Food consumption and nutrition in the Kenya Coast

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ASC Working Paper 31 / 1998

Afrika Studie centrum

African Studies Centre
Leiden
The Netherlands

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SUMMARY

The coastal region is a net importer of food. Under these conditions, household food security can still be realized thanks to non-farm income. Yet, for a sizeable portion of the population food security is not assured. Furthermore, the current food pattern, which relies heavily on maize and cassava, is lacking in dietary quality and variety. This results in nutritional problems among the population which are partly hidden, but which surface most clearly among vulnerable groups such as women and children. While these problems are the corrollary of poverty and ill health, they can be partly prevented by appropriate caring behaviour. This is both an individual and a community responsibility. While the nutritional problems are very serious, there are also signs of hope and of 'resilience': children do show catch-up growth, as soon as circumstances become a bit better, such as in the dry season, or when they grow older and become less vulnerable. In the 1990s the level of chronic malnutrition in the Coast had for the first time started to go down. There are many nutrition improvement activities going on in the Coast; the challenge remains to work with more synergy (also with the population involved) to attain a higher population coverage and effectiveness.

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1. Introduction

Food consumption and nutrition are at the far end of the 'food path', which starts from food production and food gathering (see Waaijenberg 1999). An important consideration from the consumer's perspective is the security of 'access' that users (individuals or households) have to the food they need. This is called 'food security'; it is based on their access to productive resources to produce their own food, as well as on their purchasing power (to buy food) and social network (to claim or receive food).

As much as food security is a necessary condition for good nutrition, it is not sufficient in itself: food has to be prepared, distributed between household members, consumed and digested, and the energy and nutrients that are released have to be absorbed and utilized by the body. This is where appropriate caring and health behaviour/conditions come in. Only when all these steps are secured, can we speak of 'nutrition security' (Mwadime 1996).

Food consumption and nutrition in the Kenya Coast is the result of the interplay of biological processes, which are rather universal in nature, and anthropological or socio-economic factors, which tend to be culturally specific. This chapter will look at food consumption and nutrition in terms of:

(1) the level of fulfillment of some of the 'basic needs';
(2) the socio-economic determinants;
(3) current and past activities and interventions in this domain.

Apart from being an outcome of development, good nutrition is also an input into development, as it contributes to the quality of the human resources. Mortality and morbidity data are one way to express this (see Wakajummah 1999; Boerma & Bennett 1999). Direct information on the level of productivity and performance in relation to health and nutrition are not readily available (cf Boerma & Bennett 1999), but their importance is very plausible and known from practical experience.

The sections that follow describe the food situation in the Coast (sections 2, 3 and 4) and the nutritional status of vulnerable groups (i.e. children and mothers) (section 5), while section 6 reviews past and ongoing nutrition activities.

2. Food habits in the Coastal Region

2.1. Rural family food habits[1]

In most rural households, three meals are served. Breakfast is prepared early in the morning before the children leave for school. The second meal is prepared between twelve and two o'clock, while dinner is taken in the evening, usually at about seven o'clock. Some households may skip lunch or breakfast or sometimes both when no food is available or because of work patterns. Dinner is the most important meal of the day, in which generally all resident household members partake.

Breakfast in many households consists of some leftovers from the previous evening. These leftovers, heated up or eaten cold, are usually accompanied by some tea with sugar and/or milk. Other households may prepare special foods for breakfast, such as *chapatis* (unleavened bread), *uji* (thin cereal porridge, usually from maize flour) or eat a loaf of bread. Lunch and dinner generally consist either of *ugali* (stiff porridge made from maize and/or cassava flour) taken with a relish, or of a dish prepared with boiled roots, mostly cassava. This latter type of dish is more commonly taken at lunch time when the cassava is carried home from the field for that purpose. Side dishes consist mainly of different types of cooked green vegetables, but they may also be prepared from legumes, unripe mangoes, fish, meat, or chicken, or simply consist of sour milk. If nothing else is available, some households may take *ugali* with just a little salted water.

In the coastal strip as such, the food culture is more varied: dishes generally contain more ingredients — like fish (fresh, dried, or fried) and coconut — due to the influence of the Swahili tradition on the local kitchen. This is particularly true for the Digo in Kwale District. Compared to the other coastal communities, they use more spices, and consume, beside the basic dishes mentioned above, a larger variety of snacks (such as *chapatis*, various types of fritters and snacks cooked in coconut extract) and special dishes, such as *pilau* (spiced rice) and sweetened vermicelli. Among the Digo, food-peddling is more common than among the other ethnic groups. Especially during the month of Ramadan, when people fast during day-time hours and eat during the evening and night, many peddlers and stalls open up during the evening hours. However, eating out is mainly a habit of the men and not women. This may be related to the Islamic *Pudah* regulation, that limits women's movement in public places and participation in public activities.

In polygamous households, food preparation is a duty shared among the married women of the household although they may leave the actual task of preparation to some of the younger unmarried women, who carry out their duty under their mothers' supervision. If no women are present, cooking will be done by one of the boys. In polygamous households married women often take turns in supervision or preparation, which gives them greater freedom of movement on days that the other women are preparing the meals. The fuel used for cooking is mostly

[1] This section is largely based on the so-called Coast Seasonality study of 1985/86 carried out in the context of the Food and Nutrition Studies Programme (FNSP) of the Kenyan Ministry of Planning and National Development and the African Studies Centre (Leiden, The Netherlands), funded by the Netherlands Government. It was a study among 300 rural households with young children in the three dominant agro-ecological zones (CL3, CL4 and CL5 – see Jaetzold and Schmidt 1983) in Kwale and Kilifi Districts. See Foeken and Hoorweg 1988; Foeken *et al.* 1989; Niemeijer and Klaver 1990; Niemeijer, Foeken and Klaver 1991. The overall end publication is that of Hoorweg, Foeken and Klaver 1995.
Some information comes from the National Child Nutrition Surveys (referred to with the abbreviation CNS followed by their number).

wood: 96% according to CNS-3 of 1982, which corresponded to the national figure (Kenya 1983).

When the food is prepared it is shared out between the household members. The men usually eat together, the women may take their meal together in some households, but they often eat on their own with their children. In the latter case the women will prepare food separately and each woman will send some of her food to the men, who will sample from all food prepared in the household. Eating together in age/sex eating units is meant to create intimacy and to be a way to teach communal values. In addition, there is a belief that people eat more when they are in groups.

There are traditional food taboos and food avoidances, notably affecting women. Traditional healers often recommend avoidance of specific foods during pregnancy. For instance, the pregnant woman may be advised to eat well, but not to eat foods like eggs, as the child born may not have hair (Mwadime 1995), or might develop a large spleen (Sehmi 1993). Traditionally among the Giriama people, when a girl approaches marriage age, she is forbidden from eating poultry until she has born a child (Sehmi 1993).

2.2. Breast-feeding and baby food

The first and unique food for infants is mother's milk, starting from the valuable 'first milk' (colostrum), which is particularly rich in immune substances. Exclusive breast-feeding (i.e. no food or liquid other than breastmilk, not even water) is recommended for the first four to six months of life, and from the age of about six months infants should begin to receive a variety of locally available and safely prepared foods rich in energy, in addition to breastmilk, to meet their changing nutritional requirements (ACC/SCN 1998). These so-called weaning foods are gradually introduced. Earlier weaning carries the risk of contamination and infection, while later weaning carries the risk of starving the child (cf Kenya 1977; Kenya 1979; Kenya 1983).

'Weaning' literally means: accustoming the child; it is not only a nutritional, but also an educational process. Apart from the appropriate timing (about 6 months is recommended), the quantity, frequency and quality of weaning foods are important. Nutritional quality comprises the amounts of essential nutrients, as well as the energy-nutrient density (i.e. amounts per volume of the prepared semi-liquid weaning food). Hygienic handling of the food is another prerequisite.

The three national rural child nutrition surveys between 1978 and 1988 give information on breast-feeding, although the evidence is at times somewhat conflicting. All three surveys revealed a slightly longer duration of breast-feeding in the Coast (at least in the rural parts) compared to the national figures (Kenya 1980; 1983; 1991).

The second National Child Nutrition Survey (CNS-2)[2] held from November 1978 till January 1979 (Kenya 1980), reports the distribution of breast-feeding durations (as recalled by the mothers) in the rural Coast: 92% breast-fed their baby for at least 6 months and 66% for at least 1 year. The average duration of breast-feeding can be construed from these data to have been almost 15 months, which was a bit longer than the national figure of 14 months. Breast-feeding duration by mothers in urban parts of Coast province (9.3 months on average) was about 1 month shorter than in Nairobi and other urban areas.

The third Rural Child Nutrition Survey (CNS-3) held from July to September 1982 (Kenya 1983) used a more reliable methodology to estimate the duration of breast-feeding, based on

[2] The national child nutrition surveys will be denoted in the text by the abbreviation CNS followed by their number.

the current status (prevalence) of breast-feeding at the time of the survey (i.e. not relying on recall about the past). The average duration for rural Coast was 18.7 months, again slightly longer than the national figure of 18.2 months.

The fourth Rural Child Nutrition Survey (CNS-4) held from November 1987 to January 1988 (Kenya 1991) reported an average breast-feeding duration in the rural Coast of 17-18 months, depending on the district, compared with a national average of 16 months. While the latter two reports give the distribution of breast-feeding by age for Kenya as a whole, information by age is not presented for the districts.

Several cultural and religious practices promote this higher prevalence of breast-feeding in the Coast. The practice of mothers carrying their baby on the back has several advantages: it allows them to breast-feed on demand and frequent sucking stimulates breast-milk production. The close contact between mother and infant is also important for emotional development ('bonding'). The traditional practice among the Taita of enclosing the mother and her newborn for 21 days promotes mother-infant bonding. A traditional Islamic practice is to breast-feed the child for at least 24 months; this needs to be maintained and further promoted, especially in urban areas of the Coast.

Various reasons lead mothers to stop breast-feeding. Most of them are related to factors such as sickness, a next pregnancy, or the mother having to go back to school or work (Mwadime 1995). These factors can be a combination of practical and cultural considerations. For instance, mothers may deny the breast when they are sick, for fear that the child will get the sickness. In the case of culturally disapproved behaviour (such as adultery by the mother), there can also be fear that the child will be possessed by an evil spirit and consequently develop malnutrition (*chirwa* in Digo or *marasmus* in medical terms) (Mwadime 1995).

