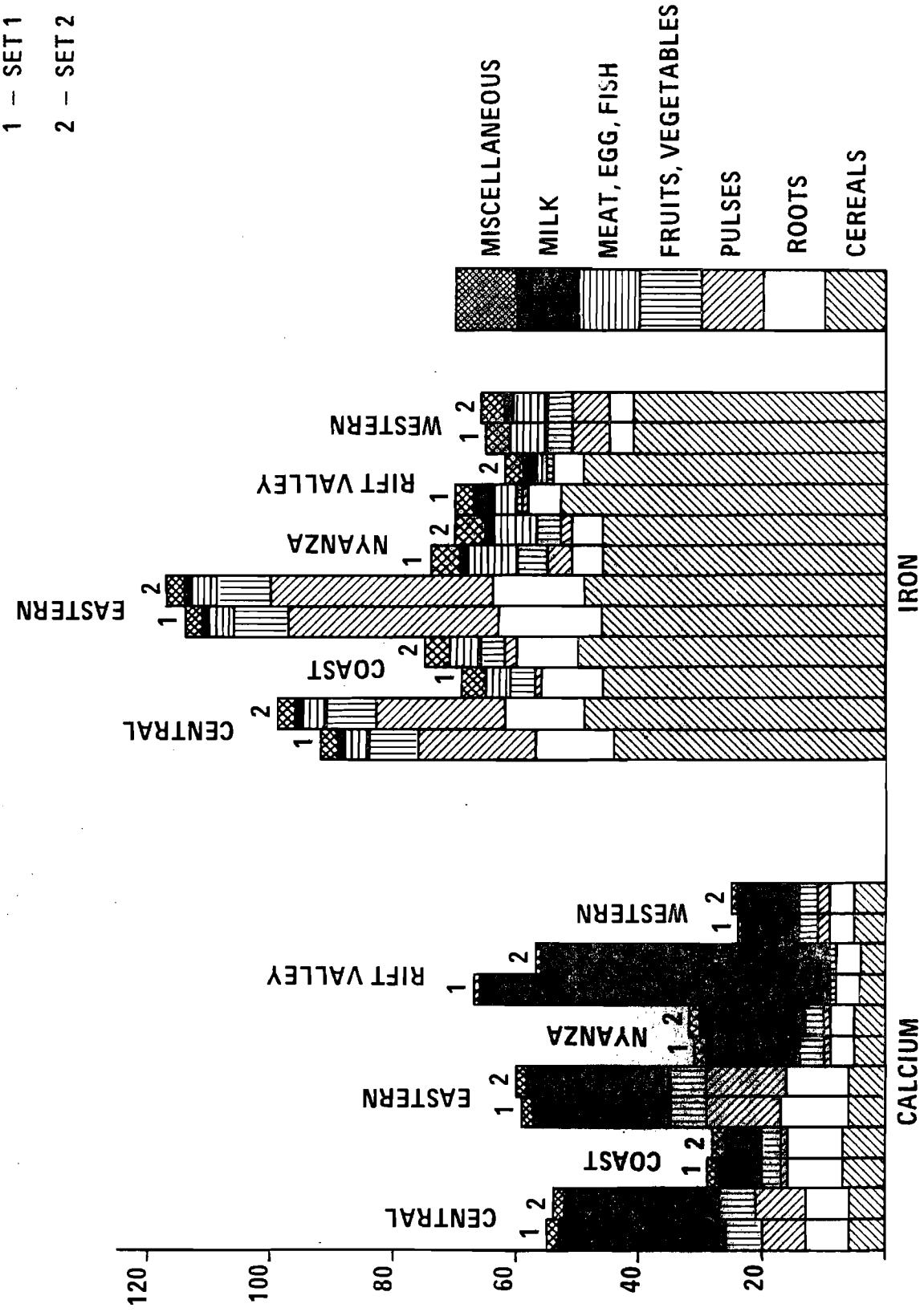
1 – SET 1
2 – SET 2
MISCELLANEOUS
MILK
MEAT, EGG, FISH
FRUITS, VEGETABLES
PULSES
ROOTS
CEREALS
IRON
CALCIUM
CENTRAL
COAST
EASTERN
NYANZA
RIFT VALLEY
WESTERN
120
100
80
60
40
20

Figure 5b

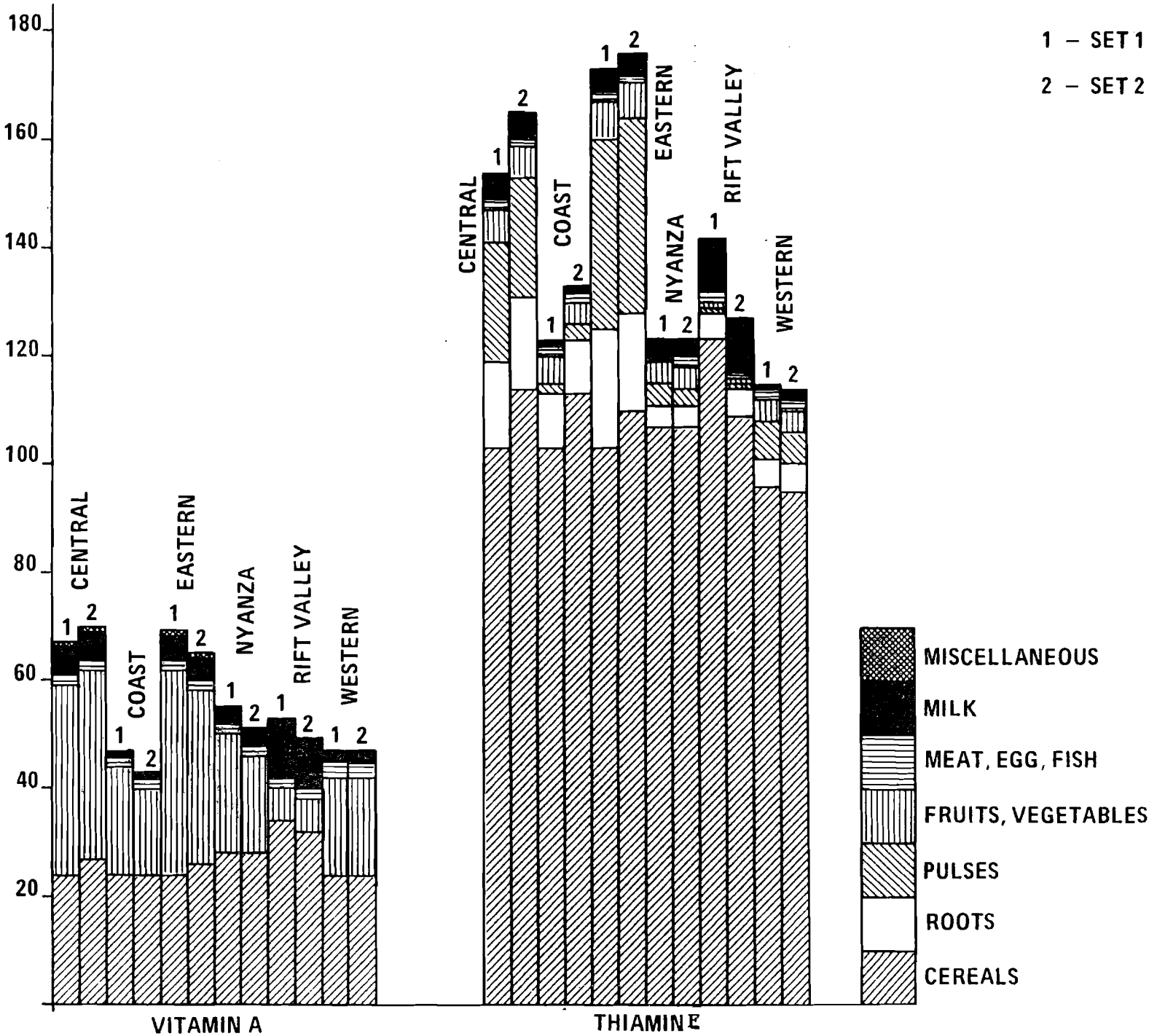
180
160
140
120
100
80
60
40
20
1 – SET 1
2 – SET 2
CENTRAL
COAST
EASTERN
NYANZA
RIFT VALLEY
WESTERN
VITAMIN A
THIAMINE
MISCELLANEOUS
MILK
MEAT, EGG, FISH
FRUITS, VEGETABLES
PULSES
ROOTS
CEREALS

Figure 5c

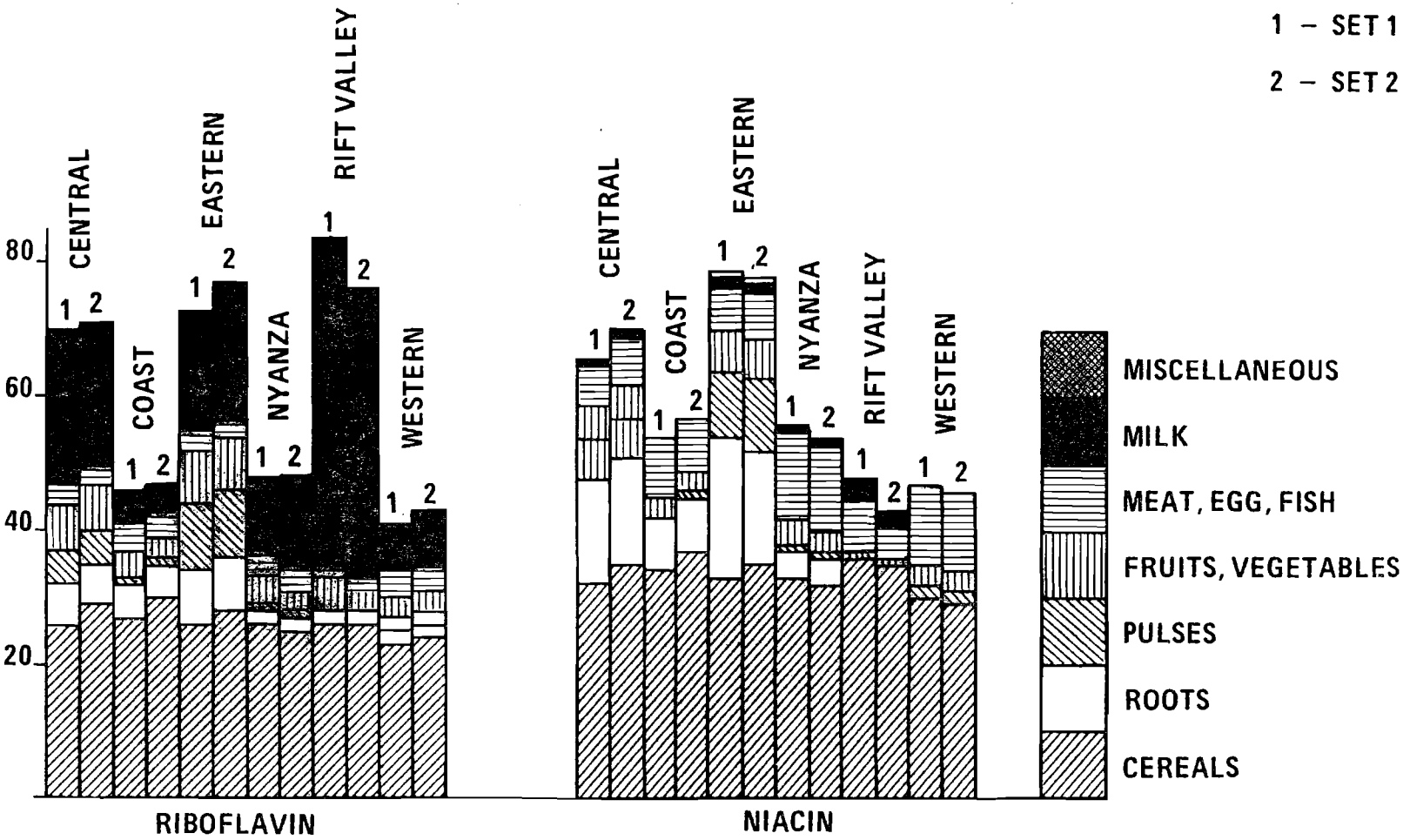
1 – SET 1
2 – SET 2
CENTRAL
COAST
EASTERN
NYANZA
RIFT VALLEY
WESTERN
80
60
40
20
MISCELLANEOUS
MILK
MEAT, EGG, FISH
FRUITS, VEGETABLES
PULSES
ROOTS
CEREALS
RIBOFLAVIN
NIACIN

Figure 5d

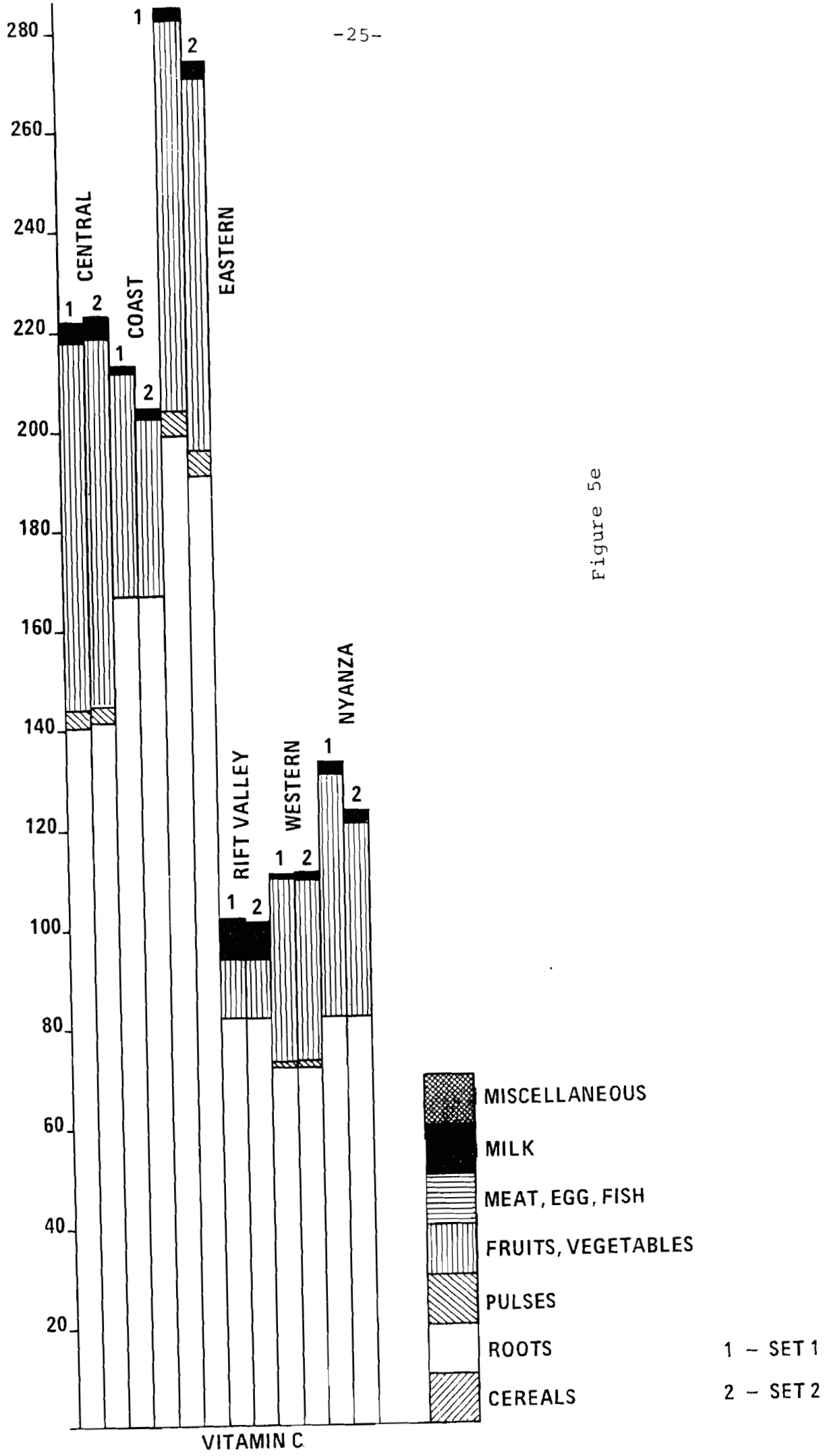
280
260
240
220
200
180
160
140
120
100
80
60
40
20
CENTRAL
COAST
EASTERN
RIFT VALLEY
WESTERN
NYANZA
1
2
MISCELLANEOUS
MILK
MEAT, EGG, FISH
FRUITS, VEGETABLES
PULSES
ROOTS
CEREALS
1 – SET 1
2 – SET 2
VITAMIN C

Figure 5e

reasoning is true for the low intake of iron, calcium and riboflavin. It is of interest to note that no cassava is eaten, the whole starchy root consumption consists solely of potatoes, therefore, the vitamin C level and the niacin level is relatively low.

The infant mortality rate[1] (Table 10 gives only a crude indicator for the nutritional situation of a group of people and should be used only with caution. The chances are relatively low for a child in this province to survive up to 3 years, which surely can be related to the low nutritional status of this age group among other factors.

Figure 5 stresses the importance of a mixed diet. This figure can be used to estimate the quality of the diet and to propose quite easily which commodity should be increased or decreased to obtain a balanced diet. The poor diet in the Western province has to be supplemented substantially in order to improve it qualitatively and quantitatively. If the missing calories are derived from an increase in milk consumption by approximately 200%, a vegetable and fruit consumption by about 400%, a pulse consumption of about 200% as well as an addition of 20-30 g nuts, an excellently balanced diet would be received.