The use of commercial baby food is uncommon among the coastal population. According to CNS-2 (Kenya 1980), the proportion of babies who had ever been given any commercial baby food (milk or cereal based) was lowest of all provinces in rural Coast (16%), while in urban coastal areas it was as high as in Nairobi, around 75%. CNS-3 (Kenya 1983) gives a similar percentage of children who ever used formula in the rural Coast (hardly 20%), with the lowest figures reported for Kilifi/Tana River/Lamu (16%) and the highest for Taita Taveta district (almost 30%). These low percentages are in a way reassuring, because when processed foods are improperly prepared and fed, they carry important health risks for the baby (notably diarrhoea). On the other hand, the low percentages may partly reflect the low income level among the rural coastal population[3].

According to CNS-3 (Kenya 1983), the mean age of introduction of the first weaning food (based on recall about the past) was almost 6 months in rural Kwale District. The age of 6 months corresponds to the upper limit of current international recommendations (see above). This result is consistent with the cross-sectional result (according to the current status method) that by 4 months 45% of the babies in rural Kwale were supplemented. Similar results for the rest of rural Coast Province are contradictory: an average age of introduction of 3 months (based on recall), versus 15% of the children by 4 months (based on the more

[3] That these relationships are complex and should be interpreted with caution is shown by the findings of CNS-2 (Kenya 1980) for the urban areas of Kenya: children ever given any commercial food had on average a better nutritional status than children never given such food; before ascribing this to the particular virtue of commercial baby foods, the difference in income levels should not be ruled out as an explanatory variable. Besides, among the latter group one would expect to find more babies who were weaned too late anyhow, which may be as much a risk factor for malnutrition as too early weaning.

reliable method). The latter figure could be indicative of a certain extent of too late weaning in areas other than Kwale. Porridge was the main type of first supplement in the rural Coast (around 80% of the cases); milk feeds were the first supplement in only around 10% of the cases. Without more complete information on the whole weaning process, no conclusion can be drawn from the low percentage of milk feeds as the first supplement; after all, the porridge given in the majority of cases must have acted as a mere complement to breast-milk in the first place.

The results of a study on weaning practices of 0-23 month old children in Kilifi (Thiuri, Gemert and Kinoti 1984) indicate that feeding at least two meals per day improved growth performance during the early weaning period.

2.3 Young child feeding

The first National Rural Child Nutrition Survey held in March 1977 (Kenya 1977; Kenya 1979) provides an impression on infant and child diets based on (conservative) estimates of food consumption frequencies. These were based on interview questions addressed to the responsible caretaker for each child on how often foods from various food groups were served to the child.

In the Coast cereals and milk (from cow and goat) were consumed most frequently, in the order of 30-40 times per month, only slightly less than elsewhere in rural Kenya. The consumption of meat, fish and eggs was uniformly low in all zones of Kenya (6 times per month; Coast: 8 times). The underfives' diet in the Coast was the most monotonous in other respects: it shared with the ecological zones west of the Rift Valley a pattern of low frequency of consumption of other foods, like potatoes/cassava, bananas and beans (4-8 times a month), and it even did not have the west's high vegetable consumption frequency (Coast: 11 times per month; western Kenya: around 30). For its low consumption frequency of meat and beans, the coastal zone was the only one where these two foods were significantly positively correlated; no other correlations were found. Whether this points to a local preference to combine meat and beans in child feeding, or to an independent joint determinant in this region (such as household welfare), cannot be decided from that study.

In households with young children, special weaning foods may be prepared in addition to the main household dishes. Sometimes this is just a portion of *ugali* (stiff maize or maize/cassava porridge) which is diluted with a little milk or reconstituted milk powder. However, *uji* (thin cereal porridge, usually from maize flour) is the most important weaning food (Niemeijer, Foeken and Klaver 1991). In many cases no special weaning foods are made for the baby, so that to a large extent adult food reflects what is fed to the child (Mwadime 1995). According to information from the second National Nutrition Survey (Kenya 1980), the main ingredient of children's weaning porridges in the rural areas of the Coast was maize (95% of cases), while in the urban areas it was a bit more varied (81% maize, 5% millet or maize mixed with millet, and 14% other or not stated). The pattern of additional ingredients showed a clear rural-urban differential: in the rural areas, the weaning porridges in almost half of the cases had neither sugar nor milk added, while the weaning porridges in more than half of the urban cases had both sugar and milk, which implies a better energy density of the dish.

Information of the third national nutrition survey CNS-3 (Kenya 1983) confirms that only one-third of rural pre-school children received milk in their porridge; in 1 out of 4 cases this was powdered milk in stead of fresh cow's, goat's or other milk.

The mother usually handfeeds the very small child, at a later age the child will drink from a cup. If *uji* is prepared in the household, the older children and adults present may also receive a share. There is no clear distinction between weaning food and adult food in this respect. At the end of the weaning period, that is from about two years onwards, the young child often eats with one of its parents. The parent will feed the child small morsels of food while taking his own meal. When the father and mother are not present, another adult or one of the older children may be given this responsibility. Afterwards, the child may still join the other children who are fed in a group, sharing a dish together. When the next born comes of age, however, the special position with the father or mother has to be relinquished and the child will have to get its share from the common dish in competition with the other children (cf Niemeijer, Foeken and Klaver 1991).

A non-food habit that does have nutritional consequences is the practice among the Taita of keeping the child indoors away from sunlight, which is the main factor in the provision of vitamin D: a short exposure now and then of part of the skin to the sun is all that would be needed.

2.4. Wild foods and food habits in times of distress

Hunting and gathering of wild foods used to be important, particularly in Taita and Tana-River and especially in times of food distress. Main foods gathered from the wild are vegetables, such as wild spinach ("*mstungu*" or "*uchunga*"), amaranth ("*myunya*") and pumpkin ("*marenge*"), fruits like tamarind (*Tamarindus indica*), leaves of the baobab tree (*Adansonia digitata* - used as sauce thickener), small game (gazelles, wild pigs and fowls) and fish. A famine that occurred between 1910 and 1912 was named *"Madzungu"* or *"Marenje"* (gourd or squash plant), after the indigenous plants eaten in order to curb hunger (Herlehy 1983). In times of famine, people resort also to root crops such as cassava and yams, which are planted partly in anticipation of periods of distress.

3. Food availability and food adequacy

Food availability ideally has to meet food needs; if they are in balance there is food adequacy. Appendix 1 gives some technical considerations on the establishment and application of nutritional requirements. Appendix 2 focuses on energy requirements and the construction of "consumer units". Section 3.1 presents an overall picture of the food situation in the coastal region. Section 3.2 addresses individual nutritional requirements and the dietary value of different food sources. Section 3.3 addresses the seasonal fluctuations in energy requirements.

3.1 Overall food availability in Kenya Coast

Data are lacking to construct a complete 'food balance sheet' (FBS) for the Kenya Coast. Such statistical tables are produced routinely for the country as a whole, on the basis of statistics on food production, food stocks and food imports and all possible forms of food 'disappearance' into different destinations (ranging from seed and feed to storage and exports). A Food Balance Sheet, which is essentially an accounting method of all 'entries' and 'exits' of food, gives an indirect estimate of the food available for human consumption. At sub-national level, the necessary statistics on food 'imports' and food 'disappearance' are lacking. Yet, it is possible to convert at least certain food production statistics into a form which is useful for comparison with food requirements. All one has to do is to express the food production figures (see for example Waaijenberg 1999) in a nutritionally meaningful way: not money value in this case, but in terms of dietary energy (kilocalories). Using a food composition table (e.g. Platt 1962) and correcting for the non-edible part of food crops ("waste"), the result is as shown in Table 1. Although this table is not complete (it does not include foods from animal origin neither foods hunted or gathered in the wild), it covers the bulk of food availability. In 1992, total food crop production (from vegetal origin) represented around 675 billion kcal, which is equivalent to 193,000 T grain equivalents. This represented 44% of the estimated food energy needs of the coastal population, which was estimated at 440,000 T[4].

So the Coast is clearly a food deficit region. This is not a new phenomenon: it can be traced to colonial times, when priority was given to agricultural development in the White Highlands; since then investment in the Coast has been lagging behind (Meilink 1999). The tourist industry in particular relies for its food supply mainly on the highlands (Mwakubo, Sambili and Maritim 1996). Whether full food self-sufficiency of a region is necessary or desirable is outside the scope of this paper; what is relevant here is that people in the Coast, in order to meet their food requirements, rely heavily on food that has to be imported from other regions and has to be purchased (see section 4). It has been found that groups that have enough income can achieve food adequacy (Mwadime 1996). As time-specific statistics of agricultural production are more difficult to come by, the seasonality in food availability (and

[4] To estimate the region's food needs, one uses estimates of its population size and of individual nutritional requirements. If demographic trends of the past decade continued, the population has reached 2 million in early 1992 and may reach 2.5 million in late 1999. With an estimated average per capita energy requirement of 2,100 kcal per day (see Appendix 1), a population of 2 million people (in 1992) required 1,200 T of grain equivalents per day (at around 3,500 kcal per kg of grain), or 440,000 T of grain equivalents per year, while a population of 2.5 million people (in 1999) will require 550,000 T of grain equivalents, that is an increase of 25% over an 8-year period! If present trends continue, that means a doubling of the food needs in less than 25 years.

purchasing) can be indirectly assessed from household intake data (see section 4 below) as well as from data on the prices of foods.

The Coast has known hunger periods since historical times (Herlehy 1983), either due to drought or insect pests (such as locusts), sometimes compounded by warfare. During the last droughts of 1992 and 1996/7, over 40% of Kilifi was affected, as well as parts of Taita, Kwale and Tana-River. Already in colonial times, food relief was organized in cases of severe famine: rice imported from India in 1898, imported wheat in 1944 and maize during the drought of 1948-52 (Herlehy 1983). Nowadays food relief consists mainly of maize and beans, in line with the local food pattern.

Table 1

Energy equivalent of annual food crop production in Coastal Province (1992)

	kcal/kg edible portion	*protein as % of energy*	*waste*	*kcal//kg as prod-uced*	*T/year prod-uced*	*kcal/year (billions)*	*Percentage of vegetal energy*	*protein/ T/y*	*Percentage of vegetal protein*
- cereals	3500	9.1	15%	2975	75091	224	33 %	5.1	37%
- legumes	3350	26.3	0%	3350	10978	37	5 %	2.4	17%
- cassava	1550	1.8	15%	1320	120079	158	23 %	0.7	5%
- sweet potato	1150	5.2	15%	980	1456	1	0%	.0	0%
- vegetables	300	40	20%	240	32543	8	1%	.8	6%
- fruits650	4.3	30%	450	179662	82	12 %	.9	6%	
. coconut	2800	7.1	35%	1800	52983	96	14 %	1.7	12%
. cashew	5900	13.6	0%	5900	10363	61	9 %	2.1	15%
. simsim	5900	13.6	0%	5950	1323	8	1 %	.3	2%
Total						675	100%	14.0	100%

Source: Food composition table (Platt 1962); T/year (1992) from Waaijenberg (1999).

An indication of the dietary quality of the foods available is the part of the energy contributed by protein (see also Appendix 1). Given that 1 gram of protein provides 4 kcal, it can be calculated from Table 1 that crude plant protein contributed some 8% to the vegetal food energy produced in the region. Assuming a protein quality score of 70-75%, this represented around 6% of energy in the form of reference ("ideal") protein. This figure does not yet include foods from animal origin, which are typically rich in high quality protein. Even a modest consumption of foods of animal origin (including fish and shark, which are widely consumed in the coastal strip) may bring the ratio of crude protein closer to the empirically desirable level of 11-12% (Périssé 1969), while at the same time increasing the protein quality score and thereby giving an extra boost to the amount of net ("ideal") protein in the diet.

The dietary quality in terms of micronutrients (vitamins and minerals) depends a lot on the availability of vegetables, fruits and foods of animal origin; as there are no reliable statistics on these foods, it is more convenient to assess their adequacy from intake data (see section 4 below).

3.2 Food sources in Kenya Coast in relation to dietary quality

Selected nutritional requirement figures are given in the upper part of Table 2. The nutritional value of different food sources is given in the lower part of Table 2. Food composition data from existing tables are per 100 g of food and cannot be directly compared to dietary requirement figures. Therefore in the lower part of Table 2, food composition data are expressed per 350 kcal of the same food, so as to allow easy comparison with the representative recommended intake data expressed on the same basis.

The bulk of food energy at the Coast comes from the so-called staple foods (cereals, roots and tubers). Foods rich in fat (such as nuts and oil) and sugar, even if they are available in lesser quantitites, are a concentrated source of energy (cf their low reference amounts in Table 2). Especially for vulnerable groups with limited stomach volume (small children, pregnant women), the latter are very important adjuncts.

Non-staple foods are necessary for dietary quality: they have to supply most of the nutrients (protein, minerals and vitamins):

- protein-rich foods, from plant or animal origin (see column 'reference protein' in Table 2), which are also generally good sources of vitamins and minerals
- foods which mainly contribute vitamins and minerals: vegetables and fruits.

The quality of the diet is not only determined by the choice of foods, but is also affected *inter alia* by the mixing of foods and by the cooking methods used. For example, when a mixture of cereals and pulses is eaten together in the same meal, the amino acid pattern (which is the result of protein digestion) meets human requirements better than when those food items are consumed separately. Cooking methods have varying effects on the retention (percentage remaining) as well as the bio-availability (percentage that can be utilized by the body) of micronutrients. For example, vitamin C is most sensitive to heat. The bio-availability of micronutrients can also be enhanced or inhibited by the presence of other food constituents. For instance, iron absorption from plant foods is enhanced by the presence of vitamin C (fruits, vegetables) or animal food, and inhibited by the presence of phytates and oxalates (coarse grains, vegetables); the absorption of carotenoids is enhanced by the presence of lipids (fat) in the diet (e.g. when coconut is used for cooking).

3.3 Seasonal variation in food requirements

Nutritional requirements for energy (and for some of the micronutrients, notably the B-vitamins) depend on the level of physical activity, which in turn is influenced by labour activity. Infections are also expected to increase requirements, but to a lesser extent. In the existing literature on the Coast (Jaetzold & Schmidt 1983; Waaijenberg 1987; Oosten 1989; see also Hoorweg, Foeken & Klaver 1995: 44), the period between March and July-August is generally regarded as the period in which labour requirements in agriculture are high. It is the period of seeding, weeding and the beginning of harvesting of maize, land preparation for a second crop, weeding and some first harvesting of beans and cowpeas, and planting of cassava. Among these agricultural tasks, the weeding of maize, a heavy task in terms of energy expenditure (WHO/FAO/UNU1985), is, according to Vervoorn & Waaijenberg (1986: 56) by far the most labour-consuming task, also in man hours. In particular, the period between, roughly, mid-April to the end of June can be considered as the annual labour peak in this part of Kenya and the combined effect of more time spent in fieldwork and the more energy-intensive physical activities result in a peak in the daily energy expenditure of most adults.

Table 2

Dietary needs and main sources at the Coast

	Reference amount:	*Energy*	*reference protein*[1]	*iron*	*vitamin A (retinol equivalents]*	*vitamin C*	*Iodine*
Recommended intake (per day)		*(kcal/)*	*(g)*	*(mg)*	*(mcg)*	*(mg)*	*(mcg)*
- per capita [2]		*2,100*	*36*	*17*	*525*	*28*	*100-150*
- baby, 1 year, 10 kg		*1,000*	*12*	*12*	*350*	*20*	
- lactating woman		*2,650*	*57*	*26*	*850*	*50*	
- adult man		*3,000*	*49*	*23*	*600*	*30*	
Representative recommended intake figures (per 350 kcal)[3]		*=350*	*6*	*3*	*90*	*5*	*15-25*

Food composition: level of selected nutrients per reference amount of edible portion, unprepared, providing 350 kcal (an arbitrary amount), or alternatively – where appropriate - representing a 'standard portion' for items typically consumed i small quantities (main sources at the Kenya Coast are indicated in ***boldface]***

	Reference amount: (g)	*(kcal)*	*(g)*	*(mg)*[4]	*(mcg)*[5]	*(mg)* [6]	*(mcg)*
- cereals	100	**350**	6	3	-	-	poor
- cassava, fresh	250	**350**	3	2	-	**65**	poor
- cassava, flour	100	**350**	1	2	-	**-**	poor
- sweet potato	300	350	4	3	30	90	poor
- legumes	105	350	**15**	**6**	-	-	poor
- cowpeas, fresh	320	350	8	**6**	75	8	poor
- oil seeds & nuts	60	350	8	3	-	-	poor
- coconut	125	350	4	2	-	-	poor
- fish (sea), fatty[7]	200	350	**40**	**3**	60	-	**rich**
- fish (inland), fillet[7]	350	350	**65**	**4**	-	-	poor
- meat[7]	200	350	**25**	**4**	-	-	poor
- milk	550	350	**18**	1	**200**	5	poor
- egg[7]	50	80	6	1	100	-	poor
- vegetables, green	150	70	6	**6**	**600**	**200**	poor
- vegetables, other	150	35	1-2	1-2	**0-40**	**6-60**	poor
- fruits	150	100	1	1-3	**100**	**60**	poor
- oil	20	180	-	-	-	-	poor
- sugar	25	100	-	-	-	-	poor
- iodized salt	1	0	-	-	-	-	**100**[8]

Calculations based on: WHO/FAO/UNU 1985; FAO 1988; Mwadime 1996; Platt 1962; West, Pepping and Temalilwa 1988; Sehmi 19

Notes with Table 2:

[1] Reference protein = "ideal" protein of optimal quality (in terms of digestibility and amino acid pattern).

[2] The figures expressed per capita are indicative only: they are based on international recommended dietary allowances aggregated across age groups, using an assumed population pyramid.

[3] This arbitrary amount is equivalent to: 100 g dry grain, or to the following portion of selected daily energy requirements: one third for a 1-year old child, one sixth per capita or 12% for a nominal adult male.

[4] Iron absorption is enhanced by a.o. vitamin C, but inhibited by phytates and oxalates (such as in tea and Khat). There is extensive use of strong black tea and Khat ('Muraa') among the Swahili, Arabs and Somalis at the Coast.

[5] When frying in shallow open pans, vitamin A may be partly destroyed.

[6] During cooking 50% of vitamin C may be easily lost; during prolonged cooking, most of it may be destroyed.

[7] Iron from animal sources (*haem* iron) is much better absorbed than iron from plant sources.

[8] Common salt is fortified at a level of 168.5 mg Potassium Iodate (KIO_3) per kg (Sehmi 1993), that is 168.5 microgram per gram of salt. The ratio of molecular weight of Iodine to KIO_3 is 127/214.

The short rains are very unreliable and a reasonable second crop is rather exceptional. Nevertheless, farmers may try a second maize crop, which may involve some extra work on weeding around November and hence a second peak, albeit lower, of daily energy expenditure. According to the FNSP Seasonality Study[5], it were mainly the farmers in Kwale who tried a second maize crop (in 1985).

As yet, no direct data exist on energy expenditure (physical activity) patterns in the different seasons. The FNSP Seasonality Study does provide some circumstantial evidence though: in the peak season, the supposedly increased energy requirements were reflected in a 11% higher energy intake per consumer unit *and* a weight loss (registered among the mothers) of slightly more than 1 kg (see section 5.2). From this we may infer an increased average requirement per consumer unit of 300-400 kcal per day; this order of magnitude corresponds to the difference in requirements between 'heavy' and 'moderate' occupational work as found in the international literature. This inference would need further substantiation[6].

Seasonal variations in requirements may also be related to other factors. Requirements are bound to be increased as a result of illnesses, diarrhoea or fever/malaria, which are more common during the rainy seasons. And it is conceivable that requirements are somewhat raised by increased walking distances to watering points in the dry season (which is common in semi-arid areas of Taita, Kilifi and Kwale districts).

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[5] See note 1.

[6] Another piece of circumstantial evidence points in the direction of less sizeable fluctuations in energy requirements due to seasonality in agriculture: Mwadime (1996) reported that farmers among the Digo (not the most agricultural community on the Coast if compared to the Taita, the Giriama and the Durumas) allocated 3.1 hours in agriculture per day for those going to the farm during the agricultural peak season of 1995. If the above inferred increase in requirements would have to be realized within such a period of 3 hours, it would involve a doubling of the physical activity ratio during that time, which is unlikely.

4. Energy and nutrient intake

As discussed in section 3.1, the Coast is a food deficit region in terms of the availability of food from own production. In other words, the region is to a great extent a net importer of food to feed its population. Direct information on those food 'imports' are not available. And even if they were, the 'food balance estimate' that could then be made would only provide aggregate data for the whole region. Thus, whatever data exist on actual food consumption have to complete the picture. Such data are not routinely collected on a population basis, but are limited to restricted samples in the context of research studies.

A seasonality study done in 1985-86 by the Food and Nutrition Studies Programme (Niemeijer, Foeken and Klaver 1991)[7] provides detailed information on the food intake of 300 rural households with young children in Kwale and Kilifi District. The results give an idea on the level of nutritional adequacy and seasonal variation in food intake, as well as on a number of determinants of food intake. A study in three rural sub-locations in Kwale (Mwadime 1996) gives information on food intake in 1994 (mid-October to mid-December).