### 1.4.2. Nyanza

The annual per capita income in Nyanza is slightly higher than in the Western province, and somewhat more money is spent on food (Table 4). For food relatively more money is spent in this province than in the whole country. However, since only 2/3 of the money is spent which actually would be needed for an adequate diet, an intake low in almost all nutrients must be expected. As in the Western province, the diet of the population in Nyanza is only adequate in thiamine and vitamin C, all the other nutrients are consumed in the average below the required amount for optimal health. As in the Western province, the consumption of pulses, fruits and vegetables as well as of milk products is far below the level which assures a balanced diet. These particular items need a substantial improvement in the general diet pattern. The meat and fish consumption is relatively high here in this province, when compared to the other provinces. It is the highest one in the whole country.

The infant mortality rates and the life expectancies are the lowest of the whole country (Table 10) which is surely related

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1) The infant mortality rates and the life expectancies of the Kenyan provinces are derived by Anker and Knowles (9) who tested the differences among the provinces statistically by various points of view. One of their variables was the amount of quality-adjusted agricultural land per capita which was positively related to life expectancy, but not statistically significant. However, the amount of quality-adjusted agricultural land cannot be used directly as a synonym for the nutritional status of the rural population, which was not evaluated as a variable. Therefore these data can be used for comparing them with the nutritional intake data, assuming that there may be a positive significant correlation.

Table 10. Infant Mortality levels and Life Expectancy at Birth (1969 census)

| Province/Towns | Percent of births surviving to age of 2 | percent of births surviving to age of 3 | life expectancy at birth, years |
|---|---|---|---|
| Central | 91.08 | 88.96 | 60.1 |
| Nyanza | 78.63 | 75.44 | 38.6 |
| Western | 82.76 | 79.50 | 43.5 |
| Coast | 81.46 | 80.24 | 43.4 |
| Rift Valley | 89.24 | 86.64 | 54.1 |
| Eastern | 86.16 | 84.36 | 49.8 |
| Nairobi | 90.39 | 88.95 | 56.8 |
| Mambasa | 85.69 | 83.94 | 49.2 |
| Kisumu* | 76.50 | 76.64 | 38.0 |
| Nakuru** | 86.99 | 83.46 | 51.2 |



* refers to the Kisumu district, and, actually, only 9% of the people are living in Kisumu Town. However, because of the close relationship between the urban and rural population, these figures may be also true for the urban population.

** refers to Nakuru District. Nakuru Town covers only 16% of the people in this district. Because of the strong migration of the urban and rural population, these figures may also hold for the town itself.

Source: R. Anker and J.C. Knowles (1977). An Empirical Analysis of Mortality Differentials in Kenya at the Macro and Micro levels. Population and Employment Working Paper No. 60. International Labour Office, Geneva.

to the nutritional status of this province.

It is not surprising that the diet patterns are similar in the Western and the Nyanza province because they border each other. The cultural, and consequently the nutritional, behaviour between both states is quite interrelated. The relatively low income and consequently the low nutritional value of their food connected with a remarkable degree of malnutrition is partially due to their poor agricultural development.

1.4.3. Rift Valley

The Rift Valley borders on the two provinces discussed before. The per capita income is higher in this province and also more money is spent on food. However, the food intake is still below the amount needed for an adequately balanced diet (Table 7 - 9 ). The improvement of the general pattern is only small and, as expected from Figure 4, only the thiamine intake is adequate in the average diet. Even vitamin C is in deficit due to the extremely low vegetable consumption. The overall food pattern in this province is even more out of balance than the ones in the provinces discussed above. The diet is even poorer in respect to the variety of items consumed (Figure 5). Besides the very low fruit and vegetable consumption, the diet is missing almost all pulses; the amount of meat available is also relatively low. Therefore, in the intake of iron, vitamin A and niacin are below the requirements. On the other hand, enough milk products are consumed in this province to contribute to a calcium and riboflavin intake which is the biggest one of all the provinces, and to a protein content of the diet which is relatively improved (which is, however, still below the requirements).

The relatively low infant mortality rates and high life expectancies are not quite related to the overall food pattern. They may be partially due to the high milk consumption which especially improves the weaning food and, therefore, is very effective just in this age group. If this is the only explanation it would show very clearly the importance of having enough milk in the diet.

As already mentioned, the diet in this province is almost completely lacking in any fruits, vegetables, and pulses. To substantiate their diet, approximately 60 g of pulses and 400 g of fruits and vegetables should be consumed per day per capita. This high discrepancy between the amount actually eaten and the amount required for a good diet does not have to exist necessarily; there is also the possibility, that these commodities were not evaluated extensively in the survey. However, this observation needs further investigation.

### 1.4.4 Central Province

The Central Province is the richest one in Kenya. The per capita income is the highest of all the provinces, however, less of it is spent on food than on average by the rural population (Table 4 ). The supply of energy is almost sufficient, depending upon whether the population is considered as moderately active or very active, whether set 1 or 2 is used, and how much of the food is lost while preparing (Table 7 - 9 ). The protein intake is slighty lower than the caloric supplies which is due to the relatively high consumption of starchy roots and the low consumption of meat products. In this province, the intake of thiamine and vitamin C is also adequate. The intake of iron is about that of the one required which is due to a sufficient consumption of pulses. The vitamin A intake,almost the highest one in the whole county, is still below the requirements,pointing to the general problem of the rural Kenyian diet, the too low consumption of fruits and vegetables. The intake of riboflavin being below the requirements as in all the other provinces needs improvement by a higher milk consumption.

As can be expected from the nutritional analysis, the chances are the highest for a child in this province to survive to the age of 3, and, consequently, the life expectancy is the highest one in this province (Table 10).

### 1.4.5 Eastern Province

The per capita income in the Eastern Province is lower than in the Central Province, however more of it is spent on food (Table 4 ). As can be expected, the diet is slightly improved in respect to all nutrients, making it adequate in calories, protein, iron,thiamine and vitamin C (Table 7-9 ). However, since the diet is not a balanced one, deficiencies arise in vitamin A, riboflavin, and niacin. The overall starchy root consumption is too high, whereas too little fruit and vegetables as well as milk products are consumed. Again, as in the other provinces, it is not known whether some nuts are consumed which would improve the niacin intake. In order to improve the diet in the Eastern Province and to make it as balanced as possible the amount of starchy roots should be cut to half the amount whereas twice as much fruits, vegetables and milk products should be eaten.

The infant mortality rates (Table 10 ) are much higher than expected for the relatively good diet. The reason for this discrepancy can be found in the different structure of the income distribution - the very poor (especially sensitive to infant mortality) may be outbalanced by the rich - as well as in a high incidence of diseases due to infections and contaminations by parasites.

### 1.4.6 The Coast Province

In comparison to the Central and the Eastern Province, the per capital income in the Coast Province is quite low (Table 4). Even if more of the money is spent on food than on average, the expected diet cannot be upgraded very much. The highest share of the income is used for food in the Coast Province, and this is influenced by the household size. The highest number of persons belonging to one household is found in this province (Table 2).

The diet in the Coast Province is deficient in all nutrients except thiamine and vitamin C (Table 7-9). The requirements of thiamine are met at the retail level but may become low at the consumption level after the food is prepared. The relatively low thiamine intake is due to the extremely low consumption of pulses (Figure 5, Table 9). The high vitamin C content of the food is derived from cassava which is the only starchy root eaten in this province. The very low content of pulses in the diet further on influences negatively the intake of riboflavin, niacin and iron.

The amount of milk contributing to the diet is also very low and, therefore, is responsible for the low riboflavin content of the diet as well as for the low calcium intake. The vitamin A intake is the lowest one of all provinces which is partially due to the low vegetable and fruit consumption. In order to improve the overall diet the same recommendations have to be given as for the other provinces - a slight decrease in the starchy root consumption followed by a substantial increase in pulses, fruits, vegetables and especially in milk products.

The infant mortality rate (Table 10) is very high, and consequently the life expectancy very low, which is due in part to the low nutritional level in this province. However, part of it is also contributed to it by the high incidence of malaria in this region.

## 1.5 The comparison of the nutritional status of the rural population with previous surveys

Nutritional surveys in Kenya were earlier carried out by Bohdal, Gibbs and Simmons (10) in May 1965 - July 1966 and by Cremer et al. (11) in 1966. These surveys have several shortcomings in respect to the nutritional states of the whole country. Only small, very specific (not necessarily representative) areas were surveyed which makes it hard or almost impossible to generalize the data for the whole province or even for the whole country. Further on, the time of the survey was quite often only very short (7 days). It was carried out very often only during one season, which does not allow the extrapolation of the data in order to obtain a consumption pattern for a whole year. In spite of these technical differences with the present survey, it will be assumed that the earlier surveys are representative

for the province, they were conducted only to get an idea whether the results of the present survey are in approximately the same magnitude.

The nutritional standards used in the surveys to calculate the value of the diet differ slightly which is due to continuous research in this field. Therefore, it appears to be advisable to compare the results in absolute numbers in order to avoid these difficulties. Further differences among the surveys are caused by using different food composition tables to calculate the nutritional value of the food eaten. Major variations seem to exist in the content of crude protein, iron and vitamin A. The differences in the vitamin A content are due to the fact that it was assumed in the present survey that yellow maize is eaten, whereas the others assumed green maize; furtheron, the vitamin A content of vegetables was assumed to be higher in the present study.

It looks like that relatively more animal products and much more sugar are consumed in the Central Province nowadays than 10 years ago. However, the bean consumption decreased considerably in the last 10 years (it also could be just due to the present survey as pointed out in Shah and Frohberg [5]. The calorie consumption of the whole province may be higher nowadays; however due to the decreased intake of pulses less protein is consumed. All the other nutrients are proportionally higher with the amount of food eaten nowadays.

Relatively more sugar and less legumes are consumed also in the Nyanza Province; in addition, more vegetables are eaten here nowadays than 10 years ago. The amount of food available may be still the same as previously; it does not look like that considerably more food is consumed nowadays. Consequently, the intake of all major nutrients is approximately the same as before.

More of the calories are derived from starchy roots, animal products and sugar, and less from cereals in the Eastern Province nowadays. However, inspite of these changes, the diet is still approximately the same in quantitative and qualitative terms.

It can be concluded that the diet of the rural population in Kenya did not change considerably during the last 10 years. The major problem is still that too less food is available to feed everyone properly and that the diet largely depends upon the food availability in an area. The diet is still an unbalanced one, which means that it was and that it is more deficient in vitamin A, niacin and riboflavin than in other nutrients.

## 1.6 Future Outlook

Estimating the average amount of food available to the rural population in the year 2000, it looks like enough food is on the market (Table 11). [A detailed description of this estimation is given in Shah (12). However, it has to be kept in mind that this assumes equal distribution among all persons. But, as shown before, huge discrepancies exist between the poor and the rich income class. Therefore, it can be supposed that the poor class, at least in part, still will be suffering from undernutrition. The nutritional problem will not be solved completely, it may just be eased somewhat.

Table 11. Estimated supplies of nutrients in the year 2000 for the rural population (moderately active)
[The method of estimation is described in part A of this presentation]

| Nutrient | in 1975 | Supply in percent of requirements* in 2000 | | | |
|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 |
| energy | 93 | 111 | 114 | 114 | 101 |
| protein | 93 | 116 | 124 | 130 | 101 |
| fat** | 11 | 15 | 17 | 18 | 12 |
| calcium | 44 | 55 | 63 | 68 | 46 |
| iron | 84 | 104 | 110 | 114 | 95 |
| vitamin A | 58 | 72 | 75 | 77 | 65 |
| thiamine | 146 | 175 | 181 | 175 | 162 |
| riboflavin | 62 | 75 | 83 | 88 | 66 |
| niacin | 61 | 78 | 83 | 86 | 69 |
| vitamin C | 177 | 180 | 182 | 179 | 178 |
| income (KSh) | 495 | 875 | 1328 | 1919 | 585 |

*requirements in the year 2000 different from Table 1:

| | |
|---|---|
| energy | 2190 kcal |
| protein | 27.4 g |
| thiamine | 1.10 mg |
| riboflavin | 1.31 mg |
| niacin | 14.45 mg |

**in percent of required energy

1 Medium population projection and likely growth (7%) of total PCE assuming in the income distribution
2 Medium population projection and likely growth (7%) of total PCE assuming a moderate change in the income distribution
3 Medium population projection and likely growth (7%) of total PCE assuming a drastic change
4 Low population projection and low growth (4.5%) of total PCE

Source: M.M. Shah (12).

The quality of the diet will not change at all, and will correspond further on to the one predicted in Figure 4. This diet will be deficient in vitamin A, riboflavin, and niacin; all the other essential nutrients will be consumed at or above the required amount. The price of this diet can be estimated to be approximately 500 KSh per caput and year, if constant prices are assumed. As a safety factor, 50 KSh have to be added to compensate for the higher meat and fat consumption, two very expensive items. If it is further assumed that 75% of the income is spent for food as in 1975 (Table 4 ), the income should be approximately 750 KSh. According to this estimation, only the projection 1 (with a medium increase in population and income and with no change in the income distribution) (Table 11) can be considered as the one which is likely to represent the behavior of the rural population. Projection 2 and 3 (medium increase in population and income with a moderate or drastic increase in the income distribution, respectively), are not very likely, because 41% and 29%, respectively, of the income would be spent for food. However, they do not correlate with the behavior of the rural population (they also do not fit Figure 3) and they would assume a similar behavior as observed among the urban population which will be shown later.

## 1.7 Conclusions

Generally speaking, the diet of the rural population in Kenya is too low in energy and high quality protein, as well as in all major nutrients. The diet as a whole cannot be considered as a balanced one because some nutrients are more deficient than others. It does not help to improve the diet just in quantity, also the quality has to be improved. The low value of the food is also reflected in the high infant mortality rate, and consequently, in the low life expectancy.

Figure 5 can be used in order to estimate the content of a balanced diet which is based on the average diet consumed in Kenya by the rural population. As already mentioned very often throughout this report, the major problem of the Kenyian diet can be found in the low consumption of pulses, vegetables, fruits, milk and nuts; therefore, the intake of these items has to be increased substantially. Taking these observations into consideration, the proposed content of the food consumed in one day per person should be composed as listed in Table 12. This theoretical diet consists mainly of maize as staple food too, but it is substantiated in addition with all the other food items in order to deliver all the required nutrients. It has to be kept in mind that this diet would be appropriate for a moderately active population. If the people are more active as assumed, the diet has to be supplemented which can be done by a higher consumption of cereals and starchy roots. Some additional food of the same quality as the proposed one should be obtained in order to compensate for the losses during preparation. This diet would cost about 450 KSh per year and person. Adding to

it an increase of about 10% for food losses, it amounts to 500 KSh per year and person. This simple calculation shows that this balanced diet would not be more expensive that the traditional one. It would just need a different distribution of the money between the food commodities. However, this may be the main problem and can be achieved only very slowly by teaching the people the importance of a good balanced diet and giving them the insentive to grow more of these items by themselves than they have done up to now.

According to this survey, the most urgent help will be needed in the Western Province. The food available there is the lowest one in quantity and quality of all the provinces. And more specifically, it will be the poor income class suffering the most from malnutrition. However, these findings have to be substantiated by further research especially at the medical level.

# Table 12.

A . Estimation of a Balanced Diet for the Rural Population Per Day and Caput

| | amount[a] (g) | energy[b] (kcal) | b) high quality protein (g) | fat[b] | calcium[b] (mg) | iron[b] (mg) | vitamin A[b] (mg) | thiamine[b] (mg) | b) ribo-flavin (mg) | b) nia-cin (mg) | b) Vitamin C (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| cereals[c] | 350 | 1,200 | 14 | 6 | 40 | 7 | 700 | 0.8 | 0.3 | 5.2 | - |
| starchy roots[d] | 100 | 100 | 1 | - | 30 | 1 | 150 | 0.1 | - | 0.7 | 22 |
| pulses | 70 | 240 | 6 | 1 | 70 | 3 | 70 | 0.4 | 0.2 | 1.6 | 3 |
| vegetables & fruits[e] | 280 | 130[g] | 1 | 1 | 70 | 2 | 2430[g] | 0.1 | 0.2 | 1.2 | 53 |
| meat, fish & eggs | 50 | 90 | 5 | 6 | 10 | 1 | 40 | - | 0.1 | 1.3 | - |
| milk | 260 | 170 | 6 | 10 | 340 | - | 420 | 0.1 | 0.5 | 0.4 | 3 |
| miscellaneous f) | 66 | 190 | - | 5 | 10 | 1 | 210 | - | - | - | - |
| nuts | 35 | 60 | 1 | 5 | 30 | 1 | - | - | - | 0.8 | 2 |
| TOTAL | | 2,180 | 34 | 34 | 600 | 16 | 4,020 | 1.5 | 1.3 | 11.2 | 83 |

B. Estimation of the Price of the Balanced Diet (assuring constant prices).

| item | amount (g) | estimate price/kg[h] (KSh) | price / amount (KSh) |
|---|---|---|---|
| cereals | 150 | 0.80 | 0.28 |
| starchy roots | 100 | 0.40 | 0.04 |
| pulses | 70 | 2.10 | 0.15 |
| vegetables and fruits | 280 | 0.50 | 0.14 |
| meat, fish and eggs | 50 | 3.50 | 0.18 |
| milk | 260 | 0.93 | 0.24 |
| miscellaneous [f] | 66 | 1.40/10.00 | 0.12 |
| nuts | 35 | 3.50 | 0.12 |
| TOTAL | | | 1.27 x 365 days = 463 Ksh/day and caput |

a) amount estimated from Figure 5

b) average of the whole commodity group as consumed in the country.

c) maize and millet

d) cassava

e) 1/2 fruit and 1/2 vegetables

f) sugar and fat [60 g of sugar (1/2 refined + 1/2 as cane) and 6 g of fat]

g) less energy and more vitamin A would be consumed if more vegetables would be eaten than fruits

h) estimated price is the average price of the whole commodity group in 1975

## 2. Nutritional Situation of Urban Population

Only the first phase of the Urban Food Purchasing Survey, April - June 1977, could be considered in this analysis. The results of this investigation have to be treated carefully because only a part of the spectrum of urban consumers (about 2% of the urban households) is covered and the residential areas of the towns may not be represented adequately. The study of the food expenditure pattern was performed by repeated visits on alternate days to a household throughout one month (= 15 visits). The survey was based on expenditure recalls for 48 hours. These consumption data were extrapolated to the consumption level of the whole year and do not consider any seasonal changes in the food pattern. Even if the data of the survey were not weighed to a total urban population figure and even of the mentioned uncertainties, these data can be used to estimate the nutritional status of the urban population.