4.1 Diet composition and nutritional quality

The diet of the coastal population is fairly monotonous. The Coast Seasonality study found that 84% of energy intake (73% of requirements) came from staple foods (cereals, cassava and bananas) and beans combined. In general, the meals consist predominantly of cereals. Most of the cereals is purchased, confirming that this is a food-deficit region. The intake from roots, tubers and starchy staples (mainly cassava), vegetables (mainly green leaves), fruits (mainly mangoes), and oil seeds and nuts (coconuts) mostly came from home production. Legumes and animal products were largely purchased. Finally, fats and various miscellaneous items (mainly soda's, syrups, sugar) were nearly always bought.

The household energy intake from cereals was fairly constant in the five survey rounds (see Table 3). This was made possible by the following mechanism: while the energy derived from home produced cereals showed a strong uni-modal seasonal pattern, this was (fully) 'compensated' by cereal purchases (see Table 4).

While the energy intake from cereals was fairly constant thanks to the above mechanism, total dietary energy intake showed a large peak in the pre-harvest months of May-June and a minor peak in the pre-harvest months of November-December. These pre-harvest peaks in food intake can to a large extent be attributed to an increased intake of roots, tubers and starchy staples, i.e. of cassava; these were mainly from home-produced origin, thus somewhat 'dampening' the concurrent dip in consumption of home-produced cereals. Fruits (especially mangoes), legumes, oil seeds and nuts (mainly coconuts) also contributed to the higher intake; these were mainly from purchased origin, thus coming on top of the increased cereal purchases mentioned above.

In terms of macronutrients, 77% of the energy was derived from carbohydrates 11% from proteins and only 12% from fats (Table 3). Although the absolute figures show fluctuations as will be described below, the relative contributions were remarkably constant throughout the year, especially for protein and carbohydrates. The contribution of fats (12%) is within the 5-35 per cent range that is considered to be "not incompatible with health". Nevertheless, it is a fairly low percentage, indicative of a one-sided, monotonous diet that is quite bulky with a low energy density (Hoorweg, Foeken and Klaver 1995).

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[7] See note 1.

Table 3
Energy intake, by food group and survey round (kcal/day/consumer unit)

(N=)	*Jul/Aug'85* (283)	*Nov/Dec'85* (278)	*Feb/Mar'86* (272)	*May/Jun'86* (269)	*Sep/Oct'86* (266)	*Average* [274]
- cereals	1948	1940	1956	1872	1836	1910
- legumes	52	97	74	180	155	112
- roots, tubers & starchy staples	113	125	138	257	89	144
- vegetables	52	41	13	43	22	34
- fruits	2	22	10	34	13	16
- animal products	111	159	154	132	132	138
- fats	49	68	17	40	21	39
- oil seeds & nuts	75	67	65	112	86	81
- miscellaneous	108	113	81	110	103	103
Total	2510	2630	2510	2780	2460	2580

Source: Niemeijer, Foeken and Klaver 1991. Appendix 10

Table 4
Energy intake by origin, by survey round
(percentage of total energy and p/s ratio)

(N=)	*Jul/Aug'85* (283)	*Nov/Dec'85* (278)	*F eb/Mar'86* (272)	*May/Jun'86* (269)	*Sep/Oct'86* (266)	*Average* [274]
By origin:						
- subsistence (s)*	42	39	31	24	49	37
- purchases (p) **	58	61	69	76	51	63
p/s ratio	1.37	1.56	2.22	3.11	1.05	1.70

Source: Niemeijer, Foeken and Klaver 1991. Table 3.5, based on Appendix 10-11
* contribution of home-produced foods to energy intake
* contribution of purchased foods to energy intake (also includes gifts of food - which are negligible)

Table 5
Contribution of macronutrients to total energy intake, by survey round
(percentage of total energy)

(N=)	*Jul/Aug'85* (283)	*Nov/Dec'85* (278)	*Feb/Mar'86* (272)	*May/Jun'86* (269)	*Sep/Oct'86* (266)	*Average* [274]
By energy giving macro-nutrients:						
- carbohydrates	76	75	78	78	76	77
- lipids	13	14	11	11	13	12
- protein	11	11	11	11	12	11

Source: Niemeijer, Foeken and Klaver 1991. Table 3.3

The average intake of proteins ranged from a minimum level of 69 grams/day per consumer unit[8] in July-August to 75 grams/day in May-June. From the international figures for individual "safe protein intakes", a household-level aggregate requirement can be worked out to be around 50 grams/day per consumer unit of protein from the current diet (which would correspond to around 40 grams of optimal quality reference protein). This aggregate value does not take care of distributional variation within the household, so that it should be increased by a certain margin (see Appendix 1) before it could qualify as a "safe household intake". The current average protein intake is apparently high enough to provide such a margin. Yet, there is no reason for complacency. Although the results for protein intake are more favourable than the results for energy intake (see below), once energy is lacking in the diet, proteins will be more readily used for energy purposes than for the body building purposes to which the requirements refer. This may explain why in the Kenya Coast vulnerable groups like young children remain at risk of what is commonly referred to as 'protein-energy malnutrition' (PEM).

As for various nutrients, the average intake of thiamin and iron corresponded to the recommended levels, vitamin C intake was ample (provided cooking losses are not excessive). However, vitamin A, vitamin B2 and niacin intakes were only half the recommended values. This reflects a diet poor in vegetables/fruits and foods of animal origin. At the end of the dry season (February/March 1986), both vitamin A and vitamin C intakes were strongly reduced (about halved), because of a very reduced consumption of vegetables and fruits.

A study done end of 1994 in Msambweni in Kwale, likewise found a protein intake that was well above recommended values, while the energy intake was only 80% of estimated requirements; the level of vitamin C appeared adequate, but the intake of vitamin A was inadequate, around 80% of the recommended value (Mwadime et al. 1996b).

4.2 Energy intake and its seasonal variation

As Table 3 shows, daily energy intake throughout the 15-month period of the Coast Seasonality study in 1985/6 averaged slightly less than 2600 kcal per consumer unit (Hoorweg, Foeken & Klaver 1995). This intake is quite comparable to the energy intake reported for groups of peasant smallholders elsewhere in Kenya. With estimated energy requirements per adult equivalent at almost 3,000 kcal/day, the actual energy intake (average of 5 days in different seasons) was 87% of that figure, i.e. 13% below the reference value[9] (namely 6-17%, depending on the season). Due to a skewed intake distribution towards higher values, this mean value of 87% of requirements gives too favourable an impression: the value in the middle of the distribution (median, or 50th percentile) is lower than the average, namely 80% of requirements. Or, in other words, half of the households had an energy intake

[8] A consumer unit ("cu") is equivalent to a male adult in terms of energy requirements. For the detailed method of calculation and the way other age/sex groups are expressed as consumer units, see Hoorweg, Foeken and Klaver 1995:119. See also Appendix 1 and 2.

[9] As the latter figure is based on assumptions regarding body size and activity pattern (see 3.3 and Appendix 1), the true deficit in food intake may differ to some extent. There is evidence of some 'adaptation' in body weight for the mothers in that same study: their weight was on average only 90% of desirable weight (see 5.2); if this would be taken to be indicative for all age groups, it would 'explain' about half of the energy deficit (though without making it any more desirable for that matter). The other half of the deficit should then be attributed to a lower activity level than the one assumed in these estimations (taken from international values for subsistence farmers - see Appendix 1).

below 80% of requirements. The percentage of households with energy intake below 60% of requirements[10] varied between 23 and 29%, depending on the survey round (average 26% of households - see Fig. 1). These figures points to a widespread prevalence of chronic energy deficiency.

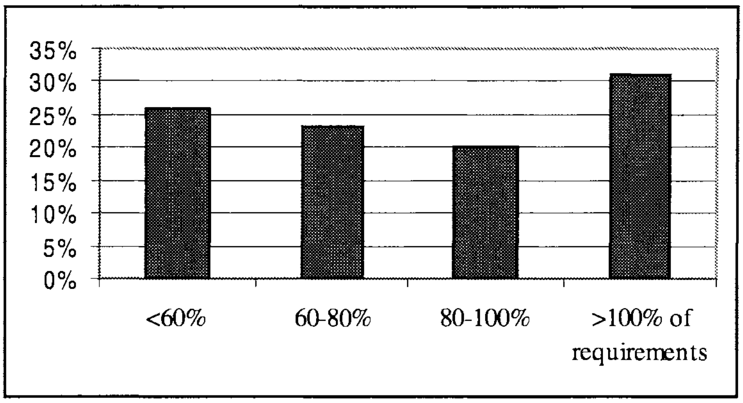

Figure 1
Frequency distribution of adequacy of household energy intake
(Source: Niemeijer, Foeken and Klaver 1991, Appendix 9).

During most of the year total energy intake was around a base level of 2500 kcal/cu and there was no pronounced dip at any time of the year. On the contrary, a peak in energy intake was found in the months of May-June with 2780 kcal/cu and a second, lower peak occurred in November-December, that is during the period of the long rains and the short rains respectively. It is noteworthy that there was no increased energy intake in the immediate post-harvest months (September-October) when stocks were plentiful. As discussed in section 4.1, the peak in May-June occurs because of a higher intake of roots (cassava), legumes (cowpeas) and oilseeds/nuts (mainly coconut). In the period February-March, at the end of the dry season, the consumption of vegetables and legumes was low (see Table 3). The seasonal pattern for protein intake was not different from the pattern for energy intake, which can just be interpreted to mean that the overall composition of the diet did not change appreciably (see 4.1).

The peaks in household intake occurred in the pre-harvest months (May-June; November-December) and not in the post-harvest periods when food from own production is more plentiful. This finding was explained by the interplay of two factors: (i) the structure of the local food base (low own food production complemented by high food purchasing and by cassava as a buffer food in some areas) and (ii) seasonal variation in food requirements (Hoorweg, Foeken & Klaver 1995). As for the latter, activity patterns were not assessed directly in this study, so no estimates have been attempted of season-specific energy requirement figures (see section 3.3). Yet, there is indirect evidence of increased energy stress in the pre-harvest period. Body weight fluctuations of mothers (see section 5.2) indicate, that the energy balance was slightly negative in November-December 1985 and more so in May-June 1986 (minus 1 kg on average). These effects are moderate though and much less than

[10] The level of 60% of requirements does not even cover an activity level that would allow only mere survival (i.c. 1.2 times Basal Metabolic Rate – see Appendix 1).

one would have expected under the classical scenario for nutrition and seasonality in the international literature, which consists of a pre-harvest phase of strong 'tightening of the belt' followed by a post-harvest phase of 'feasting' (Chambers 1981; Rowland et al, 1981).