The analysis of the food balance sheets was performed as the one of the rural population which was described earlier. The requirements of the urban population calculated from the age structure of the population are listed in Table 1. The urban population is physically not working as hard as the rural population and, therefore, their requirements should be considered as somewhere between lightly active and moderately active. However, the urban population should be considered as moderately active in respect to their protein requirements because the amount of protein needed does not depend upon the physical activity.

### 2.1. The Total Urban Population

The most characteristic feature of the nutritional situation in Kenya is the same one whether the urban or the rural part of the population is considered (Tables 3 and 13). Both these groups do not in general have enough food available to meet the energy and protein requirements. Therefore, it can be supposed

Table 13: The Relative Daily Supply of Nutrients to the Urban Population in 1975.

1. The urban population is considered as lightly active.
2. The urban population is considered as moderately active.

| | energy | | protein | | | | fat* | | cal-cium | iron | vita-min A | thiamine | | ribo-flavin | | niacin | | vita-min C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | crude | | high quality | | | | | | | | | | | | | |
| | % | | % | | % | | % | | % | % | % | % | | % | | % | | % |
| | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1+2 | 1+2 | 1+2 | 1 | 2 | 1 | 2 | 1 | 2 | 1+2 |
| Urban | | | | | | | | | | | | | | | | | | |
| Total | 96 | 91 | 221 | 208 | 102 | 96 | 17 | 16 | 43 | 93 | 99 | 148 | 140 | 62 | 58 | 69 | 65 | 162 |
| Poor | 84 | 79 | 192 | 181 | 86 | 81 | 13 | 12 | 33 | 84 | 82 | 135 | 127 | 50 | 47 | 57 | 54 | 136 |
| Medium | 99 | 94 | 231 | 218 | 107 | 100 | 19 | 18 | 45 | 97 | 106 | 151 | 142 | 64 | 60 | 79 | 74 | 173 |
| Rich | 115 | 108 | 270 | 255 | 126 | 119 | 23 | 22 | 61 | 111 | 119 | 166 | 157 | 80 | 76 | 89 | 84 | 207 |
| Nairobi | | | | | | | | | | | | | | | | | | |
| Total | 101 | 95 | 230 | 216 | 103 | 97 | 18 | 17 | 46 | 98 | 111 | 156 | 147 | 68 | 64 | 75 | 70 | 188 |
| Poor | 92 | 87 | 206 | 194 | 91 | 86 | 15 | 14 | 38 | 92 | 95 | 149 | 141 | 58 | 54 | 63 | 59 | 167 |
| Medium | 105 | 99 | 241 | 227 | 112 | 106 | 20 | 19 | 46 | 100 | 116 | 158 | 149 | 68 | 64 | 80 | 75 | 183 |
| Rich | 117 | 111 | 273 | 257 | 126 | 119 | 22 | 21 | 61 | 112 | 124 | 169 | 159 | 81 | 76 | 94 | 89 | 216 |
| Mombasa | | | | | | | | | | | | | | | | | | |
| Total | 101 | 95 | 240 | 226 | 108 | 102 | 16 | 15 | 42 | 101 | 79 | 157 | 148 | 63 | 59 | 74 | 70 | 138 |
| Poor | 85 | 80 | 201 | 189 | 88 | 83 | 11 | 10 | 27 | 85 | 56 | 141 | 133 | 44 | 41 | 58 | 55 | 92 |
| Medium | 107 | 100 | 257 | 243 | 116 | 109 | 18 | 17 | 42 | 105 | 84 | 167 | 158 | 64 | 60 | 81 | 76 | 141 |
| Rich | 133 | 125 | 319 | 301 | 149 | 140 | 28 | 26 | 76 | 129 | 129 | 188 | 177 | 100 | 94 | 104 | 98 | 238 |
| Nakuru | | | | | | | | | | | | | | | | | | |
| Total | 81 | 76 | 172 | 162 | 80 | 75 | 15 | 14 | 35 | 72 | 84 | 120 | 113 | 55 | 52 | 55 | 52 | 163 |
| Poor | 72 | 68 | 148 | 140 | 69 | 65 | 11 | 11 | 29 | 64 | 76 | 109 | 103 | 45 | 42 | 47 | 44 | 166 |
| Medium | 101 | 95 | 218 | 205 | 102 | 96 | 18 | 17 | 45 | 93 | 102 | 152 | 143 | 66 | 62 | 70 | 66 | 171 |
| Rich | 85 | 80 | 190 | 179 | 92 | 87 | 19 | 18 | 41 | 75 | 91 | 116 | 110 | 58 | 54 | 62 | 59 | 155 |
| Kisumu | | | | | | | | | | | | | | | | | | |
| Total | 83 | 78 | 197 | 185 | 95 | 90 | 15 | 14 | 38 | 85 | 102 | 127 | 119 | 54 | 51 | 61 | 58 | 168 |
| Poor | 79 | 75 | 189 | 178 | 89 | 83 | 13 | 13 | 34 | 81 | 101 | 124 | 117 | 52 | 49 | 57 | 54 | 152 |
| Medium | 75 | 70 | 181 | 170 | 88 | 83 | 14 | 13 | 36 | 79 | 96 | 114 | 108 | 50 | 47 | 48 | 45 | 152 |
| Rich | 101 | 95 | 228 | 215 | 109 | 103 | 20 | 19 | 41 | 97 | 104 | 146 | 137 | 63 | 60 | 75 | 70 | 177 |

* percent of total energy requirement

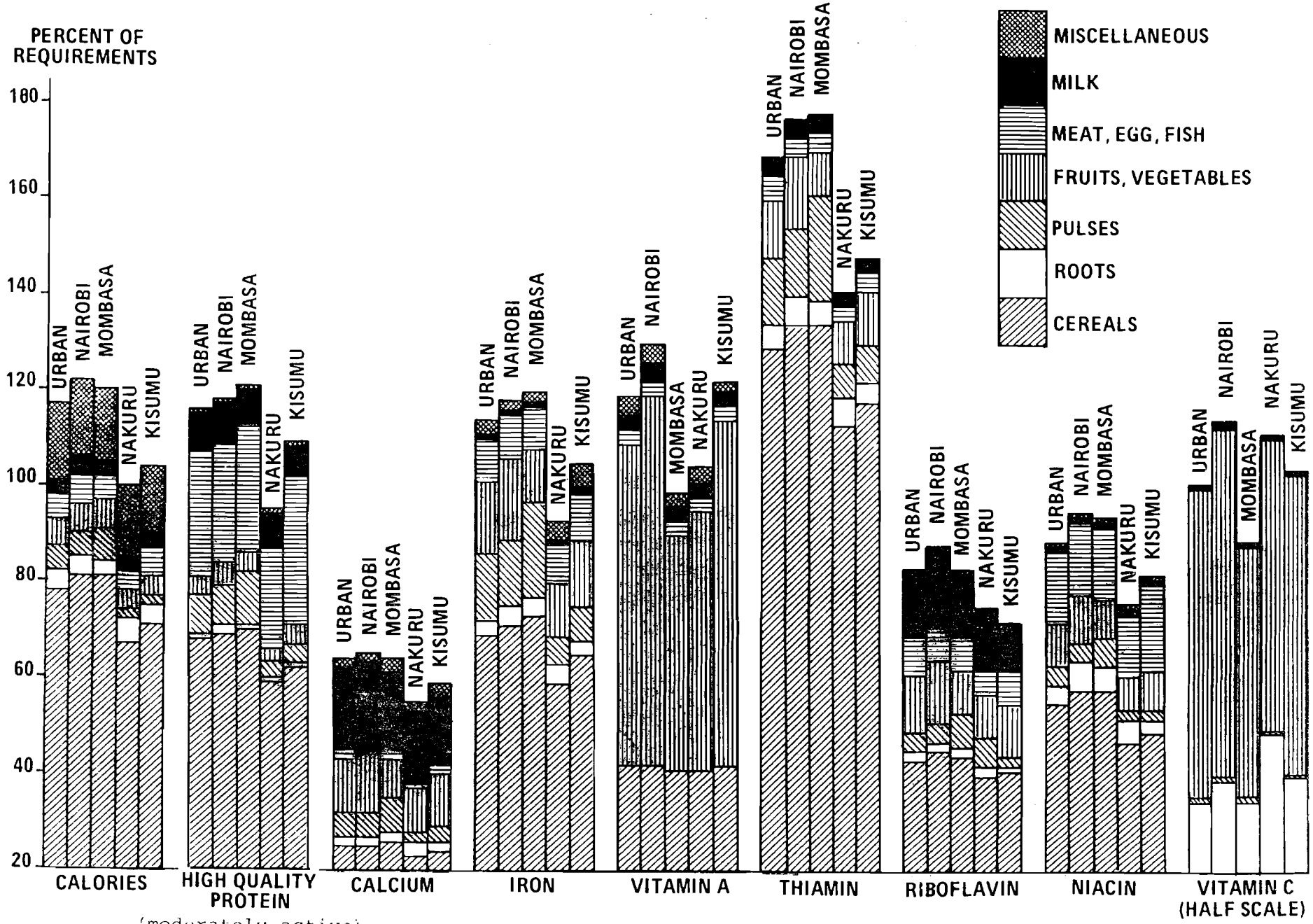
Absolute figures are given in Tables 14 - 18.
Source: M.M. Shah and H. Frohberg [5].

that a high percentage of the urban population will also be undernourished, partially even to a high degree. However, some qualitative improvements are noticeable in the diet of the urban population, even if it is quantitatively as low as the one of the rural populace. The overall content of minerals and vitamins is elevated in the diet of the urban people, and, therefore, their food consumption pattern has to be considered as a more balanced one (but not as a perfect one). Furthermore, the gap between the nutritional situation of the poor and the rich income class is not as wide any more; the poor people are a little bit better off than the ones in the countryside whereas the rich do not consume so much of the whole food basket which is available for all of them. However, analogous to the rural population, only the rich income class can buy enough food to compensate the energy requirements and the food losses during preparation.

In comparison to the rural population, the people in the towns eat less starchy roots but more fruits and vegetables, meat, fish and eggs as well as fats and oils (Figure 6, Table 68). The shift in the dietary preferences influences positively the content of iron and vitamin A in the diet which are consumed in an almost sufficient amount. However, no improvement is observed in the riboflavin [1]) and niacin [1]) intake, which is as insufficient as the one of the rural population, because an increase in the consumption of milk products and nuts is not detected. The thiamine and the vitamin C intake is also as substantive as the one of the rural population. The main staple food is still maize flour, however, more rice and wheat products are consumed by the urban population, which brings slightly more variations to the diet. Because of these variations in the food, the diet cannot be considered in general as poor as the one of the rural population.

---

1) The amount of riboflavin supplied in the diet is still sufficient for all income groups to prevent clinical symptoms (the minimum dietary level is around 0.6 mg/day for the lightly active urban population). However, the intake of niacin (without the contribution from tryptophan, but which may be low anyhow) is below the dietary level (9.37 mg), that will prevent clinical symptoms, for the poor income group in all the cities. Therefore, a high incidence of dermatitis and perhaps mental depresions should be expected among the urban poor population provided no other items rich in niacin are consumed than the ones elaborated in the survey.




(moderately active)

Figure 6 SOURCE OF NUTRIENTS OF THE URBAN POPULATION (light activity)

TABLE 14 : CONSUMPTION PATTERN OF THE URBAN POPULATION IN 1975

| | Energy (kcal) | protein crude (g) | protein high quality (g) | fat (g) | calcium (mg) | iron (mg) | vita-min A (I.U.) | thiamin (mg) | ribo-flavin (mg) | niacin (mg) | Vita-min C (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | | | | | | | | | | | |
| cereals | 1235 | 33.0 | 13.2 | 11.4 | 39 | 6.9 | 988 | 1.16 | 0.30 | 4.97 | - |
| starchy roots | 78 | 1.0 | 0.4 | - | 14 | 0.4 | - | 0.05 | 0.02 | 0.50 | 13.2 |
| pulses | 98 | 6.3 | 2.2 | 0.5 | 39 | 1.9 | 9 | 0.15 | 0.05 | 0.60 | 0.9 |
| fruits & veg. | 121 | 3.0 | 1.2 | 0.5 | 84 | 2.1 | 3027 | 0.13 | 0.15 | 1.26 | 57.9 |
| meat,egg,fish | 117 | 10.2 | 7.1 | 8.2 | 12 | 1.2 | 139 | 0.05 | 0.09 | 2.12 | - |
| milk | 71 | 3.6 | 2.2 | 3.9 | 136 | 0.1 | 153 | 0.04 | 0.18 | 0.14 | 1.1 |
| miscellaneous * | 331 | 0.6 | 0.2 | 15.9 | 19 | 0.4 | 161 | - | - | 0.12 | - |
| | 2051 | 57.7 | 26.5 | 40.4 | 343 | 13.0 | 4477 | 1.58 | 0.79 | 9.75 | 73.1 |
| Poor | | | | | | | | | | | |
| cereals | 1173 | 31.3 | 12.6 | 11.6 | 33 | 6.7 | 1066 | 1.13 | 0.29 | 4.49 | - |
| starchy roots | 78 | 0.8 | 0.3 | 0.1 | 15 | 0.4 | - | 0.04 | 0.02 | 0.49 | 17.3 |
| pulses | 85 | 5.5 | 1.9 | 0.4 | 34 | 1.7 | 7 | 0.13 | 0.04 | 0.52 | 1.0 |
| fruits & veg. | 71 | 2.2 | 0.9 | 0.3 | 64 | 1.5 | 2361 | 0.09 | 0.10 | 0.87 | 42.3 |
| meat,egg,fish | 79 | 7.3 | 5.1 | 5.4 | 8 | 0.9 | 85 | 0.03 | 0.06 | 1.48 | - |
| milk | 50 | 2.5 | 1.5 | 2.7 | 92 | 0.1 | 103 | 0.02 | 0.13 | 0.08 | 0.7 |
| miscellaneous * | 251 | 0.5 | 0.2 | 10.2 | 16 | 0.4 | 88 | - | - | 0.09 | - |
| | 1787 | 50.1 | 22.5 | 30.7 | 262 | 11.7 | 3710 | 1.44 | 0.64 | 8.02 | 61.3 |
| Medium | | | | | | | | | | | |
| cereals | 1255 | 33.8 | 13.3 | 11.5 | 41 | 7.2 | 974 | 1.17 | 0.30 | 5.09 | - |
| starchy roots | 75 | 1.0 | 0.3 | 0.1 | 13 | 0.5 | - | 0.06 | 0.02 | 0.70 | 14.1 |
| pulses | 94 | 6.1 | 2.1 | 0.5 | 38 | 1.8 | 8 | 0.15 | 0.05 | 0.58 | 0.8 |
| fruits & veg. | 123 | 3.3 | 1.3 | 0.5 | 90 | 2.3 | 3266 | 0.14 | 0.16 | 1.80 | 61.7 |
| meat,egg,fish | 138 | 11.8 | 8.3 | 9.7 | 14 | 1.4 | 164 | 0.05 | 0.10 | 2.54 | - |
| milk | 72 | 3.6 | 2.2 | 3.9 | 135 | 0.1 | 152 | 0.04 | 0.18 | 0.14 | 1.1 |
| miscellaneous * | 359 | 0.8 | 0.3 | 18.1 | 26 | 0.3 | 190 | - | 0.01 | 0.19 | - |
| | 2116 | 60.4 | 27.8 | 44.3 | 357 | 13.6 | 4754 | 1.61 | 0.82 | 11.04 | 77.7 |
| Rich | | | | | | | | | | | |
| cereals | 1278 | 34.2 | 13.4 | 10.3 | 47 | 7.1 | 802 | 1.16 | 0.28 | 5.53 | - |
| starchy roots | 63 | 1.1 | 0.4 | 0.1 | 8 | 0.5 | - | 0.06 | 0.02 | 0.86 | 9.2 |
| pulses | 151 | 9.8 | 3.3 | 0.8 | 61 | 3.0 | 13 | 0.24 | 0.08 | 0.93 | 1.3 |
| fruits & veg. | 225 | 4.4 | 1.9 | 0.7 | 108 | 2.8 | 3777 | 0.19 | 0.22 | 1.91 | 80.8 |
| meat,egg,fish | 168 | 14.1 | 9.9 | 12.0 | 16 | 1.8 | 202 | 0.06 | 0.12 | 2.90 | - |
| milk | 116 | 5.9 | 3.6 | 6.3 | 221 | 0.2 | 248 | 0.06 | 0.30 | 0.23 | 1.8 |
| miscellaneous * | 449 | 1.1 | 0.4 | 24.7 | 25 | 0.1 | 309 | - | 0.01 | 0.21 | - |
| | 2450 | 70.6 | 32.9 | 54.9 | 486 | 15.5 | 5351 | 1.77 | 1.03 | 12.57 | 93.1 |

* miscellaneous = sugar, fat, nuts, spices, stimulants, alcoholic beverages

Source: M.M. Shah and H. Frohberg [5].