Admittedly, the daily energy derived from home production followed a strongly uni-modal pattern, much in line with the logic of the classical scenario for nutrition and seasonality in the international literature (see Hoorweg, Foeken & Klaver 1995): it was lowest (615 kcal) in the pre-harvest period (May-June) and highest (around 1050 kcal) in the (post-)harvest period from July onwards. The unimodal fluctuation was strongest in areas where consumption of subsistence energy was high and where cassava consumption was low. Cassava is a traditional crop mainly among the Mijikenda; it is less so among Taitas and other coastal tribes (Pokomos, Arabs). Thus, cassava (a crop that can be harvested throughout the year) acts as a stabilizer of the level of food intake in some areas.

However, the fact that the peaks in *total* household intake in the Coast were the exact reverse of this classical scenario was largely made possible by the high reliance on food purchases. The ratio of purchased over subsistence energy was always more than one (Table 4), showing that at all times the largest part of energy intake came from purchases, not from home-produced foods. On average throughout the year, purchased foods contributed 63 per cent of the energy intake (see Table 4). This agrees with the low degree of food self-sufficiency calculated from the production findings (see section 3.1). Maritim (1982) reported that expenses on maize in Coast Province in 1976-77 were higher than in all other provinces and this was confirmed by CBS (Kenya 1988). The high food purchases in the coastal region in turn depend on the combination of adequate incomes available at the right time and affordable prices on the markets and in the *duka's* (small dry good stores).

As no direct evidence was available on energy requirements (see above), it cannot be ruled out that other factors may have contributed to the peaks in household energy intake. They occurred at times of the year when money may have been most available in the households, due to an increased inflow (from cashew nuts, casual labour or remittances) while the outflow for non-food purposes was less (for instance, the payment of school fees occurs at another time of the year). In theory the possible influence of religious holidays (Ramadhan in May 1986 and Christmas in December) may be considered: increased food consumption may to some extent be inherent to those celebrations, and/or be the result of particular circumstances (for instance, to the extent that most men stay at home in the villages at that time, which may lead to higher expenditure on food than usual). At the time of the study there was no indication of such phenomena; the majority of the study population were non-moslem.

Thus, in the Coast of Kenya the availability of money appears to be quantitatively more important for ensuring household food security than their own food production: people were able to compensate largely for diminishing household stocks of food by purchasing food when they most needed it, not only compensating for the drop in home-produced energy of about 400 kcal/cu but also enabling the increase in total intake of about 300 kcal/cu during the rainy season (to meet increased requirements). The food purchases at this time consisted of cereals (mostly maize flour) but also of legumes and a mixed group that included animal products and nuts. Whether the food purchased reached all members of the household and whether the peak during the long rains was meant for the 'workers' in the household is something that cannot be answered from these household estimates. However, the findings in respect of weight gain of children during that period suggest that they also received their share (see section 5.1 below).

Other factors were explored for their possible effect on the level of household energy intake and its seasonal fluctuation (Niemeijer, Foeken and Klaver 1991; Hoorweg, Foeken & Klaver 1995). These factores were: agro-ecological zone, income and district. Agro-ecological zone as such did not explain much: in the agro-ecological zones with the least agricultural potential, energy intake levels were not lowest, neither were the seasonal fluctuations higher. Again this is at variance with the classical seasonality scenario (Chambers 1981), which incidentally applies to situations where food purchasing is low. This finding is however consistent with the dominant influence of income rather than home production in this area.

Income did affect energy intake. Households in the low-income class (less than 1,000 KSh per consumer unit per year) had the lowest energy intake, as expected, but not the highest seasonal variation, apparently because they succeeded in (or were forced to) spreading the consumption of their subsistence food more evenly throughout the year than the other two income groups. In combination with a lower total intake level they were able (or forced) to keep down their food purchases. Only during the May-June period did they show an upsurge in intake from purchased energy. The unimodal pattern of home produced cereal consumption discussed above was apparent for all three income groups. Food purchasing was paramount in all groups, even among the poorest (where it ranged between 1300 and almost 2000 kcal per cu per day, depending on the season). The bimodal pattern of total energy intake discussed above was strongest for the middle income groups (between 1,000 and 4,000 KSh per consumer unit per year); the richer group seemed to have its pre-harvest peak some months later, while the lowest income group did not show a peak in November-December. The contribution to peak intakes by cassava was seen in two of the three income groups (not the richest). In other words, among the richer households, who could afford food purchases throughout the year more easily, the secondary coping mechanism referred to above was not prevalent. What is more, they even had the lowest consumption of home-produced food in the May-June period.

There was a notable difference in average energy intake between Kwale and Kilifi district, the average energy intake in Kwale being about 250 kcal higher than in Kilifi. During the 'peak' in May-June, the difference even came up to over 400 kcal per consumer unit. These differences can be related to an important finding, i.e. a statistically significant negative relationship between household size on the one hand and energy intake per consumer unit on the other: in larger households the average food intake is lower than in smaller households (Figure 2). In the present survey, one consumer unit more means around 75 kcal less energy intake per consumer unit. In Kwale, the average household counts 4.6 consumer units (6.7 members), against 7.0 consumer units (11.1 members) in Kilifi. Thus, almost three quarters of the difference in average energy intake per consumer unit between the two districts may be attributed to the difference in average household size. Although income level had effects of a comparable order of magnitude *within* districts, it does not explain the intake differential *between* the two districts, as the income levels were comparable.

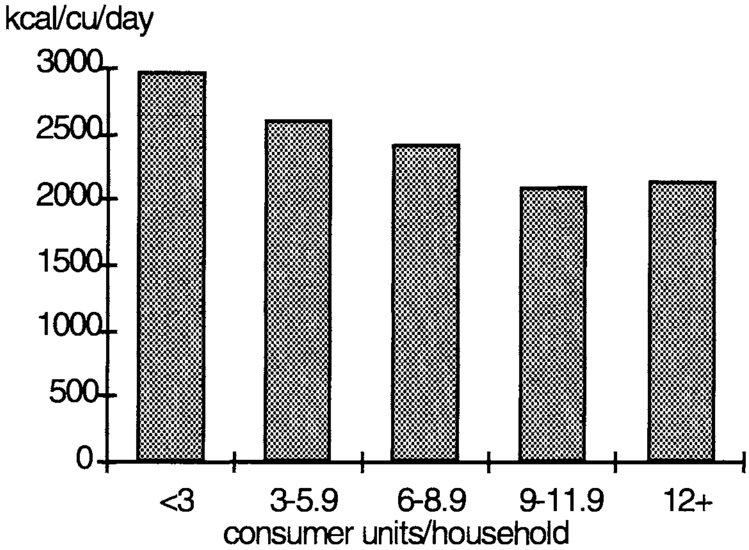

Figure 2
Average energy intake, by household size
(Source: Niemeijer, Foeken and Klaver 1991, page 35)

In summary, rural households in the Coast depend to a large extent on income generation which offers a coping mechanism to deal with seasonal energy stress. The monetary income allows them, firstly, to preserve a large part of their food stocks throughout the year (instead of selling it shortly after the harvest) and, secondly, to purchase more food during the cultivation season when home stocks are running low. This agrees with observations by others that coping mechanisms in rural Africa consist increasingly of monetarization (Garine & Harrison 1988). In the Coast Seasonality study, this coping mechanism was active in all agro-ecological zones and income classes. A secondary coping mechanism (but quantitatively less important) among part of the households was the increased consumption of cassava in the period of low cereal stocks.

5. Nutritional status

A measure further down the "food path", and taken from individuals, is nutritional status. The classical method relies on anthropometric measurements (such as body weight and height). They reflect the state of nutriture of the body of individuals, as a cumulative result of the balance between intake and requirements of energy, protein and (micro)nutrients. Population data on growth can come from two types of studies: (i) cross-sectional studies and (ii) longitudinal studies. The former can only give figures on attained growth at the moment of the survey; the latter give both attained growth and growth velocities (see Appendix 3).

Anthropometric information per se is non-specific and inadequate for identifying the cause of thinnes or growth failure (Golden 1995). Its usefulness lies in its close correlation with nutritional outcome and its socioeconomic determinants. Such information is usually (and the Coast is no exception) not available systematically for all age groups, but only for the vulnerable groups: young children (see section 5.1) and mothers (see section 5.2). Yet, because of their very vulnerability, this information is quite indicative of the general situation.

Representative information on child nutrition is available from the five national nutrition surveys done by CBS (since 1977)[11], and from the FNSP Coast Seasonality study[12]. While the former give cross-sectional results of attained growth, the latter study in addition reports growth velocities throughout the seasons[13].

In the last decade or so, there is renewed interest in specific micronutrient deficiencies. Recent knowledge in international nutrition has shown that the roles of the micronutrients in growth, development and immunity are more fundamental than was formerly believed and that even mild deficiency has adverse consequences. The results of the recent Micronutrients Survey are discussed in section 5.3.

For the Mijikenda, malnutrition is not new. Local concepts of malnutrition refer to the severe forms, which are most visible, but which in actuality only constite the 'tip of the iceberg'. The local concept of *kirwa (chirwa* among the Digo*)*, also known as *kanyanzo* corresponds to the medical term 'marasmus' (emaciation). The local term *mwazulu* corresponds more or less to the medical term 'kwashiorkor' (characterized by the presence of oedema). Sometimes there is confusion in the terms; health personnel tend to use *kirwa* for any form of severe malnutrition (marasmus and kwashiorkor). With the local term goes a local understanding about what causes it. *Kirwa* is seen not as a disease, but as a condition of the child, that is caused by adultery of one of the parents, or sometimes by the evil eye. Since the cause is in the spiritual domain, it needs cleansing by a traditional healer. *Mwazulu* however is a disease, that can occur both among children and adults. If a child has *mwazulu*, it was born with it. It is a disease in the parents, notably if the parents are greedy and/or donot like sharing with other people, especially relatives. Under the influence of nutrition education, the term *kashiako* has been introduced besides *mwazulu*, and also the the notion that malnutrition is caused by poor feeding (Mwadime 1995).

Nyongoo (problems of pregnancy, among which anaemia is included) are well known by traditional healers and traditional treatment is available.

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[11] (= note 2). These surveys are denoted in the text by the abbreviation CNS followed by their number.

[12] See note 1 above.

[13] Growth data are also routinely collected by the Ministry of Health (CHANIS[13]) and the Ministry of Education. These can be very valuable for surveillance purposes, but caution is needed for their interpretation due to possible sampling biases and shifting group composition. Such data are not incorporated in this paper.

5.1 Child anthropometry.

National (rural) surveys of child nutrition have been carried out by the Kenyan Central Bureau of Statistics in 1977, 1978/9, 1982, 1987 and 1994 (Kenya 1977, 1979 & 1980, 1983, 1991, 1996), a longer time series than in any other African country (ACC/SCN 1993). Seasonality varies greatly across the country and to some extent from year to year, so that stunting (retarded height growth: a measure of attained linear growth over a longer time period) is generally considered to be a better indicator than underweight to make comparisons over time. Trend analysis is somewhat hampered by changing sampling criteria (broadening of the age group from 12-47 months in CNS-1 to 6-59 months in later surveys), and the change in the early 1980s to another mode of expression of the results, i.e. from percentages of the median to standard deviation scores - the 1978/9 results of CNS-2 have been recalculated in a later report (Kenya 1991), but not those of CNS-1.
Child nutrition in Kenya as a whole showed an improvement in the mid-1980s (see Table 6 and Figure 3), despite a severe drought in 1983/4. In part this may be explained by relatively favourable prices for export crops (tea, coffee) and good harvests in the mid-1980s (ACC/SCN 1993). The most recent national survey of 1994 (MPND 1996) indicates static or

Table 6 Kenya: Trends in prevalence of stunted children, 1977-1994

			1977	1978/9	1982	1987/8	1994
Kenya - rural	[1] children 12-47m	below 90% H/A	24.0%	26.7%	28.0%	23.0%	-
Kenya - rural	[1] children 6-59 m	[2] below -2 SD H/A	-	37.0%	37.1%	32.2%	34.0%
Kenya - urban	children 6-59 m	[2] below -2 SD H/A	-	26.4%	-	-	32.1%

Notes: [1] Excluding northern ASAL region, except in the 1994 survey
[2] Slightly different age group below -2SD in 1982 (children 3-59m) and 1994 (children 0-59m).
References: Kenya 1977, 1979 & 1980, 1983, 1991, 1996.

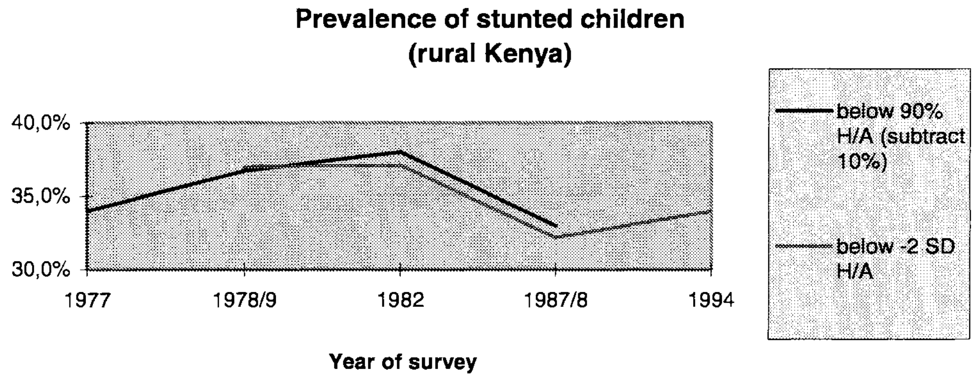


Figure 3 Prevalence of stunted children (rural Kenya) - 5 national surveys

Note: Figure adapted from ACC/SCN 1994. The old <90% figures are empirically about 10% lower than the new <-2SD prevalence figures, which use a higher 'cut-off point'. Therefore, to facilitate viewing trends in these plots, the <90% values are plotted 10% higher on the <-2SD scale. See Table 6 for the exact percentages.

worsening nutritional conditions amongst Kenyan children compared to the 1987/8 national rural survey: stunting among underfives went up from 32% in the late 1980s to 34% in 1994 (see Table 6 and Figure 3). Similarly, the prevalences of wasting and underweight (weight-for-height and weight-for-age below -2 standard deviations), went up from 5% and 18% in 1987/8, to almost 8% and 22%, respectively, in 1994. These new rates were very closely confirmed by a Demographic and Health Survey carried out in 1993 (NCPD/Kenya/MI 1994), and they were even exceeded by the results of the Micronutrients Survey held in 1994, which gave results similar to the early 1980s (see Table 9.A). The new rates can be seen as an indication of reverses in the gains in nutrition that were reported in the previous decade (ACC/SCN 1994). In absolute numbers the stunting problem affected 1.7 million Kenyan preschool children by 1994, compared to 1.3 million in 1987.

The situation in Coast Province has consistently been among the worst in Kenya, with 10-17% more stunting than for Kenya as a whole (cf Table 7 *versus* Table 6 and fig. 4 *vs* fig. 3).

Table 7 Coastal Region: Trends in prevalence of stunted children, 1977-1994

			1977	1978/9	1982	1987/8	1994
Coast - rural	children 12-47m	below 90% H/A	[14%][1]	40.0%	39.0%	40.0%	-
Coast - rural	children 6-59 m	[2]below -2 SD H/A	-	46.3%	49.6%	50.0%	38.3%
Coast - urban	children 6-59 m	[2]below -2 SD H/A	-	28.8%	-	-	36.9%

Notes: [1] The 1977 result for the Coast is considered doubtful due to small sample size and general problem of accuracy (see Kenya 1980).
[2] Slightly different age group below -2SD in 1982 (children 3-59m)
References: Kenya 1977, 1979 & 1980, 1983, 1991, 1996.

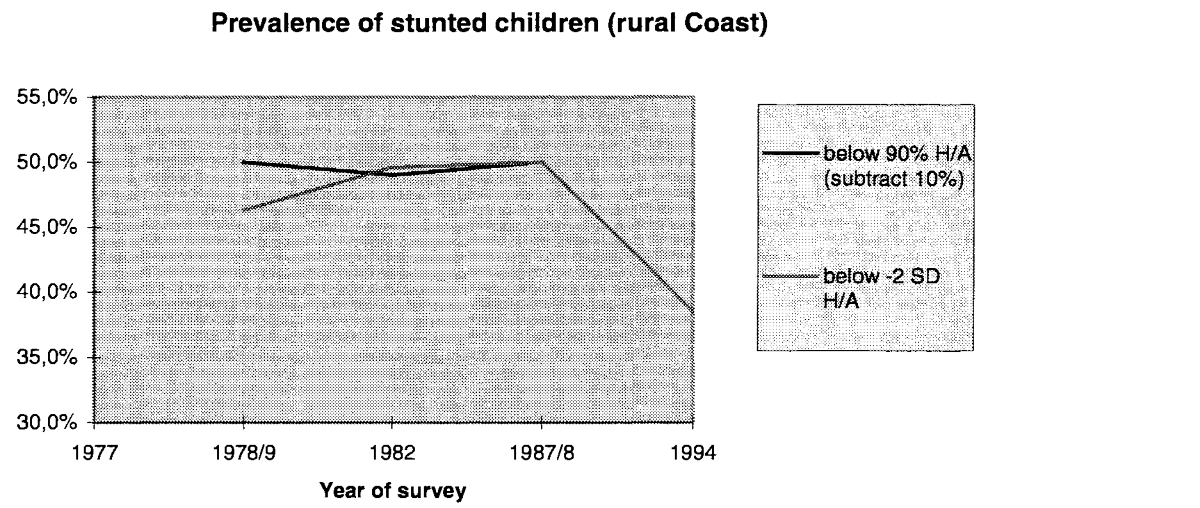


Figure 4 Prevalence of stunted children (Coastal Region - rural) - 5 national surveys

Note: Figure adapted from ACC/SCN 1994. The old <90% figures are empirically about 10% lower than the new <-2SD prevalence figures, which use a higher 'cut-off point'. Therefore, to facilitate viewing trends in these plots, the <90% values are plotted 10% higher on the <-2SD scale. See Table 6 for the exact percentages.

In a regional comparison, it was concluded that the factors which probably contribute to these very high malnutrition figures include poor land productivity in addition to a high rate of sickness (Test et al. 1984). This crude classification of causes deserves further specification and expansion (cf Mwadime 1995). Poor agricultural productivity is not only because of poor soil quality, but also because vast tracts of land are tied-up in cashewnuts or coconut plantations. Additional household income thus becomes a main determinant of food security in such a situation. Non-farm employment among women in a community with good access to such opportunities (i.c. Mwsambweni, Kwale District) was found to have a positive effect on nutritional status of their children under five years of age, through increased food purchases (Mwadime et al 1996a). Unfortunately, many people have inadequate sources of earning outside agriculture and have to depend on meagre remittances from kin members working elsewhere.

Even if the climate may favour the incidence of infectious diseases, part of the morbidity load can be prevented. For example, the high incidence of diarrhoea is attributed to poor sanitation conditions in the community, as few households own a toilet, and to poor water quality. Other care-related causes are low dietary quality and variety, lack of time for child care[14], social/family problems, traditional health-seeking behaviour and lack of community support for women. Peters & Niemeijer (1987) have pointed at the relation between poor maternal caring behaviour and malnutrition in Coast Province. It has further been observed (Mwadime 1995) that many of the severely malnourished children come from homes where there are strong social problems and from 'broken homes'. Because of strong cultural and spiritual beliefs, most parents with a severely malnourished child go to a traditional healer (*mganga*) first and seek modern medical care only when the condition worsens. Men and community leaders tend to relegate nutrition to the "women's domain", so much so that the woman is the one blamed for a child's poor nutritional condition (Mwadime 1995).

The low level of education makes preventive action and behavioral change in the areas of health and nutrition more difficult. In this respect, average education of household members may be more strongly related to good quality child care and house living conditions than maternal education only, as was illustrated by the recent village study in coastal Kwale (Mwadime et al 1996c).

During the mid-1980s the Coast did not show (see fig. 4) the improvement of underfives' nutritional status that was found for Kenya as a whole (see fig. 3); much of that improvement occurred in the more central areas of the country (ACC/SCN 1993). However, the last survey in 1994 showed a sizeable decrease in the coastal stunting rate by more than ten percentage points. These results conform to those of a Demographic and Health Survey carried out in 1993 (NCPD/Kenya/MI 1994). Curiously, the pattern for the Coast as it looks now mimics the overall pattern of stunting for Kenya, albeit at a higher level and roughly 5 years later. The most recent level of stunting in the Coast was still above Kenyan average; future surveys will have to tell whether the rate will continue to drop, although - if the national trend would 'trickle down' to the Coast - it may be expected to rise again.