As discussed above, the rural population just purchases more food of about the same quality when the income of a household increases; no big general changes in the preference of different commodity groups are noticed. An opposite behavior is observed among the people in the cities. The total amount of cereals consumed by the poor and the rich income class does not differ very much; however, the poor people eat more maize flour and only a small amount of rice and wheat products, whereas the latter items are consumed in a much higher quantity by the rich class. The same shift is noticed for the starchy root consumption - the poor eat slightly more of this commodity and they especially stress the cheaper cassava meal, whereas potatoes are preferably eaten by the rich class. An even stronger dependency upon the income was observed for all the other items . Much more vegetables, fruits, meat, fish, eggs, and milk products are consumed by the rich income class than by the poorer people (Table14 , Figure 7). The fat and sugar consumption is also depending upon the income, because both items are considered as luxury foods. Due to these additions, the intake of energy and protein is sufficient for the rich income class to meet the requirements and the food losses during preparation. The medium class is approaching this stage, but it has not reached it quite yet. The improvement of the diet pattern is pointed out in Figure 7. The shift in the preferences of the different commodity groups influences especially positively the content of protein, calcium, vitamins A and C, riboflavin and niacin in the food.

The eating habits of the urban population are influenced by the portion of the income people are willing to spend on food. Therefore, it can be supposed that the diet of the poor class becomes more or less sufficient in all major nutrients when enough money is available. It also can be concluded already at this stage that the diet of the urban population would become a very balanced one when slightly more milk products and a few more nuts would be consumed in addition. This diet, then, should be quite desirable for the whole country. This observation implies further on that the major nutritional problem in the

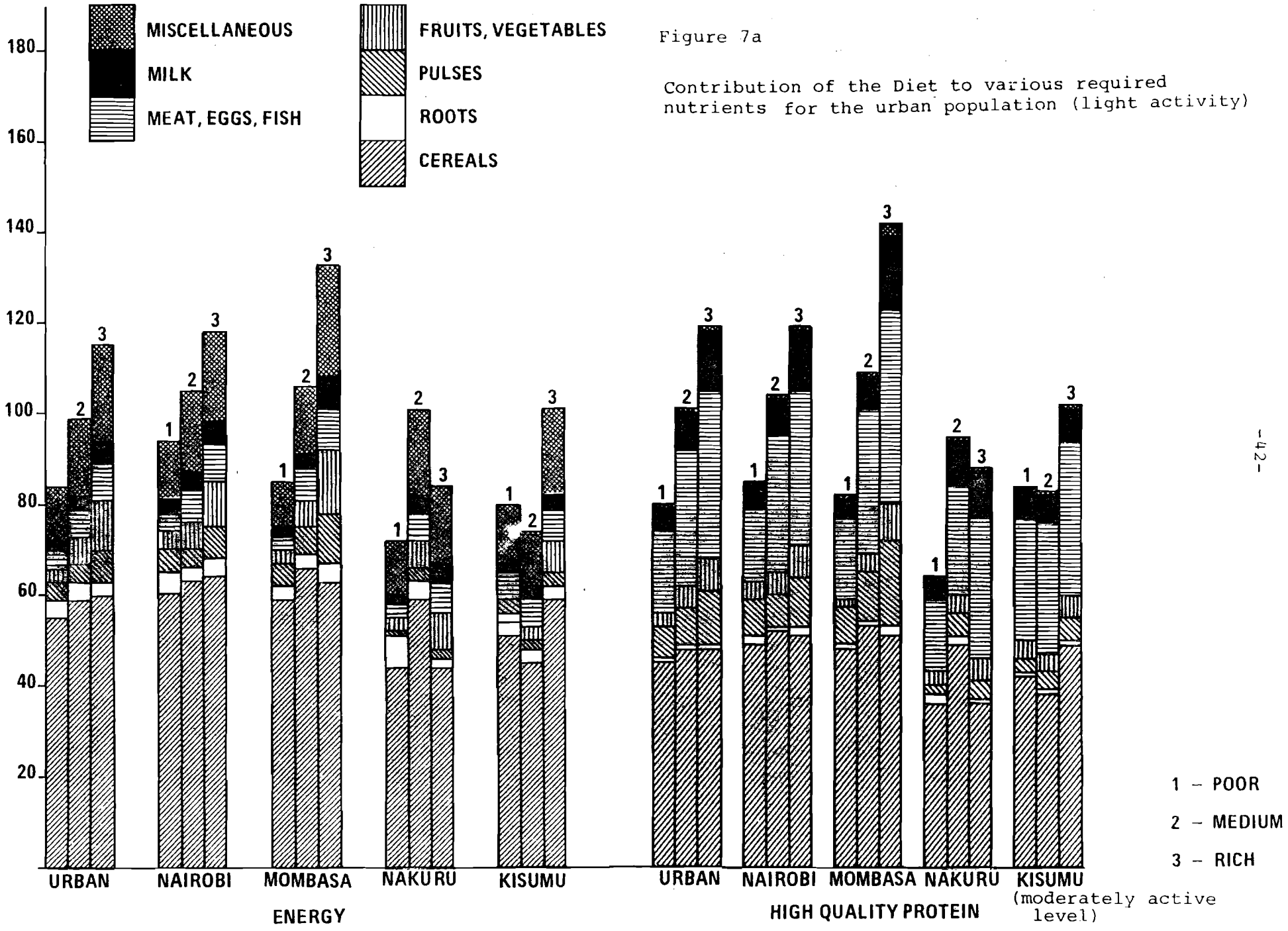
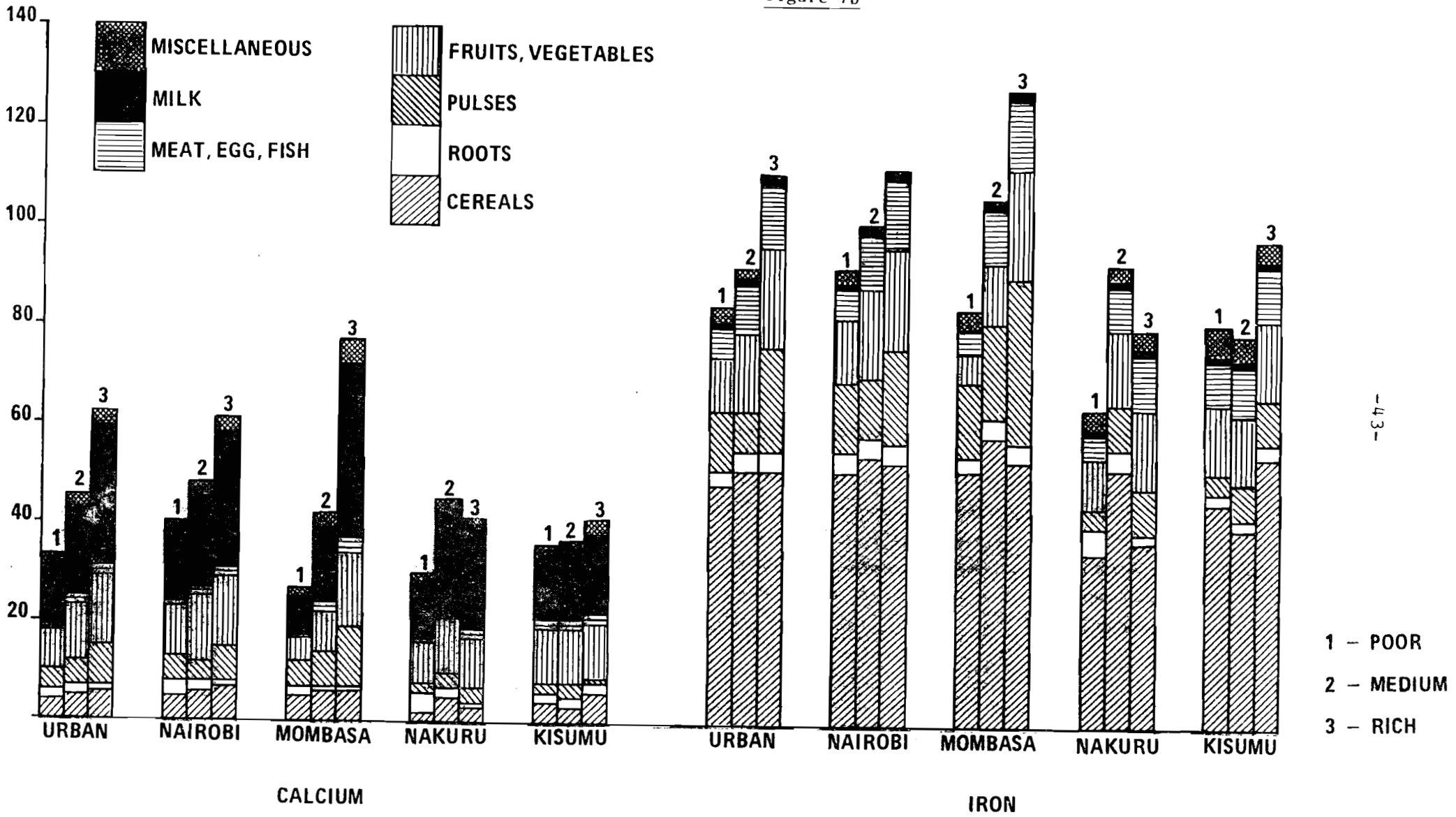



Figure 7a

Contribution of the Diet to various required nutrients for the urban population (light activity)
(moderately active level)

Figure 7b


140
120
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40
20
MISCELLANEOUS
MILK
MEAT, EGG, FISH
FRUITS, VEGETABLES
PULSES
ROOTS
CEREALS
1
2
3
URBAN
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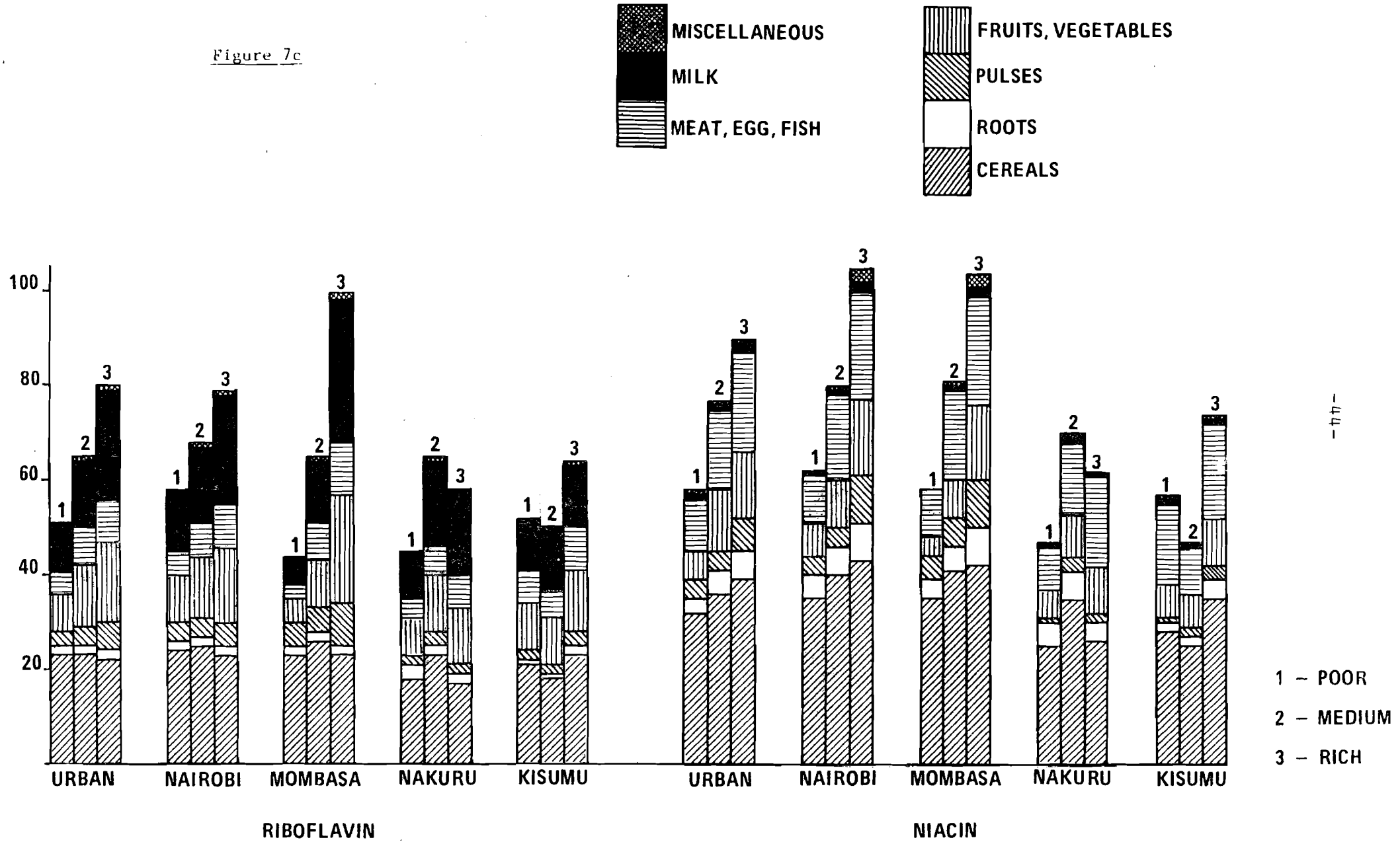
MOMBASA
NAKURU
KISUMU
CALCIUM
IRON
1 – POOR
2 – MEDIUM
3 – RICH

Figure 7c


MISCELLANEOUS
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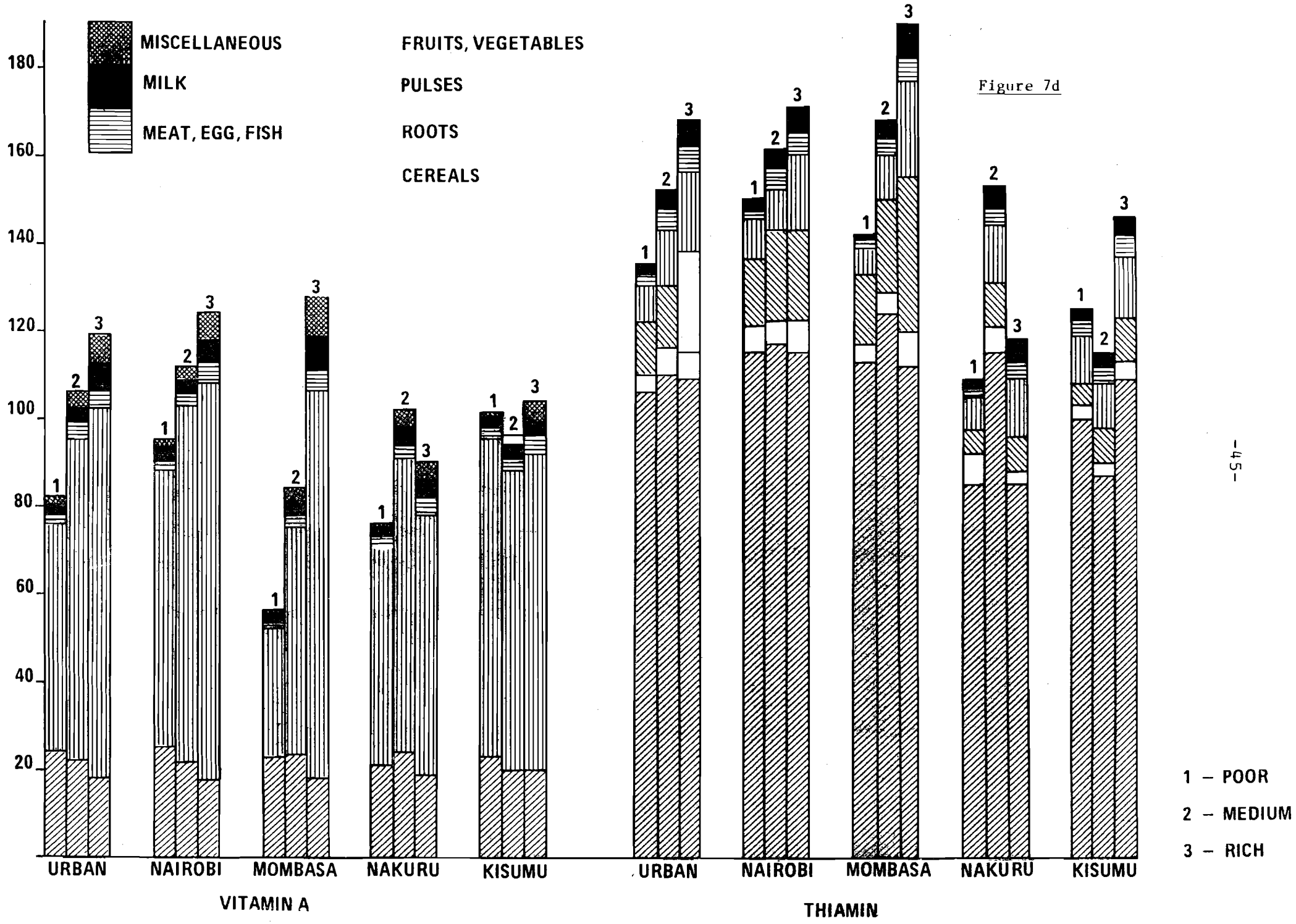
MOMBASA
NAKURU
KISUMU
RIBOFLAVIN
NIACIN
1 – POOR
2 – MEDIUM
3 – RICH


MISCELLANEOUS
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MEAT, EGG, FISH
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VITAMIN A
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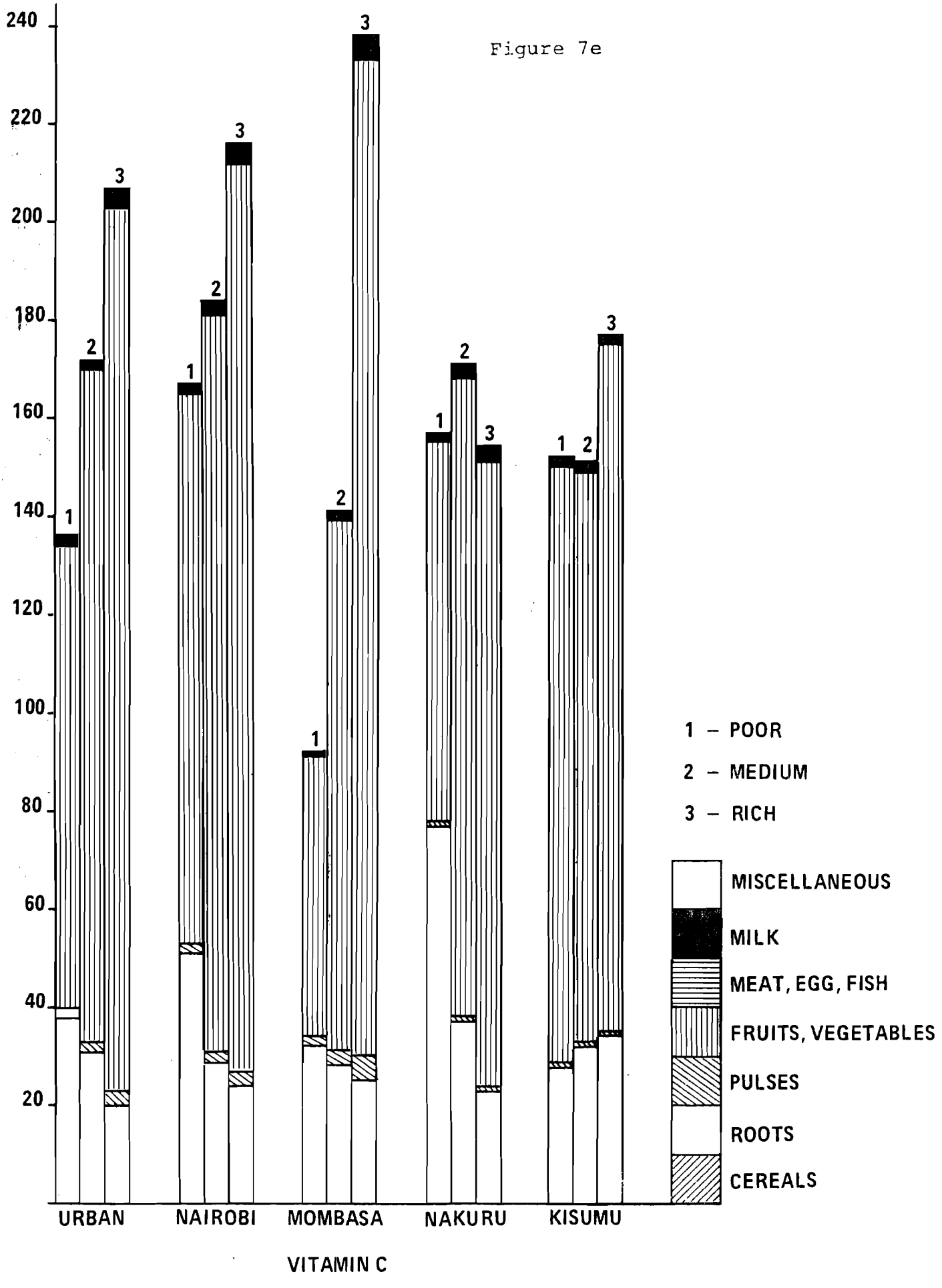
2 – MEDIUM
3 – RICH

Figure 7d

Figure 7e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NAIROBI
MOMBASA
NAKURU
KISUMU
VITAMIN C
1 – POOR
2 – MEDIUM
3 – RICH
MISCELLANEOUS
MILK
MEAT, EGG, FISH
FRUITS, VEGETABLES
PULSES
ROOTS
CEREALS

cities is a quantitative and not a qualitative one.

## 2. 2. Nairobi

The nutritional situation in Nairobi is above the average of the total urban population (Table 13). Slightly more food can be purchased in this city and consequently the intake of energy, protein and all other essential nutrients is elevated. It is also worth noticing that the differences are much smaller in the food pattern of the poor and the rich income class than in the other cities of this survey. The nutritional situation of the poor class is here the best one of all cities, but it is still far below the acceptable level.

The diet pattern of the people in Nairobi differs slightly from the average one of the urban population (Table 15, Figure 7). Somewhat more cereals are consumed here than in the average and, what is remarkable and what will be different to the other cities, higher quantities of this food commodity group are purchased with increasing income. This augmentation in total cereal consumption is due to a steep raising of wheat flour products and rice. In addition, slightly more starchy roots are consumed by all the income classes - especially by the poor class - than in the other cities. However, its total consumption decreases with increasing income, and, as noticed throughout the whole country; also the proportions shift between the purchased amount of cassava and potatoes depending on the income, with more cassava eaten if less money is available for food and more potatoes consumed if more money is available. In Nairobi, the bean consumption - a relatively expensive item - is also much stronger depending upon the income than in the other cities; the poor people purchase only about half of that which the rich people buy. The consumption pattern of all the other items corresponds to the level in the other cities.

Not only the quantity but also the quality of the food is above average in Nairobi. The average diet of these citizens is sufficient in thiamine, vitamins A and C, and almost in iron, implying that the diet is supplemented with enough fruits and vegetables. As expected, the content of all essential

TABLE 15: CONSUMPTION PATTERN IN NAIROBI IN 1972

| | Energy (kcal) | protein crude (g) | protein high quality (g) | fat (g) | calcium (mg) | iron (mg) | Vitamin A (I.U.) | thiamin (mg) | riboflavin (mg) | niacin (mg) | Vitamin C (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | | | | | | | | | | | |
| cereals | 1298 | 34.7 | 13.7 | 11.7 | 42 | 7.2 | 1006 | 1.21 | 0.32 | 5.29 | - |
| starchy roots | 89 | 1.2 | 0.5 | 0.1 | 16 | 0.5 | - | 0.06 | 0.03 | 0.80 | 17.0 |
| pulses | 96 | 6.3 | 2.1 | 0.5 | 39 | 1.9 | 8 | 0.15 | 0.05 | 0.59 | 0.8 |
| fruits & veg. | 129 | 3.5 | 1.4 | 0.5 | 97 | 2.4 | 3476 | 0.16 | 0.16 | 1.41 | 65.4 |
| meat,fish,eggs | 119 | 9.7 | 6.8 | 8.6 | 11 | 1.3 | 156 | 0.04 | 0.09 | 2.14 | - |
| milk | 78 | 3.9 | 2.3 | 4.2 | 147 | 0.1 | 165 | 0.04 | 0.21 | 0.15 | 1.2 |
| miscellaneous * | 348 | 0.6 | 0.2 | 17.8 | 17 | 0.3 | 180 | - | 0.01 | 0.10 | - |
| | 2157 | 59.9 | 27.0 | 43.4 | 369 | 13.7 | 4991 | 1.66 | 0.87 | 10.48 | 84.4 |
| Poor | | | | | | | | | | | |
| cereals | 1270 | 33.9 | 13.7 | 12.5 | 36 | 7.2 | 1130 | 1.22 | 0.31 | 4.88 | - |
| starchy roots | 106 | 1.2 | 0.5 | 0.1 | 21 | 0.6 | - | 0.06 | 0.03 | 0.68 | 23.0 |
| pulses | 100 | 6.5 | 2.2 | 0.5 | 40 | 2.0 | 9 | 0.16 | 0.05 | 0.61 | 0.9 |
| fruits & veg. | 83 | 2.6 | 1.1 | 0.4 | 78 | 1.8 | 2833 | 0.10 | 0.13 | 1.04 | 50.3 |
| meat,fish,eggs | 78 | 6.4 | 4.5 | 5.5 | 6 | 0.8 | 95 | 0.02 | 0.06 | 1.45 | - |
| milk | 59 | 2.9 | 1.7 | 3.3 | 110 | 0.1 | 123 | 0.03 | 0.16 | 0.11 | 1.0 |
| miscellaneous * | 272 | 0.3 | 0.1 | 12.9 | 9 | 0.4 | 68 | - | - | 0.03 | - |
| | 1968 | 53.8 | 23.8 | 35.2 | 300 | 12.9 | 4258 | 1.59 | 0.74 | 8.80 | 75.2 |
| Medium | | | | | | | | | | | |
| cereals | 1349 | 36.2 | 14.4 | 11.8 | 46 | 7.5 | 985 | 1.25 | 0.32 | 5.57 | - |
| starchy roots | 74 | 1.1 | 0.4 | 0.1 | 12 | 0.5 | - | 0.05 | 0.03 | 0.78 | 12.9 |
| pulses | 88 | 5.7 | 1.9 | 0.4 | 35 | 1.7 | 8 | 0.14 | 0.05 | 0.54 | 0.8 |
| fruits & veg. | 123 | 3.6 | 1.5 | 0.5 | 100 | 2.5 | 3656 | 0.15 | 0.17 | 1.44 | 67.4 |
| meat,fish,eggs | 143 | 11.8 | 8.4 | 10.2 | 14 | 1.5 | 183 | 0.05 | 0.09 | 2.60 | - |
| milk | 76 | 3.9 | 2.3 | 4.2 | 144 | 0.1 | 162 | 0.04 | 0.20 | 0.15 | 1.2 |
| miscellaneous * | 375 | 0.7 | 0.4 | 20.5 | 20 | 0.2 | 212 | - | 0.01 | 0.13 | - |
| | 2228 | 63.0 | 29.3 | 47.7 | 371 | 14.0 | 5206 | 1.68 | 0.87 | 11.21 | 82.3 |
| Rich | | | | | | | | | | | |
| cereals | 1357 | 36.1 | 14.1 | 10.4 | 52 | 7.4 | 803 | 1.21 | 0.30 | 6.04 | - |
| starchy roots | 77 | 1.4 | 0.5 | 0.1 | 10 | 0.6 | - | 0.08 | 0.03 | 1.08 | 10.9 |
| pulses | 140 | 9.1 | 3.1 | 0.7 | 56 | 2.7 | 12 | 0.22 | 0.07 | 0.86 | 1.2 |
| fruits & veg. | 211 | 4.5 | 1.9 | 0.7 | 114 | 2.8 | 4046 | 0.18 | 0.21 | 1.89 | 83.3 |
| meat,fish,eggs | 166 | 13.4 | 9.5 | 12.3 | 16 | 1.9 | 221 | 0.05 | 0.12 | 2.96 | - |
| milk | 115 | 5.8 | 3.5 | 6.2 | 218 | 0.2 | 243 | 0.06 | 0.30 | 0.24 | 1.9 |
| miscellaneous* | 435 | 0.9 | 0.4 | 22.8 | 22 | 0.1 | 264 | - | 0.01 | 0.17 | - |
| | 2501 | 71.2 | 33.0 | 53.2 | 488 | 15.7 | 5589 | 1.80 | 1.04 | 13.24 | 97.3 |

* miscellaneous = sugar, fat, nuts, spices, stimulants, alcoholic beverages

Source: M.M. Shah and H. Frohberg [5].

nutrients is below the average in the diet of the poor people. Their diet - as the diet of all other poor Kenyans - is especially lacking riboflavin and niacin; the intake of iron and vitamin A is still in the acceptable range, while thiamine and vitamin C are supplied adequately. On the other hand, the diet of the rich income class is very close to an excellent one, in respect to the balance between energy, protein and all the other nutrients. This diet just would need a supplementation in riboflavin and niacin which are, however, still far above the minimum level that will prevent clinical symptoms. If more emphasis can be put on food rich in these two vitamins as, i.e.,milk products and nuts, the diet of the rich class in Nairobi can be used as an example of a balanced diet which also has the taste of the native population.

Nairobi has the highest average income level in Kenya (Table 18 ), and, therefore, it is expected to have the highest nutritional level, too. However, the preferences for food are much lower in this city than in the others because a relatively smaller portion of the income is spent for food. Thus, it is one of the tasks to educate people about the importance of more and better food with the hope that they change their eating habits towards the desired direction.

The lowest infant mortality rates and highest life expectancies of all four cities under investigation are observed in Nairobi (Table 10). This is due among other facts to the high medical care and high educational level which are products of the high development as well as the high income level in this city, but also, at least in parts, due to the relatively high nutritional level.

## 2. 3. Mombasa

The average nutritional situation in Mombasa is comparable with the one in Nairobi. The people in both cities can obtain the same amount of energy on a per capita basis; only slightly more protein is consumed in Mombasa. The intake of vitamins and minerals is also the

same in both cities except that the amount of vitamin A is much lower in Mombasa (Tables 13, 14, and 16, Figures 6 and 7). However, the nutritional gap between the poor and the rich income class is much wider in Mombasa. The diet of the poor class is not better than the average diet of this income class in all cities together. On the other hand, the rich class consumes a much bigger part of the total food basket than observed for the rich income class in the other cities.

The poor income class eats an exceptionally small amount of fruits and vegetables and drinks not much milk. Further on, the consumption of starchy roots and meat is below the average of this income class. Fortunately, many more beans are eaten in this town than on average, which upgrades the whole diet to some extent. These deviations in the food pattern make the diet of the poor income class exceptionally low in calcium, vitamins A and C; all the other vitamins and minerals are as low as already observed for the poor income group of all other cities.