As stated above, stunting is generally held to be a better indicator than underweight to make comparisons over time, because it is less influenced by seasonality than body weight. The results of the FNSP Coast Seasonality Study (1985/6) provide in-depth information that allow us to see the clear seasonality in the pattern of stunting and thus to put the results of the national nutrition surveys in perspective. While the FNSP results confirm the general level of

[14] A study elsewhere in Kenya reported a strong negative correlation between time spent on child care on food production, indicating that these activities may be in direct competition (Paolisso, Baksh and Thomas 1990).

stunting in the 1980s, they also warn us that cross-sectional figures produced by periodic surveys are not immune to seasonal influences and to year-to-year variations. In Table 8.a and

Table 8.a Prevalence of stunting **[classical expression]** among children by age groups (1985/6 and 1987/8): percentage of children with a height for age **below 90%** of the NCHS reference median

		FNSP study on seasonality in the coastal lowlands, 1985/86						CNS-4 Coastal prov.	
	N	Jul-Aug '85	Nov-Dec'85	Feb-Mar'86	May-Jun'86	Sep-Oct'86	Average	N	Nov'87-Jan'88
Age group (m)									
6-11	46	14.0	15.2	24.0	24.0	28.3	20		19
12-23	81	31.3	40.5	48.7	48.7	53.9	42.5		38
6-23	**127**	**25.4**	**31.5**	**30.9**	**39.2**	**45.2**	**34.4**		**[32]**
24-35	93	39.6	37.7	33.0	34.8	44.8	38.0		43
36-47	92	42.2	40.4	34.8	29.5	40.0	37.4		39
48-59	78	34.5	33.3	34.8	31.6	38.7	34.6		30
24-59	**263**	**39.3**	**37.2**	**34.2**	**31.8**	**40.9**	**36.6**		**[37]**
12-47	266	38.0	39.5	38.4	37.2	45.9	39.2		[40]
6-59	390	34.6	35.4	33.2	34.1	42.5	35.9	6909	33.6
60-119	**386**	**40.5**	**37.7**	**33.8**	**34.1**	**31.4**	**35.5**		**---**

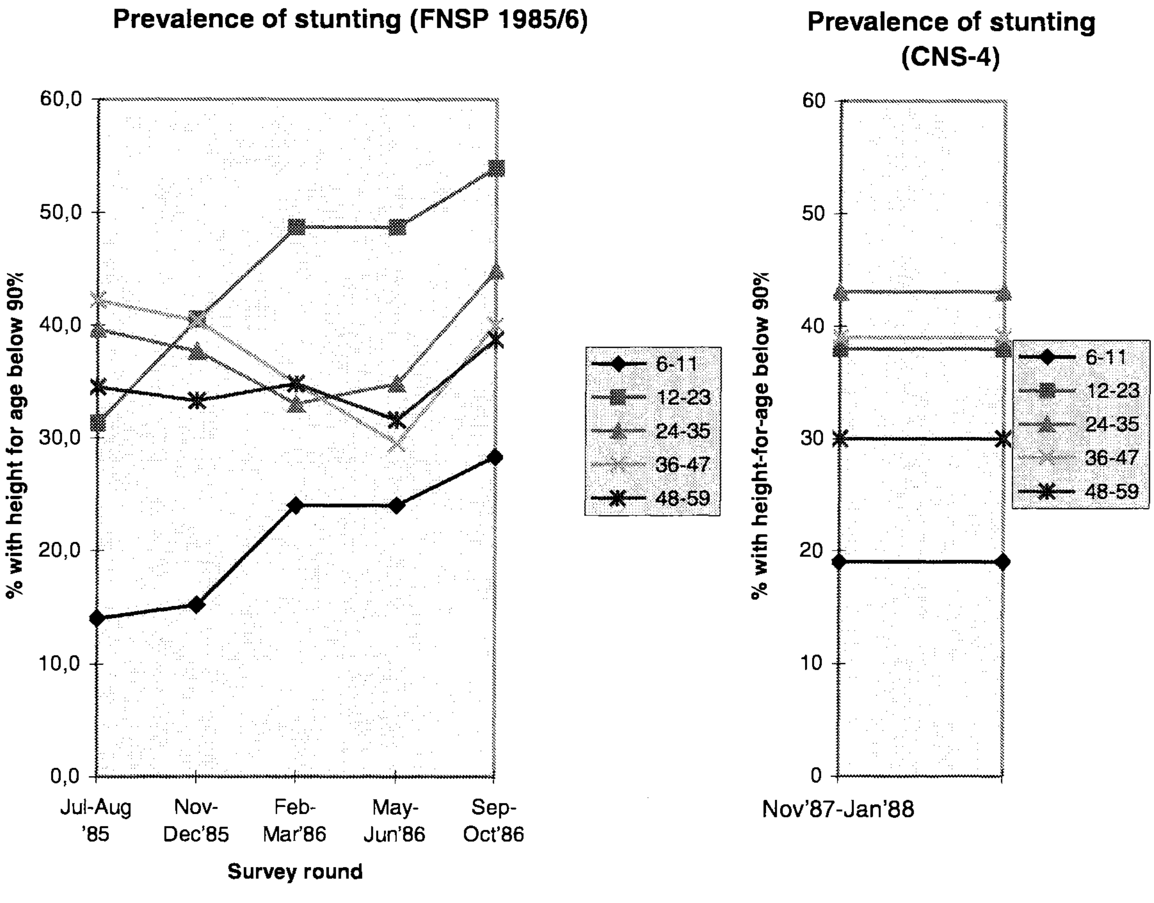


Figure 5 Prevalence of stunting among children by age groups:
FNSP Coast Seasonality study (1985/6) compared to CNS-4 (1987/8) coastal data.

Figure 5 a comparison is made with the results of the most nearby national rural child nutrition survey, i.c. CNS-4, held from November 1987 to January 1988 (CBS 1991), which gave a breakdown by age according to the classical mode of expression only (percentage of children below 90% of the median of the reference population). The profile of stunting rates by age group in CNS-4 corresponds remarkably well with the results of the FNSP Seasonality Study for the same time of the year (i.c. Nov/Dec), although the latter study was held two years earlier. The overall rate of stunting among underfives (6-59 months of age) between July 1985 and June 1986 (i.e. survey rounds 1 to 4) was found to be around 34%, the same figure as CNS-4. However, in September-October 1986 (survey round 5) the underfives showed a marked increase in stunting by 5-10% in all age groups; one may thus speculate that the end-of-the-year stunting rate may have been higher in 1986 than in both the previous and the following year. Incidentally, the apparently stable overall prevalence during FNSP survey rounds 1-4 concealed considerable internal dynamics: stunting rates among children below 2 years increased by almost 15 percentage points between the first and third survey round, while stunting rates among children of 2-3 years old fell by 7 percentage points during that same period.

To come back to the general drop in stunting rates experienced by the Coast in the early 1990s (Table 7 and fig. 4), its order of magnitude is much greater than the year-to-year variations suggested by the FNSP study. Thus, it most likely reflects a true improvement. Interestingly, in a rapid survey in 1995 in communities within a 20 km radius around the Family Life Training Centres (FLTC) of Kwale and Kilifi, respondents in focus group discussions ventured that the cases of severe malnutrition seen in the villages were fewer than a decade ago. This may reflect a general improvement rather than the effect of the FLTCs themselves, considering their limited geographical outreach (roadside bias), limited population coverage (less than 1 out of 5 malnourished children) and the proven low effectiveness of these services in preventing recurrence of malnutrition in the same child or in other siblings (Mwadime 1995; Peters and Niemeijer 1987). The nutritional gains in Kenya as a whole during the 1980s were attributed to (1) a strong political commitment towards the education of both men and women, and (2) stability of food prices relative to other consumer goods (ACC/SCN 1993).

Table 8.b Prevalence of stunting **[modern expression]** among children by age groups (FNSP, 1985-1986): % of children with a height for age **below -2 sd** of the NCHS reference

		FNSP study on seasonality in the coastal lowlands, 1985/86					
	N	Jul-Aug '85	Nov-Dec'85	Feb-Mar'86	May-Jun'86	Sep-Oct'86	Average
Age group (m)							
6-23	**127**	**50.8**	**56.7**	**60.0**	**57.9**	**71.1**	**59.3**
24-59	**263**	**55.1**	**51.4**	**47.7**	**49.5**	**54.3**	**51.6**
60-119	**386**	**50**	**48.2**	**44.5**	**42.9**	**42.1**	**45.6**

Table 8b gives some results for the FNSP study in terms of the **new** mode of expression (standard deviation scores). These results show more clearly than those according to the classical expression (Table 8a), that the stunting rate in 1985/6 was maximal among the 1-year olds and thereafter decreased with age. Assuming no special cohort effects, this points to a certain degree of catch-up from chronic malnutrition as the child grows older. In turn, this leads one to think that food accessibility *per se* may not be the major factor in determining nutritional conditions among the children, but rather the complex of low energy and nutrient

Table 9 Summary of anthropometrical results of child nutrition surveys
(**A.** Rural Kenya; **B.** Kenya Coast; **C.** FNSP Coast by age groups)

year of survey	Survey[1)]	area	months	reference	age group (months)	nr. of children	average H-A (z)	prevalence of stunting (%<-2)	average W-H (z)	prevalence of was-ting (%<-2)	average W-A (z)	prevalence under weig (%<-
		A. Kenya rural smallholders (national, excl. ASAL and nomadic areas)										
1978/9	CNS-2	Kenya	Nov-Jan	Kenya 1980	6-60	2659		37.0		5.0		
1982	CNS-3	Kenya	Jul-Sep	Kenya 1983	3-59	5323		37.1		4.5		
1987/8	CNS-4	Kenya	Nov-Jan	Kenya 1991	6-59	6909	-1.40	32.2	-0.04	4.5		
1993	DHS	Kenya	Feb-Aug	NCPD 1994	6-59	4752		33.7		5.9		2[illegible]
1994	NMS	Kenya	Feb-Jul	UNICEF/Kenya	6-72	6421		37.2		6.0		2[illegible]
1994	CNS-5	Kenya		Kenya 1996	6-59	8942		34.0		7.8		2[illegible]
		B. Kenya **Coast** (excl. Lamu District) and FNSP Seasonality study										
1978/9	CNS-2	Coast/rural[2)]	Nov-Jan	Kenya 1980	6-59	252	-1.59	46.3	-0.18	9.4		
1978/9	*CNS-2*	*Coast/urban*	*Nov-Jan*	*Kenya 1980*	*6-59*	*222*	*-1.17*	*28.8*	*-0.25*	*9.4*		
1982	CNS-3	Coast/rural[3)]	Jul-Sep	Kenya 1983	3-59	419	-1.88	49.6	-0.18	7.0		
1982	CNS-3	Kwale/Kilifi/ rural	Jul-Sep	Kenya 1983	3-59	348	-2.05	53.7	-0.11	7.1		
1985/6**	FNSP	Kwale/Kilifi/ rural	'85-86	[4)]	6-59	390	-2.12	54.1	-0.80	9.3	-1.91	47
1987/8	CNS-4	Coast/rural[2)]	Nov-Jan	Kenya 1991	6-59	782	[-2.08][5)]	[50]	[-0.09]	[5.1]		
1987/8	CNS-4	Kwale/Kilifi/ rural	Nov-Jan	Kenya 1991	6-59	576	[-2.18][5)]	[53.3]	[-0.10]	[5.3]		
1987/8	CNS-4	Kwale/rural	Nov-Jan	Kenya 1991	6-59	205	-2.50	56.1	+0.11	6.7		
1987/8	CNS-4	Kilifi/rural	Nov-Jan	Kenya 1991	6-59	371	-2.00	51.7	-0.21	4.5		
1987/8	CNS-4	Taita-Taveta /rural	Nov-Jan	Kenya 1991	6-59	206	-1.80	41.2	-0.09	4.6		
1993	DHS	Coast/rural	Feb-Aug	NCPD 1994	0-59	n.a.		41.3		10.6		31
1994	NMS	Kwale District	Feb-Jul	UNICEF/Kenya	6-72	258		50.5		3.7		30
1994	NMS	Mombasa	Feb-Jul	UNICEF/Kenya	6-72	189		43.4		5.6		28
1994	CNS-5	Coast/rural[3)]	n.a.	Kenya 1996	6-59	484		38.5		7.0		26
1994	*CNS-5*	*Coast/urban (Mombasa)*	*n.a.*	*Kenya 1996*	*6-59*	*84*		*36.9*		*9.6*		*27.*
		C. FNSP Seasonality study (1985/6), different **age groups**										
1985/6**	FNSP	Kwale/Kilifi*	'85-86	[4)]	6-23	127	-2.24	59.3	-0.89	12.8	-2.11	55.
1985/6**	FNSP	Kwale/Kilifi*	'85-86	[4)]	24-59	263	-2.06	51.6	-0.75	7.6	-1.82	43.
1985/6**	FNSP	Kwale/Kilifi*	'85-86	[4)]	60-119	386	-1.88	45.6	-0.94	8.5	-1.82	43.