The medium income class is able to spend much more money on food and, therefore, it should be expected that their whole diet pattern improves. These people eat slightly less maize than the poor group; instead of it, they consume more wheat flour, rice, and almost twice as much bread. Their behavior towards starchy roots is the same one as already observed for all groups in the whole country - the cassava consumption decreases and the potato consumption increases with having available more money for food. However, the energy obtained from this commodity group is still the same. Also, more desirable food such as fruits, vegetables, milk products, meat, eggs, fish, fats and sugar can be purchased with a higher per capita income.
Therefore, the diet of the medium income class is adequate in energy, protein, iron, thiamine, and vitamin C; however, all the other essential nutrients are still insufficiently supplied. This behavior indicates that the diet desired by the people in Mombasa is not a very balanced one because it is low in vitamin A, riboflavin and niacin. The reason

TABLE 16: CONSUMPTION PATTERN IN MOMBASA IN 1975

| | Energy (kcal) | protein crude (g) | protein high quality (g) | fat (g) | calcium (mg) | iron (mg) | Vitamin A (I.U.) | thiamin (mg) | riboflavin (mg) | niacin (mg) | Vitamin C (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | | | | | | | | | | | |
| cereals | 1291 | 34.8 | 13.8 | 11.5 | 45 | 7.4 | 950 | 1.21 | 0.31 | 5.31 | - |
| starchy roots | 71 | 1.0 | 0.3 | 0.1 | 12 | 0.5 | - | 0.05 | 0.02 | 0.70 | 13.0 |
| pulses | 142 | 9.2 | 3.1 | 0.7 | 57 | 2.8 | 12 | 0.23 | 0.08 | 0.87 | 1.2 |
| fruits & veg. | 136 | 2.6 | 1.1 | 0.4 | 63 | 1.6 | 2186 | 0.10 | 0.12 | 1.13 | 47.0 |
| meat,eggs,fish | 117 | 11.0 | 7.6 | 7.8 | 13 | 1.2 | 118 | 0.04 | 0.09 | 2.12 | - |
| milk | 66 | 3.3 | 2.0 | 3.6 | 124 | 0.1 | 139 | 0.04 | 0.17 | 0.13 | 1.0 |
| miscellaneous* | 321 | 0.8 | 0.3 | 14.1 | 23 | 0.6 | 151 | - | 0.01 | 0.16 | 0.1 |
| | 2144 | 62.7 | 28.2 | 38.2 | 337 | 14.2 | 3556 | 1.67 | 0.80 | 10.42 | 62.3 |
| Poor | | | | | | | | | | | |
| cereals | 1256 | 33.8 | 13.3 | 12.0 | 40 | 7.2 | 1043 | 1.20 | 0.30 | 4.94 | - |
| starchy roots | 69 | 0.8 | 0.3 | 0.1 | 13 | 0.4 | - | 0.04 | 0.02 | 0.51 | 14.5 |
| pulses | 105 | 6.8 | 2.3 | 0.5 | 42 | 2.1 | 9 | 0.17 | 0.06 | 0.64 | 0.9 |
| fruits & veg. | 58 | 1.4 | 0.6 | 0.2 | 37 | 0.9 | 1318 | 0.06 | 0.06 | 0.59 | 25.6 |
| meat,eggs,fish | 71 | 7.4 | 5.1 | 4.4 | 8 | 0.7 | 58 | 0.02 | 0.04 | 1.34 | - |
| milk | 33 | 1.7 | 1.0 | 1.8 | 62 | - | 70 | 0.01 | 0.08 | 0.06 | 0.5 |
| miscellaneous* | 211 | 0.5 | 0.3 | 6.5 | 13 | 0.6 | 32 | - | - | 0.07 | 0.1 |
| | 1803 | 52.4 | 22.9 | 25.5 | 215 | 11.9 | 2530 | 1.50 | 0.56 | 8.15 | 41.6 |
| Medium | | | | | | | | | | | |
| cereals | 1405 | 37.9 | 14.7 | 12.7 | 48 | 8.1 | 1016 | 1.32 | 0.33 | 5.75 | - |
| starchy roots | 69 | 1.0 | 0.3 | 0.1 | 11 | 0.5 | - | 0.05 | 0.02 | 0.70 | 12.5 |
| pulses | 136 | 8.8 | 3.0 | 0.7 | 55 | 2.7 | 12 | 0.22 | 0.07 | 0.84 | 1.2 |
| fruits & veg. | 133 | 2.7 | 1.1 | 0.4 | 64 | 1.7 | 2318 | 0.11 | 0.13 | 1.17 | 48.7 |
| meat,eggs,fish | 143 | 12.9 | 8.9 | 9.7 | 14 | 1.5 | 142 | 0.04 | 0.10 | 2.66 | - |
| milk | 64 | 3.2 | 2.0 | 3.5 | 120 | 0.1 | 135 | 0.04 | 0.16 | 0.13 | 1.0 |
| miscellaneous* | 320 | 0.7 | 0.3 | 14.8 | 20 | 0.1 | 144 | - | 0.01 | 0.15 | 0.1 |
| | 2270 | 67.2 | 30.3 | 41.9 | 332 | 14.7 | 3767 | 1.78 | 0.82 | 11.40 | 63.5 |
| Rich | | | | | | | | | | | |
| cereals | 1345 | 35.8 | 14.0 | 10.5 | 50 | 7.4 | 809 | 1.19 | 0.30 | 5.94 | - |
| starchy roots | 79 | 1.5 | 0.5 | 0.1 | 10 | 0.6 | - | 0.08 | 0.03 | 1.11 | 11.1 |
| pulses | 234 | 15.2 | 5.2 | 1.2 | 94 | 4.6 | 21 | 0.37 | 0.12 | 1.44 | 2.1 |
| fruits & veg. | 300 | 5.1 | 2.1 | 0.9 | 116 | 3.1 | 3944 | 0.23 | 0.29 | 2.27 | 91.4 |
| meat,eggs,fish | 186 | 16.7 | 11.8 | 12.8 | 20 | 2.0 | 246 | 0.05 | 0.14 | 3.27 | |
| milk | 146 | 7.5 | 4.5 | 8.0 | 278 | 0.2 | 312 | 0.08 | 0.38 | 0.30 | 2.3 |
| miscellaneous* | 541 | 1.5 | 0.7 | 31.7 | 42 | 0.2 | 466 | - | 0.02 | 0.36 | 0.1 |
| | 2831 | 83.3 | 38.8 | 65.2 | 610 | 18.1 | 5798 | 2.00 | 1.28 | 14.69 | 107.0 |

*miscellaneous = sugar, fats, nuts, spices, stimulants, alcoholic beverages.

Source: M.M. Shah and H. Frohberg (15).

for that is a very general one in Kenya - the desire for fruits, vegetables, milk products and nuts is too low.

The rich income class in Mombasa reflects nicely the shift in the diet pattern which occurs when more money is available for food. The amount of total cereals eaten decreases while especially the consumption of pulses, fruits, vegetables, meat, milk products, fats and sugar increases. The lower cereal consumption is due to a decrease in maize flour indicating that this is the main staple food if the money is limited. On the other hand, as also already pointed out for the medium income class, the intake of rice and wheat flour - two relatively expensive items - increases. This diet of the rich income class is adequate in all essential nutrients but it is too high in energy and, therefore, cannot be considered as a balanced diet. It has to be pointed out, that this is the only income group in all four cities under investigation who receive the required amount of all essential nutrients - these are 4% of the total urban population (Table 19 )!

It is not surprising that the nutritional level is the highest in Mombasa because it is also the highest one in the whole Eastern province, where Mombasa is located. The portion of the income spent on food is also the highest in this city pointing out that the preference of being well nourished is higher than that of the average Kenyian. Further on, the relatively low infant mortality rate and the relatively high life expectancies (Table 10) are in accordance with the results of this survey.

## 2. 4 Nakuru

The poorest among the cities is Nakuru in respect to its nutritional situation (Tables 13, 17, Figures 6 and 7), which may may be due to an overall shortage of food on the market as well as of money for purchase of the available food. Remarkably low is the cereal consumption, which is almost exclusively derived from maize flour. Almost no other cereals as wheat products, rice and millet are eaten in Nakuru. On the other hand, the starchy root consumption, especially of the poor income class, is quite high. The intake of all the other commodity groups

TABLE 17 : CONSUMPTION PATTERN IN NAKURU IN 1975

| | Energy (kcal) | protein | | fat (g) | calcium (mg) | iron (mg) | Vita-min A (I.U.) | thiamin (mg) | ribo-flavin (mg) | niacin (mg) | Vita-min C (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | crude (g) | high quality (g) | | | | | | | | |
| Total | | | | | | | | | | | |
| cereals | 997 | 26.6 | 10.8 | 10.2 | 24 | 5.4 | 955 | 0.99 | 0.25 | 3.80 | - |
| starchy roots | 115 | 1.2 | 0.4 | 0.1 | 24 | 0.6 | - | 0.06 | 0.03 | 0.72 | 25.9 |
| pulses | 42 | 2.7 | 0.9 | 0.2 | 17 | 0.8 | 4 | 0.07 | 0.08 | 0.26 | 0.4 |
| fruits & veg. | 93 | 2.5 | 0.9 | 0.4 | 69 | 1.6 | 2441 | 0.10 | 0.12 | 1.01 | 46.0 |
| meat,eggs,fish | 95 | 8.3 | 5.7 | 6.7 | 10 | 1.1 | 118 | 0.03 | 0.06 | 1.77 | - |
| milk | 64 | 3.2 | 1.9 | 3.5 | 120 | 0.1 | 135 | 0.03 | 0.17 | 0.12 | 1.0 |
| miscellaneous* | 309 | 0.4 | 0.2 | 13.3 | 16 | 0.5 | 117 | - | - | 0.08 | - |
| | 1715 | 44.9 | 20.8 | 34.4 | 280 | 10.1 | 3770 | 1.28 | 0.71 | 7.76 | 73.3 |
| Poor | | | | | | | | | | | |
| cereals | 929 | 24.7 | 10.0 | 9.8 | 19 | 4.9 | 964 | 0.91 | 0.23 | 3.48 | - |
| starchy roots | 147 | 1.3 | 0.6 | 0.2 | 32 | 0.7 | - | 0.07 | 0.04 | 0.76 | 34.7 |
| pulses | 29 | 1.9 | 0.6 | 0.1 | 12 | 0.6 | 3 | 0.05 | 0.02 | 0.18 | 0.3 |
| fruits & veg. | 59 | 2.0 | 0.8 | 0.3 | 61 | 1.4 | 2244 | 0.09 | 0.10 | 0.78 | 39.2 |
| meat,eggs,fish | 67 | 6.3 | 4.4 | 4.5 | 7 | 0.7 | 75 | 0.02 | 0.05 | 1.25 | - |
| milk | 47 | 2.3 | 1.4 | 2.6 | 87 | 0.1 | 98 | 0.02 | 0.13 | 0.08 | 0.7 |
| miscellaneous* | 249 | 0.2 | 0.1 | 9.5 | 12 | 0.6 | 52 | - | - | 0.03 | - |
| | 1527 | 38.7 | 17.9 | 27.0 | 230 | 9.0 | 3436 | 1.16 | 0.57 | 6.56 | 74.9 |
| Medium | | | | | | | | | | | |
| cereals | 1261 | 33.6 | 13.6 | 12.2 | 39 | 7.3 | 1068 | 1.22 | 0.30 | 4.87 | - |
| starchy roots | 85 | 1.2 | 0.5 | 0.1 | 15 | 0.5 | - | 0.06 | 0.03 | 0.81 | 16.8 |
| pulses | 67 | 4.4 | 1.5 | 0.3 | 27 | 1.3 | 6 | 0.11 | 0.04 | 0.42 | 0.6 |
| fruits & veg. | 126 | 3.1 | 1.2 | 0.5 | 84 | 2.1 | 3011 | 0.14 | 0.15 | 1.30 | 58.3 |
| meat | 118 | 9.6 | 6.7 | 8.4 | 11 | 1.2 | 149 | 0.04 | 0.08 | 2.15 | - |
| milk | 86 | 4.4 | 2.7 | 4.7 | 164 | 0.1 | 184 | 0.05 | 0.23 | 0.17 | 1.4 |
| miscellaneous * | 399 | 0.6 | 0.3 | 16.7 | 18 | 0.4 | 179 | - | 0.01 | 0.15 | - |
| | 2142 | 56.9 | 26.5 | 42.9 | 358 | 13.0 | 4597 | 1.62 | 0.84 | 9.87 | 77.1 |
| Rich | | | | | | | | | | | |
| cereals | 936 | 25.1 | 10.0 | 9.5 | 25 | 5.2 | 860 | 0.90 | 0.22 | 3.64 | - |
| starchy roots | 53 | 0.8 | 0.3 | 0.1 | 9 | 0.3 | - | 0.03 | 0.02 | 0.50 | 10.5 |
| pulses | 52 | 3.4 | 1.1 | 0.3 | 21 | 1.0 | 5 | 0.08 | 0.03 | 0.32 | 0.5 |
| fruits & veg. | 162 | 3.2 | 1.3 | 0.5 | 76 | 1.9 | 2674 | 0.14 | 0.15 | 1.41 | 57.1 |
| meat | 145 | 12.0 | 8.5 | 10.4 | 14 | 1.6 | 187 | 0.04 | 0.09 | 2.67 | - |
| milk | 90 | 4.6 | 2.7 | 4.9 | 171 | 0.1 | 191 | 0.05 | 0.23 | 0.18 | 1.5 |
| miscellaneous* | 370 | 0.4 | 0.2 | 19.1 | 11 | 0.4 | 193 | - | - | 0.05 | - |
| | 1808 | 49.5 | 24.1 | 44.8 | 327 | 10.5 | 4110 | 1.24 | 0.74 | 8.77 | 69.6 |

* miscellaneous = sugar, fats, nuts, spices, stimulants, alcoholic beverages
Source: M.M. Shah and H. Frohberg [5].

is also below the average consumption level of all the cities . Therefore, the diet in Nakuru is in general deficient in all essential nutrients; only thamine and vitamin C are supplied in an acceptable range at the retail level.

The nutritional level in no other city in Kenya is as low as the one of the poor income class in Nakuru. The diet of these people is extremely deficient in energy, protein and all other essential nutrients. Therefore, a high incidence of disease has to be expected being related to malnutrition, i.e., kwashiorkor, marasmus, goitre, avitaminosis, and many others.

As soon as the per capita income is slightly above the minimum, people buy more food, especially more cereals. Only the total amount of purchased energy decreases due to a sharp decrease in the cassava consumption. The consumption of pulses, fruits, vegetables, meat, eggs, fish, and milk products was almost double for the medium class income when their diet was compared with the one of the poor income group. This additional food substantiates the intake of energy, protein, and all other essential nutrients. However, just thiamine, vitamins A and C are obtained close to an adequate level by this diet - all the nutrients received are still below their required level.

The nutritional status of the rich class is not the highest one of the whole city as would have been expected from the results discussed up to now in this report. Several reasons can be given for this phenomenon:

(i) The per capita income of the rich income class is only slightly higher than the one of the medium class because the number of dependencies on one salary is higher for the rich class in Nakuru than for the other income groups (Table 19 ).

(ii) The percentage of the money spent for food is smaller for the rich income group than for the medium class (Table 19 ).

(iii) The same behavior is observed here as already in Mombasa - the rich income class eats relatively less of the cheap maize flour but more of the expensive items as fruits, vegetables, meat, fish, eggs, and milk products.

Therefore, the diet of the medium income class has nutritionally a higher value and is more sunstantive than the one of the rich income class.

The general attitude of the rural population in Rift Valley - the province where Nakuru is located - towards food is better, because they spend more money of their money on food in order to receive a qualitatively and quantitavely better diet. The phenomenon that the diet in rural areas is better than in cities is characteristic of some developing countries (7). Very often the quality of the diets deteriorate when people move into towns, since they then have to buy most of their food and they cannot grow it themselves anymore. In addition, the number of dependencies upon one income becomes larger, and the temptation to buy other foods rather than quality food also increases.

In spite of the very low nutritional level in Nakuru, the infant mortality rate is relatively low. Reasons for that may be good medical care and good infant feeding habits.

## 2. 5. Kisumu

The per capita income in Kisumu is lower than the one in Nakuru and, thus, the lowest one of all four cities under investigation (Table 18). In spite of that, the overall nutritional status is slightly higher than in Nakuru which is due to the fact that more of the income is spent for food (Tables 13 and 18, Figures 6 and 7). The characteristics of the average diet in this town are that the cereal consumption is below the average, because only a very small amount of wheat products and rice is eaten. Further on, the average amount of beans, fruits, and milk products available is below that in the other cities. However, much more fish is consumed than anywhere else and relatively many vegetables are eaten in this city.

TABLE 18: CONSUMPTION PATTERN IN KISUMU IN 1975

| | Energy (kcal) | protein crude (g) | protein high quality (g) | fat (g) | calcium (mg) | iron (mg) | Vita-min A (I.U.) | thiamin (mg) | ribo-flavin (mg) | niacin (mg) | Vita-min C (mg) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total | | | | | | | | | | | |
| cereals | 1076 | 28.7 | 1.6 | 10.8 | 31 | 6.3 | 972 | 1.04 | 0.27 | 4.05 | - |
| starchy roots | 78 | 0.7 | 0.3 | 0.1 | 17 | 0.4 | - | 0.04 | 0.01 | 0.43 | 18.1 |
| pulses | 49 | 3.2 | 1.1 | 0.2 | 20 | 1.0 | 4 | 0.08 | 0.03 | 0.30 | 0.4 |
| fruits & veg. | 83 | 2.9 | 1.2 | 0.4 | 88 | 2.0 | 3230 | 0.12 | 0.14 | 1.12 | 56.4 |
| meat,eggs,fish | 135 | 12.4 | 8.7 | 9.1 | 15 | 1.4 | 148 | 0.04 | 0.09 | 2.51 | - |
| milk | 58 | 2.9 | 1.8 | 3.2 | 108 | 0.1 | 121 | 0.03 | 0.15 | 0.10 | 0.9 |
| miscellaneous* | 293 | 0.5 | 0.2 | 10.9 | 21 | 0.7 | 97 | - | - | 0.09 | - |
| | 1772 | 51.3 | 24.9 | 34.7 | 300 | 11.9 | 4572 | 1.35 | 0.69 | 8.60 | 75.8 |
| Poor | | | | | | | | | | | |
| cereals | 1085 | 28.9 | 11.7 | 11.2 | 30 | 6.3 | 1038 | 1.06 | 0.27 | 4.00 | - |
| starchy roots | 56 | 0.6 | 0.3 | 0.1 | 12 | 0.3 | - | 0.03 | 0.01 | 0.32 | 12.7 |
| pulses | 32 | 2.1 | 0.7 | 0.2 | 13 | 0.6 | 3 | 0.05 | 0.02 | 0.20 | 0.3 |
| fruits & veg. | 66 | 2.7 | 1.0 | 0.4 | 88 | 2.0 | 3225 | 0.12 | 0.13 | 1.04 | 54.6 |
| meat,eggs,fish | 127 | 11.9 | 7.6 | 8.3 | 13 | 1.2 | 122 | 0.04 | 0.09 | 2.35 | - |
| milk | 53 | 2.6 | 1.6 | 2.9 | 97 | 0.1 | 109 | 0.02 | 0.14 | 0.09 | 0.8 |
| miscellaneous* | 273 | 0.4 | 0.2 | 8.5 | 20 | 0.8 | 62 | - | - | 0.07 | - |
| | 1692 | 49.2 | 23.1 | 31.6 | 273 | 11.3 | 4559 | 1.32 | 0.66 | 8.07 | 68.4 |
| Medium | | | | | | | | | | | |
| cereals | 957 | 25.5 | 10.4 | 9.9 | 26 | 5.6 | 903 | 0.93 | 0.23 | 3.54 | - |
| starchy roots | 62 | 0.5 | 0.2 | 0.1 | 14 | 0.3 | - | 0.03 | 0.01 | 0.32 | 14.5 |
| pulses | 53 | 3.4 | 1.2 | 0.3 | 21 | 1.0 | 5 | 0.08 | 0.03 | 0.33 | 0.5 |
| fruits & veg. | 69 | 2.7 | 1.1 | 0.4 | 84 | 1.9 | 3057 | 0.11 | 0.13 | 1.02 | 52.3 |
| meat,eggs,fish | 128 | 11.7 | 8.1 | 8.7 | 13 | 1.4 | 136 | 0.04 | 0.08 | 1.40 | - |
| milk | 60 | 3.0 | 1.8 | 3.3 | 112 | 0.1 | 126 | 0.03 | 0.16 | 0.11 | 1.0 |
| miscellaneous* | 262 | 0.4 | 0.2 | 10.7 | 16 | 0.7 | 77 | - | - | 0.05 | - |
| | 1591 | 47.2 | 23.0 | 33.4 | 286 | 11.0 | 4304 | 1.22 | 0.64 | 6.77 | 68.3 |
| Rich | | | | | | | | | | | |
| cereals | 1247 | 33.3 | 13.6 | 11.2 | 46 | 7.6 | 890 | 1.16 | 0.30 | 4.96 | - |
| starchy roots | 70 | 0.8 | 0.3 | 0.1 | 14 | 0.4 | - | 0.04 | 0.02 | 0.54 | 15.1 |
| pulses | 68 | 4.4 | 1.5 | 0.3 | 5 | 1.3 | 6 | 0.11 | 0.04 | 0.42 | 0.6 |
| fruits & veg. | 141 | 3.5 | 1.3 | 0.5 | 91 | 2.3 | 3235 | 0.15 | 0.16 | 1.44 | 63.1 |
| meat,eggs,fish | 155 | 13.6 | 9.5 | 10.8 | 16 | 1.6 | 175 | 0.05 | 0.11 | 2.86 | - |
| milk | 66 | 3.3 | 2.0 | 3.6 | 125 | 0.1 | 140 | 0.04 | 0.17 | 0.13 | 1.0 |
| miscellaneous* | 411 | 0.7 | 0.3 | 21.6 | 27 | 0.6 | 247 | - | 0.01 | 0.15 | - |
| | 2158 | 59.6 | 28.5 | 48.1 | 324 | 13.6 | 4693 | 1.55 | 0.81 | 10.50 | 79.8 |

* miscellaneous = sugar, fats, nuts, spices, stimulants, alcoholic beverages

Source: M.M. Shah and H. Frohberg (5).

As already observed several times throughout this report, the diet of the poor income class is deficient in nearly all nutrients. Only thiamine, vitamins A and C are sufficiently supplied in the diet, at least at the retail level.

The diet of the medium income class even would need substantive improvement because it is quantitatively and qualitatively worse than the one of the poor income class. The reasons are the same as already mentioned for the rich income class in Nakuru.

On the other hand, the diet of the rich class improves tremendously as compared to the poor and medium classes. These people consume many more cereals, especially wheat products and rice, fruits, vegetables, and fats. The intake of the other commodity groups is only slightly elevated. Because of this additional food, the total diet becomes sufficient in protein, thiamine, vitamins A and C; the iron content almost meets its required level and no signs of dificiencies should occur. The diet just needs some substitution in energy, riboflavin and niacin, which should preferably be derived from milk products and nuts.

## 2.6 Correlation of the Income with the Nutritional Status for the Urban Population

The per capita income of the urban population is much higher than the one of the rural population (Tables 4 and 19 ), however, food is also more expensive in the towns. Anyhow, the percentage of the income spent on food is on average much lower in the cities - the rural population spends on average 75% of their income for food, whereas the urban population only spends 39% in the average. However, spending practices are slightly different from town to town. The people in Nairobi have the highest per capita income, however they spend less of it for food than the people in Mombasa who's income is slightly lower. As these examples show, the preference for food which means the percentage of the income spent on eating is linked to the overall nutritional status.

TABLE 19: INCOME AND POPULATION DISTRIBUTION OF THE URBAN POPULATION IN 1975

| | Income(Ksh)/ year & caput | Food expenditure (Ksh)/year & caput | percent of total urban population | percent of urban population within the city | percent of salary spent on food | household size |
|---|---|---|---|---|---|---|
| Urban | | | | | | |
| Total | 2160.00 | 844.29 | 100.0 | 100.0 | 39 | 5.60 |
| Poor | 1288.64 | 638.64 | 42.5 | 42.5 | 50 | 5.28 |
| Medium | 2360.89 | 915.95 | 24.7 | 24.7 | 39 | 5.83 |
| Rich | 3827.39 | 1190.45 | 17.7 | 17.7 | 31 | 6.28 |
| Nairobi | | | | | | |
| Total | 2497.18 | 904.23 | 47.4 | 100.0 | 36 | 5.68 |
| Poor | 1503.27 | 693.82 | 18.3 | 39.1 | 46 | 5.50 |
| Medium | 2583.48 | 970.12 | 12.9 | 27.1 | 38 | 5.69 |
| Rich | 4437.62 | 1213.86 | 8.6 | 18.1 | 27 | 6.06 |
| Mombasa | | | | | | |
| Total | 1909.77 | 854.71 | 20.9 | 100.0 | 45 | 5.63 |
| Poor | 1014.50 | 586.26 | 9.2 | 43.9 | 58 | 5.24 |
| Medium | 2185.51 | 921.74 | 4.8 | 22.8 | 42 | 6.21 |
| Rich | 3644.30 | 1389.26 | 4.0 | 19.0 | 38 | 5.96 |
| Nakuru | | | | | | |
| Total | 1704.41 | 677.29 | 3.8 | 100.0 | 40 | 5.90 |
| Poor | 1119.69 | 534.61 | 1.8 | 48.4 | 48 | 5.23 |
| Medium | 2428.38 | 873.65 | 0.7 | 17.7 | 36 | 5.92 |
| Rich | 2483.04 | 851.21 | 0.7 | 19.4 | 34 | 8.67 |
| Kisumu | | | | | | |
| Total | 1673.87 | 728.49 | 4.1 | 100.0 | 44 | 5.09 |
| Poor | 1320.26 | 678.04 | 2.1 | 52.2 | 51 | 4.69 |
| Medium | 1574.60 | 677.25 | 1.1 | 26.9 | 43 | 5.67 |
| Rich | 2789.08 | 921.50 | 0.6 | 13.4 | 33 | 5.86 |

of a group of people in a developing country. As more of the income is spent on food by these people, the relatively better the diet pattern will be.

The main features of the urban diet pattern are that the percentage of the energy derived from animal and vegetable protein as well as from refined sugar does not vary with increasing income (Figure 8). which is in contrast to the behavior of the rural population (Figure 2). The urban population also consumes more sugar than the rural population. On the other hand, a strong dependency of the fat consumption is observed upon the income for the urban population. The percentage of the energy derived from fat is also much higher for the urban population than for the rural one because oils and fats are very expensive and treated as luxury goods. The diets of the inhabitants of Kenya's cities contain on average 11% protein and 10% refined sugar. Furthermore, 16% and 21% of the energy in the diet of poor and rich people, respectively, is derived from fat. Therefore, 56% and 63%, respectively, of the energy is from carbohydrates in the rich man's and poor man's diet. The composition of these diet patterns is relatively good from the point of view of the distribution between protein, fat and carbohydrates.

In contrast to the rural population which shows a high demand for more food with increasing income (Figure 3), the urban population does not have such a pronounced dependency (Figure 9). A shift to better food with increasing income is more pronounced in the cities, which, however, can hardly be detected when only the amount of purchased energy is compared with the income. This described effect is most obvious in Nairobi, the city with the highest per capita income. In this city, the income-supplied energy curve levels off near to the required amount of energy leading to a very favorable tendency towards high quality food, with the result of a more balanced diet. The demand for higher quantity - not quality - prevails in Mombasa. This leads to the conclusion that food is a very highly ranged commodity in Mombasa causing the widest quantative gap in the food habits of the poor and the rich classes which

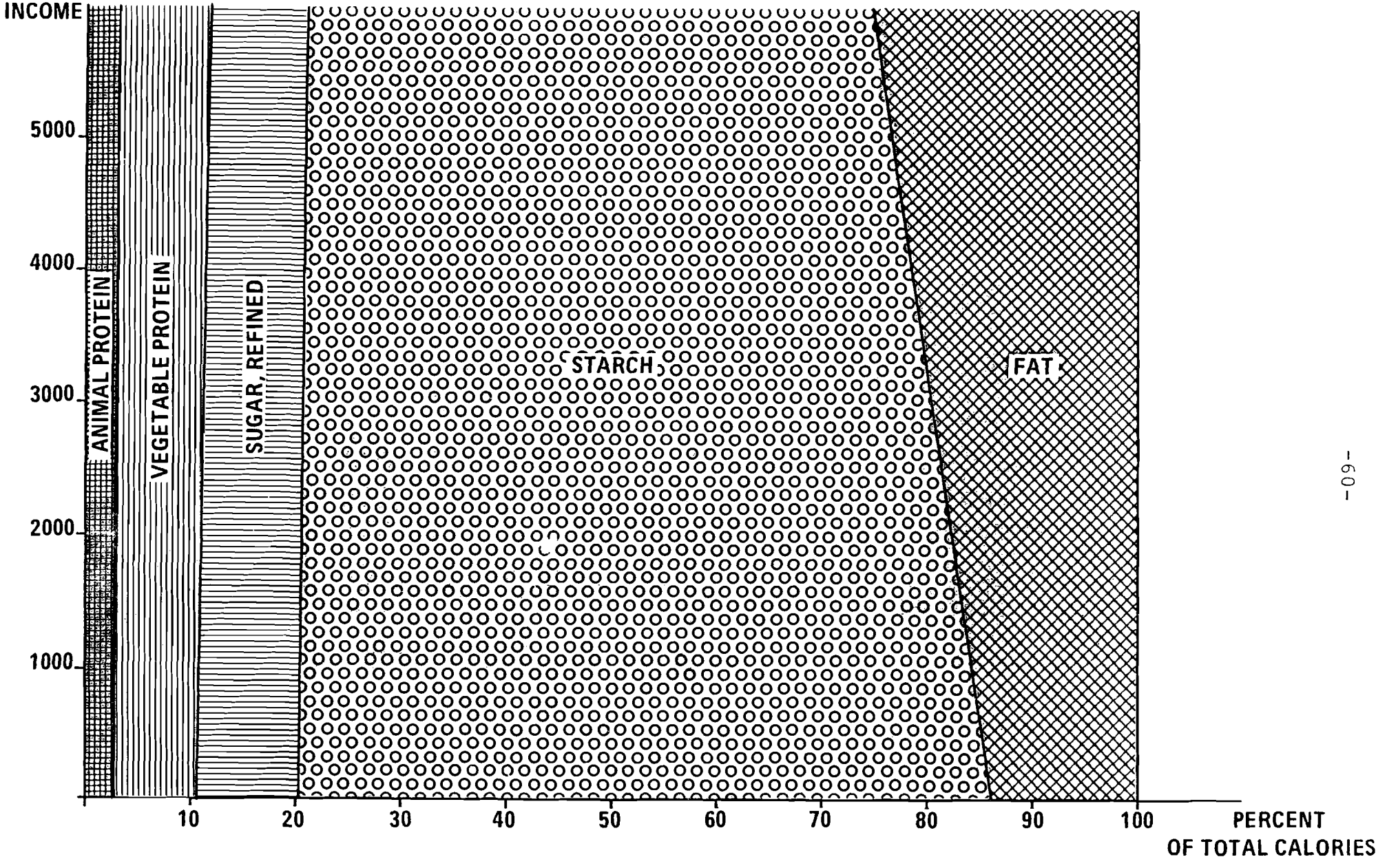


Figure 8 COMPOSITION OF THE DIET OF THE URBAN POPULATION (LIGHT ACTIVE) DEPENDING ON THE INCOME

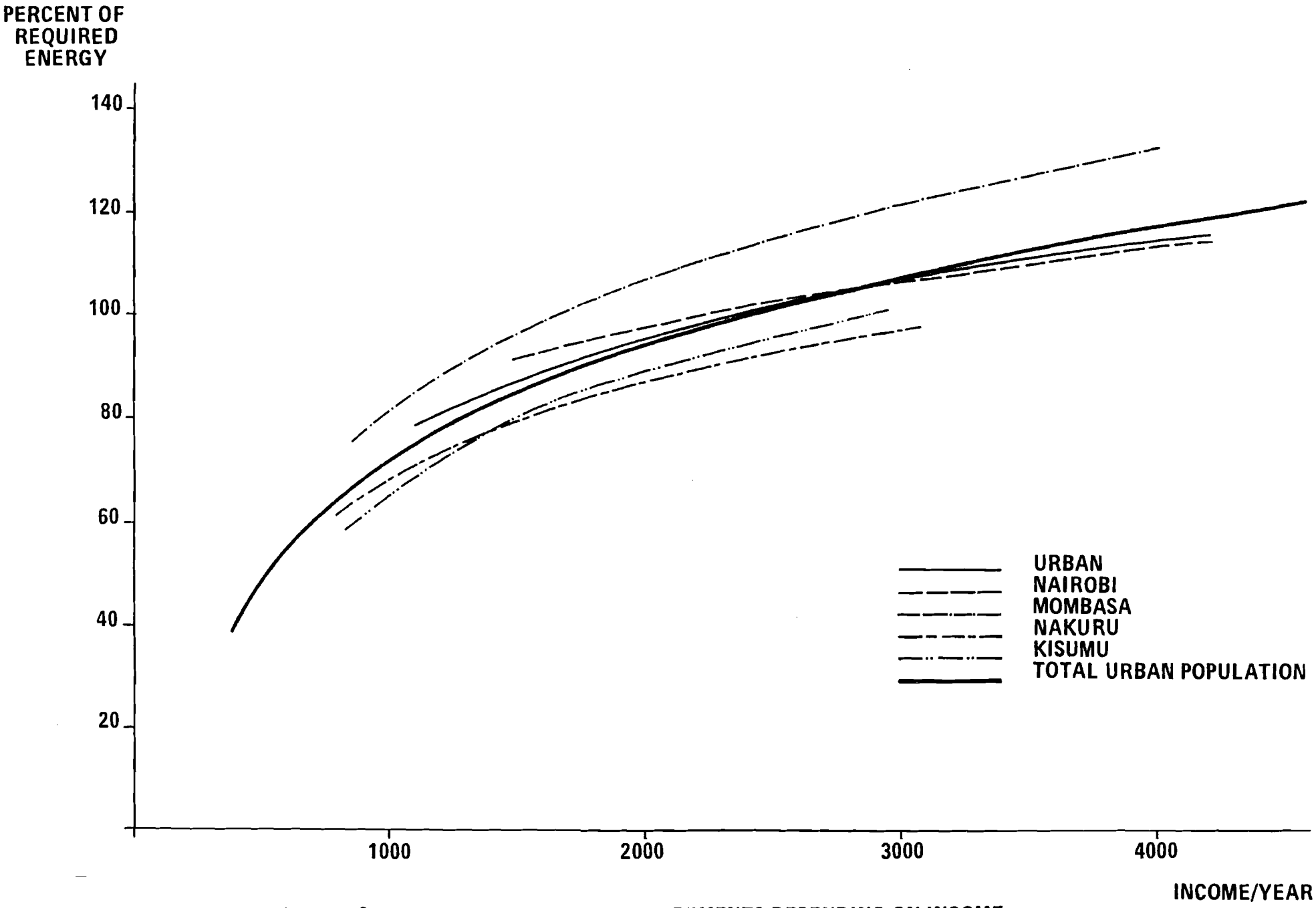


Figure 9 SOURCE OF CALORIC REQUIREMENTS DEPENDING ON INCOME

was observed in all the cities under investigation. However, the income-supplied energy curve clearly shows a possible existence of overeating. The amount of energy consumed is lowest in in Kusumu and Nakuru, where the income is also the lowest, and, consequently, where least money is available for food. However, the demand for more food is also not very high and the preference for better food is not very pronounced in these cities. If the food pattern of all four cities under investigation is agglomerated and, if each income group is considered as a part of the whole urban population, the result is very close to the behavior of the total urban population. Therefore, this aggregation can be used further on as a rough approximation for the behavior of the total urban population in Kenya towards food.

The general conclusion about the behavior of the urban population towards food can be stated from the income-supplied energy curve as such that the demand for a better food quality and, consequently, for a more balanced diet is higher than the demand for more food with increasing income. If this behavior is extrapolated, a per capita income of 3200KSh is needed in any Kenyian city to be able to purchase a sufficient amount of calories (this assumption was derived from Figure 9), providing a light activity grade. However, if heavier work has to be done, more energy is needed which means that the income has to be higher too, if the same portion can be spent on food.

On the other hand, if the influence of food expenditures is considered upon the amount of energy obtained, a straight line dependency is observed in the range of the survey (Figure 10), which is analogous to the behavior of the rural population (Figure 4). As expected, the increase is the least in Nairobi, but much higher in Mombasa. The spending practices are similar in Nakuru and Kisumu.

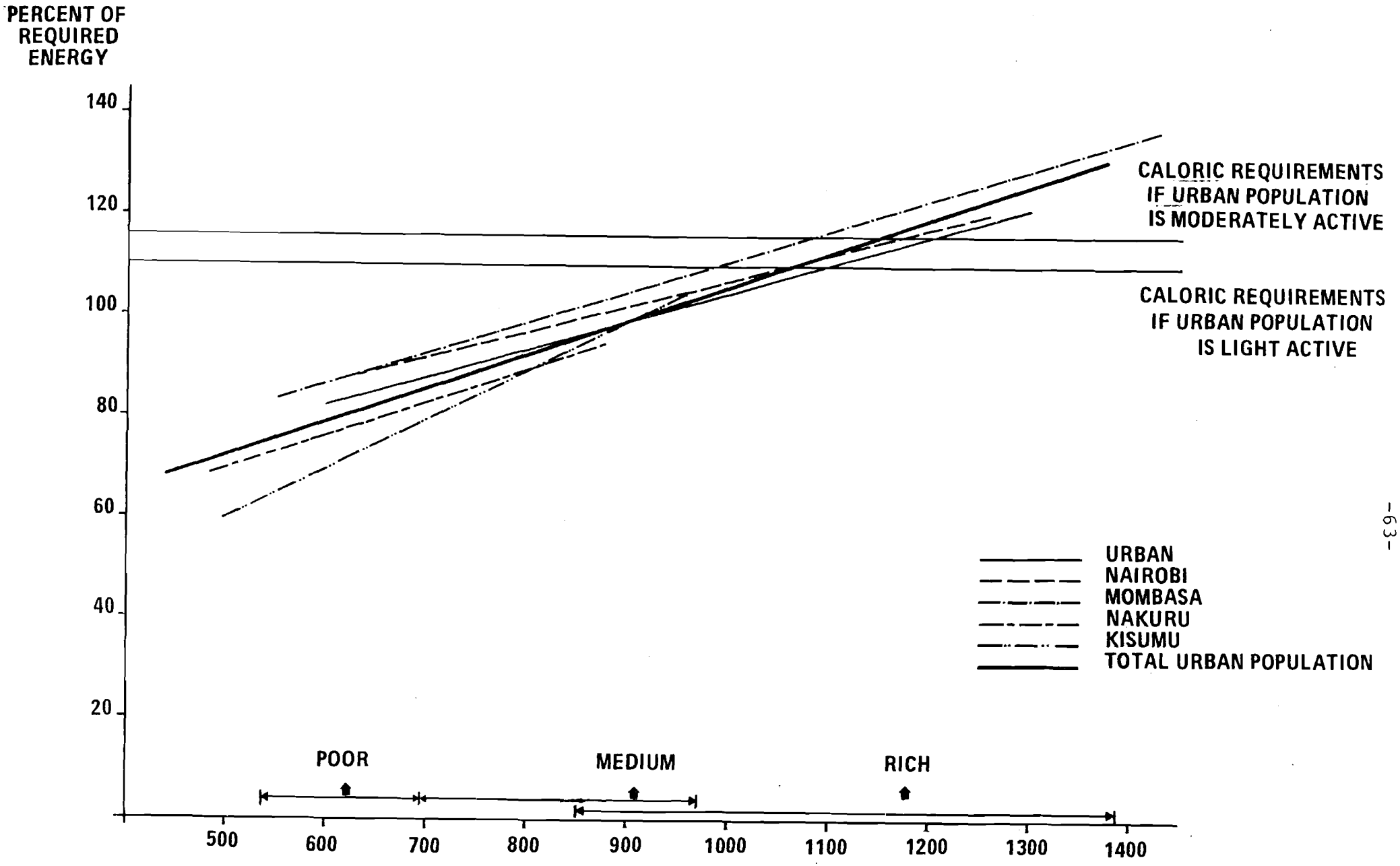


Figure 10 SUPPLY OF CALORIC REQUIREMENTS DEPENDING ON EXPENDITURES FOR FOOD

Assuming that the behavior of the population stays the same, approximately 1050 kSh would be needed per caput and year to buy a calorically adequate diet for a group of people at a light activity level. If they are more active, they need more food, and consequently, the expenditures will be higher. The costs of this diet would require about 33% of that income which was estimated to be necessary for a calorically adequate diet. The purchased diet will then be deficient in niacin, riboflavin and low in calcium; all the other nutrients will be adequately supplied. (Figure 11). These deficiencies stress once more that the diet of the urban population is not a completely balanced one and that substitution of the diet with milk products and nuts is needed.

## 2.7 The Comparison of the nutritional states of the urban population to a previous survey

A survey in an urban area of Kenya was carried out by Munoz only in 1962. It was reevaluated by Bohdal et al [10]. The survey of the Bondeni Location of Nairobi will be considered as being representative for the whole city in order to compare it with the present survey. However, it should be kept in mind that this is a gross oversimplification.

According to this survey, more calories are derived from cereals and vegetables nowadays. However, proportionally less legumes and starcht roots are consumed. It seems, that more food is available nowadays but that it is of a lower quality than 15 years ago which may be due especially to the shift in cereal and bean consumption.

## 2.8 Future Outlook

The nutritional situation was calculated for the urban population in the year 2000 without taking into consideration any changes in the eating habits, (Shah [12]. If a medium population growth and a likely increase in income (7%) is assumed, enough energy and protein would be available to meet everyone's

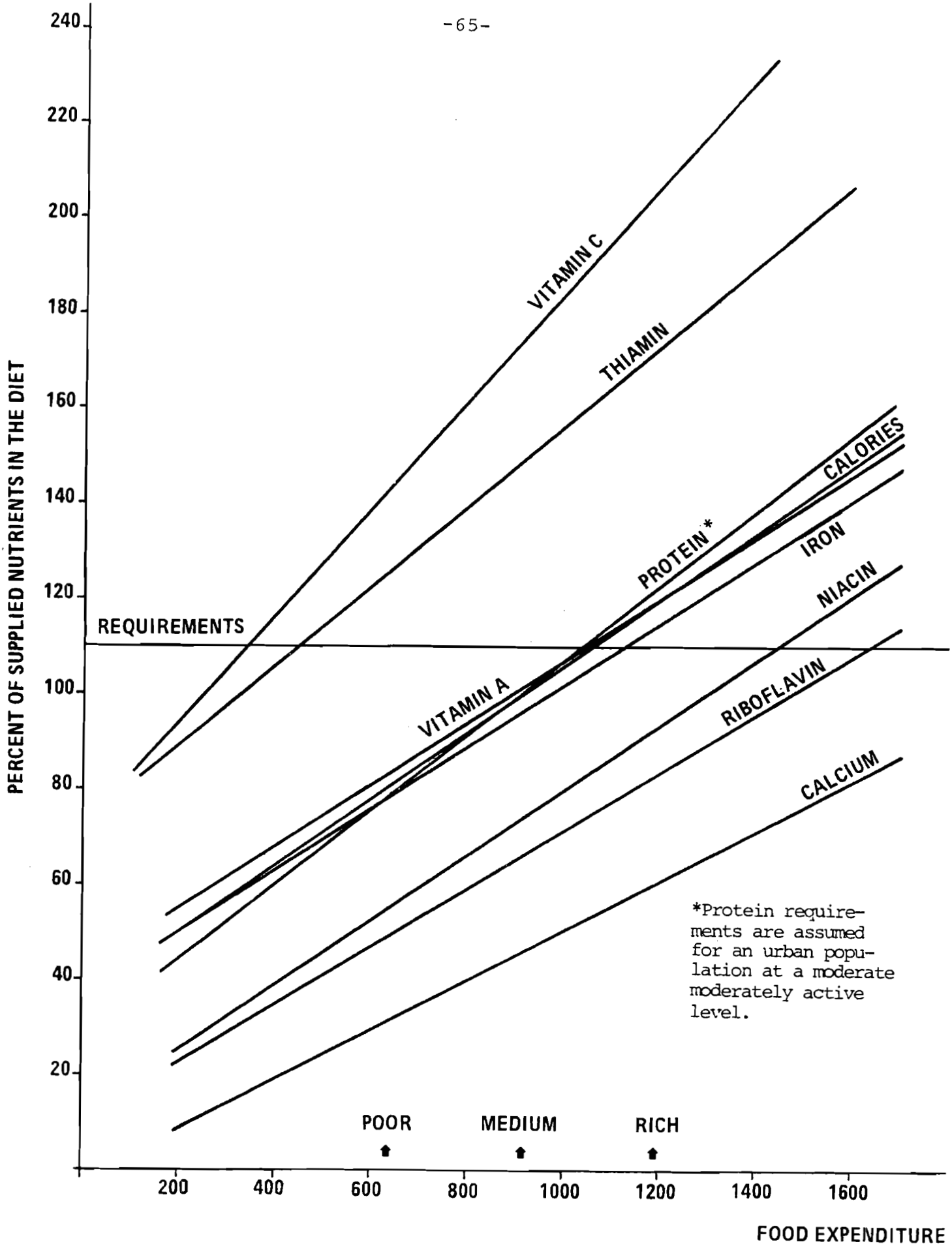


Figure 11 DEPENDENCE OF THE QUALITY OF THE DIET UPON FOOD EXPENDITURE FOR THE URBAN POPULATION (LIGHT ACTIVE)

requirements providing equal distribution of the food throughout the country (Table 20, 1-3). Approximately 11-12% more energy will be available to the urban population. The composition of this diet in respect to nutrients is comparable with the one predicted from Figure 11 for the given amount of energy - it is sufficient in all nutrients except calcium, riboflavin and niacin. Therefore, it can be assumed that this diet will cost about 1050 kSh which will be about 27-28% of the total income. These spending practices are comparable with the ones of the rich class in Nairobi. However, the earnings of this group are still slightly higher and, therefore, their diet is also slightly better than the expected one of the total urban population in the year 2000. The low content of riboflavin and niacin strongly enforces the neccesity to educate the urban population about the need to supplement their diet with food which is rich in these nutrients, i.e., milk products and nuts, in order to obtain a balanced diet.

If a low population growth and a low increase in income (4.5%) is assumed, the diet of the urban population will improve only slightly in energy and all other nutrients in the future. The food available under these assumptions would not be enough to meet everyone's requirements on the consumption level. (Table 20, 4). It is also expected that more of the income (35%) would have to be spent on this diet as compared with the spending practice when medium growth in population and income is assumed. In the case when low increase takes place, the spending practices of the urban population are still the same as observed in 1975 and, therefore, the distribution of food among the urban population may also be similar.

Table 74

Estimated Supplies of Nutrients in the Year 2000 for the Urban Population (light activity)

| Nutrient | Supply in percent of requirements * | | | | |
|---|---|---|---|---|---|
| | in 1977 | in 2000 | | | |
| | | 1 | 2 | 3 | 4 |
| energy | 96 | 108 | 108 | 107 | 99 |
| protein | 96 | 110 | 110 | 109 | 99 |
| fat ** | 17 | 21 | 21 | 21 | 18 |
| calcium | 43 | 52 | 52 | 51 | 46 |
| iron | 93 | 103 | 103 | 101 | 96 |
| vitamin A | 99 | 119 | 119 | 118 | 106 |
| thiamine | 140 | 157 | 157 | 156 | 152 |
| riboflavin | 58 | 72 | 72 | 72 | 65 |
| niacin | 65 | 82 | 82 | 81 | 73 |
| vitamin C | 162 | 202 | 202 | 200 | 178 |
| income *** (KSh) | 2160 | 3818 | 3863 | 3723 | 2552 |

* requirements in the year 2000 different from Table 5: calculated from the estimated age distribution of the population.

| | |
|---|---|
| energy | 2,160 kcal |
| protein | 28.4 g (moderately active) |
| thiamine | 1.08 mg |
| riboflavin | 1.30 mg |
| niacin | 14.26 mg |

** in percent of required energy

*** constant 1977 KSh

1 Medium population projection and likely growth (7%) of total PCE assuming no change in the income distribution

2 Medium population projection and likely growth (7%) of total PCE assuming a moderate change in the income distribution

3 Medium population projection and likely growth (7%) of total PCE assuming a drastic change in the income distribution

4 low population projection and low growth (4.5%) of total PCE

Source: M.M. Shah, [12].

## 2 .9 Conclusion

The result of these two surveys in Kenya is that no difference exists between the amount of energy and protein available in the diet for the total urban and for the total rural population. The poorest rural income class (R11) also consumes about the same amount of food as the poor class in Nakuru, the city with the lowest nutritional level. However, the diet of the urban people is more balanced than the one of the rural population because they eat more fruits and vegetables which are lacking considerably in the diet of the people in the rural areas. In general, the diet of the people in a city is better than the one of the whole province where this city is in. A difference can also be noticed in the amount of food available to the urban and rural population. It can be estimated from the present surveys that 39%of the rural population and 51% of the urban population obtain less than 2000 kcal per caput. In addition 38% of the rural population and 29% of the urban population obtain between 2000 and 2500 kcal per caput. The remaining part consumes more than 2500 kcal. It indicates that, in the average, more of the rural people have more food available than the people in the cities.

These observations are in contrast to previous surveys in India, Sri Lanka and Brazil (7) in which the urban poor have lower caloric availabilities than the rural poor. However, studies in some African countries, i.e., Swaziland (13), Nigeria (14), Ghana (15), and Kenya (10) showed that the rural population is underfed whereas the urban people have more to eat. The present study can be ranged just in between these two extremes. The reasons for these differences may be of different nature.

(i) It is difficult to estimate the value of the food and the income of the rural population and, therefore, earnings and food expenditures of the rural population may be seriously underestimated.

(ii) The survey may not be representative for the whole urban/rural population.

(iii) There are differences in the nutritional status among different areas and different cities of the same country. The evaluation is depending upon what is compared with.

(iv) There may be differences from country to country.

The problems with the present nutritional survey for the urban population are - as mentioned already earlier - that the survey was conducted only throughout one month and no changes in the food pattern (i.e., because of seasonal shortages) were considered. Further on, only 2% of the urban population were surveyed and it is not for sure that all residential areas were considered proportionally. These uncertainties are reason enough to regard these results only as preliminary ones which still need more support by further research, especially from medical field studies.

Anyhow, it can be generalized from this study that the average diet of the urban population is not too much out of balance. To obtain the optimal quality of a diet, some supplementations with riboflavin and niacin are needed. This can be achieved if food rich in these nutrients, i.e., milk products, nuts, fruits and vegetables would be more stressed in the average diet. According to the present survey, the main nutritional problem in the cities is related to poverty, and, as soon as people have enough money, they will buy more or less the right food (quantitatively and qualitatively) to fulfill their nutritional requirements. It has to be stressed once more, that an individual does not have to be undernourished just because he belongs to the poor class - the nutritional analysis refers only to the class as a whole and not to the individual in this class.

When the diet is taken which may be available to the urban population in 2000 (assuming medium population and income growth),

and when this diet is supplemented with about 15-20 g of nuts per day and caput, a diet is obtained which is a very balanced one and which is even to the taste of the native urban people. Therefore, this diet should be used as an example of a good one and this degree of the diet should be made available to each person in the cities.

REFERENCES

[1] Frohberg, H.C. The Relationship between Nutrition and Health: The Present Situation in Africa. Forthcoming.

[2] Chatfield, C. 1954. Food Composition Tables--Minerals and Vitamins for International Use. Rome: FAO Nutritional Studies No. 11.

[3] World Health Organization Technical Report Series No. 522. 1973. FAO Nutrition Meetings Report Series No. 52, Energy and Protein Requirements. Report of a joint FAO/WHO Ad Hoc Expert Committee. Published by FAO and WHO, Geneva.

[4] National Research Council, Food and Nutrition Board. 1974. Recommended Dietary Allowances, 8th revised edition. Washington D.C.: National Academy of Science.

[5] Shah, M.M., and H. Frohberg. 1978. Food Consumption Patterns--Rural and Urban Kenya". Working Paper No. WP- - IIASA, Laxenburg, Austria.

[6] Périssé, J., F. Sizaret, and P. Francois. 1969. FAO Nutrition Newsletter, 7,3, p.1.

[7] FAO, 1977. The Fourth World Food Survey. FAO Statistic Series No. 11, FAO Food and Nutrition Series No. 10. Rome: FAO.

[8] FAO, 1977. Provisional Food Balance Sheets, 1972-1974 Average. Rome: FAO.

[9] Anker, R., and J.C. Knowles. An Empirical Analysis of Mortality Differentials in Kenya at the Macro and Micro Levels. Working Paper No. 60, Population and Employment. Geneva: ILO. 1977.

[10] Bohdal, M., N.E. Gibbs, and W.K. Simmons. Nutrition Survey and Campaign Against Malnutrition in Kenya, 1964-1968. Report to the Ministry of Health of Kenya on the WHO/FAO/UNICEF Assisted Project.

[11] Kraut, H., and H.-D. Cremer (eds). 1969. Investigations into Health and Nutrition in East Africa, Weltforum Verlag, Munich.

[12] Shah, M.M. 1979. Food Demand Projections Incorporating Income Distribution and Urbanization, Kenya 1975-2000. Kenya: Food and Marketing Project, Ministry of Agriculture, Kenya.

[13] Jones, S.M. 1963. A Study of Swazi Nutrition. Durban: Institute for Social Research, University of Natal.

[14] Dema, I.S. 1967. Nutritional Problems of the Niger Delta Area. Mimeograph, University of Ibadan.

[15] Report of Nutritional Studies in Accra Area, Ghana. 1967. Ibadan: London/Ibadan Nutrition Course.