Notes: 1) CNS = Child Nutrition Survey; FNSP = Food and Nutrition Studies Programme; DHS = Demographic and Health Survet; NMS = National Micronutrients Survey
2) Excluding Lamu District
3) Kwale, Kilifi/Tana River/Lamu and Taita Taveta Districts
4) CL3, CL4, and CL5 zones; average of 5 survey rounds (calculated from the original data of the Coast Seasonality study

Legend: n.a. = not available; [ ] denote authors' aggregation of figures from the CNS report density of the foods fed to infants, feeding patterns (such as low feeding frequency), recurrent infections and inadequate care, factors to which children below 2 years are the most susceptible (Mwadime 1995). Stunting is already quite prevalent among the infants 6-11 months old; it may even have started before birth (Niemeijer & Klaver 1990). Therefore, the influence of maternal malnutrition cannot be ruled out (both seasonal and chronic, even over several generations) - see section 5.2.

Comparing the nutritional survey findings over the years is not an easy task: the time series of results are incomplete, because of changes in the age group sampled and in the mode of expression of the results. Table 9 compiles the overall anthropometrical results of the national surveys from 1978/9 to the present and of the FNSP study of 1985/6 (in terms of standard deviation scores). For a compilation in terms of the classical percentage system, the reader is referred to earlier publications (Niemeijer, Foeken and Klaver 1991; Hoorweg, Foeken and Klaver 1995).

The surveys reveal that the reversal of trends in nutritional status in Kenya as a whole, observed since the mid 1980s (Table 6 and Figure 3) is also apparent in the stunting rates in the Coast (Table 7 and Figure 4), but only since the early 1990s. The higher rates of stunting (retarded height growth) in the Coast go along with higher rates of wasting (thinness), except in the last survey (CNS-5). As expected (see above), the wasting rates show stronger fluctuations between the years than the stunting rates do. In this respect, the years of the FNSP study (July 1985 to October 1986) were perhaps a comparatively bad time, just like the period of February-August 1993 when the DHS survey was held.

The FNSP data suggest a higher level of stunting (and, consequently, underweight) in 1985/6 in Kilifi District than in Kwale District. However, CNS-4 (1987/8) did not confirm this district differential: it found the reverse: 56% stunting in Kwale against 52% in Kilifi. A local survey in 1995 in communities within a 20 km radius around the Family Life Training Centres of Kwale and Kilifi found quite similar prevalences of stunting of 46 and 47% (Mwadime 1995). The National Micronutrients Survey of 1994 (UNICEF/Kenya, n.d.) did not cover all districts of the Coast; the stunting rate in Kwale remained high (50.5%, the highest in the sample of 14 districts); in Mombasa it was lower (43%), but still among the 6 highest (see Table 9.B). The various surveys do not point to significant sex differentials in the nutritional status indices in the Coast[15].

[15] Caveat: the sex differential that the first national nutrition survey of 1977 did suggest at first (CNS-1; ref Kenya 1979), disappeared when sex-specific anthropometric references were applied.

The seasonal dynamics in child growth can be expressed in two ways, as attained growth at any moment (such as in Tables 6-9 and Figures 3-5) and as growth velocities (based on differences from round to round – see Appendix 3). Growth velocities reflect more directly the underlying dynamics (i.e. accelerations or decelerations) in growth. Table 10 gives the velocities of length growth observed in the FNSP seasonality study, by broad age group and for each of the periods between two successive survey rounds. Table11 gives the velocities in weight growth for the same groups and intervals between survey rounds. Figures 6.A-C have been calculated from these Tables and summarize the growth results for each of the 3 broad age groups (babies, toddlers and school age children). The seasonal patterns in attained growth are given as prevalence rates below 2 standard deviations of the international (cross-sectional) WHO/NCHS reference (WHO, 1983). The growth velocities are depicted as deficits/excesses in weight and height growth velocities compared to a reference "horizon" based on international (longitudinal) reference data (Baumgartner, Roche and Himes 1986).

From Table 9.C it could already be noted that for a similar average value, babies had a higher prevalence of wasting than toddlers and school age children: only in November-December 1985 was the wasting rate for the babies below the 10% mark (see Figure 6.A). For toddlers and beyond, the wasting rate was only above 10% in February-March 1986 (see Figure 6.A). The sustained high level of wasting among the babies is a result of the greater 'spread' of their frequency distribution and this in turn can be ascribed to the greater vulnerability of the babies to the stresses of life. After a relatively safe period before 6 months, they become more susceptible to various illnesses as soon as they enter the weaning age. This means an extra demand for care (time and appropriate health-promoting behaviour) from their parents/caretakers.

Table 10
Linear growth velocity among children
(average height growth in cm per month)

		FNSP study on seasonality in the Coastal lowlands 1985/86						
Between... and...	*(N)*	*Year-round average (+ average s.d.*)*	*Jul/Aug'85 Nov/Dec'85*	*Nov/Dec'85 Nov/Dec'85*	*Nov/Dec'85 May/Jun'86*	*May/Jun'86 Sep/Oct'86*	*max diff [+% of av.]*	*NCHS Reference***
Age group (months)								
6-23	(112)	.69 (.50)	64	.78	.72	.62	.16 (23%)	1.20
24-59	(247)	.62 (.36)	.57	.80	.56	.53	.27 [44%]	.65
60-119	(354)	.50 (.32)	.45	.63	.43	.48	.20 [40%]	.50

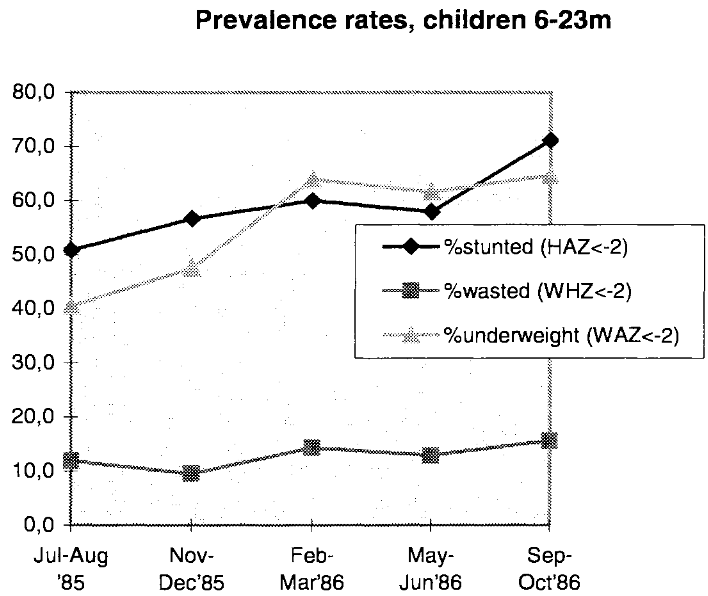
Source: Niemeijer et al., 1991: Appendix 37
Notes: * Within each age group, standard deviations do not show much seasonal deviation from the year-round average s.d. val Therefore, only the average figure is presented in the table (between brackets).
** Incremental growth tables (Baumgartner, Roche and Himes 1986).

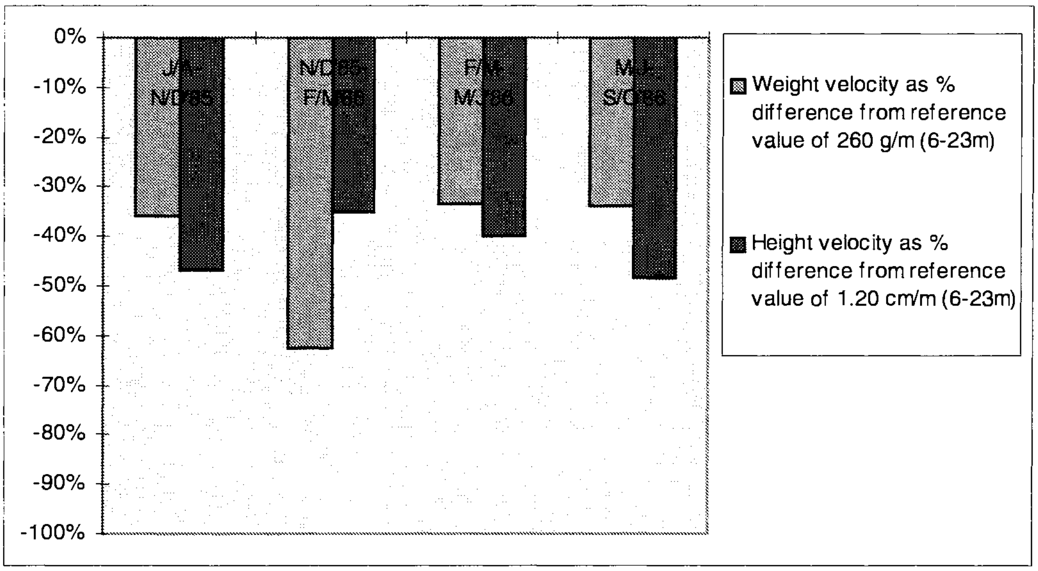
Table 11
Weight growth velocity among children
(average weight growth in g per month)

		FNSP study on seasonality in the Coastal lowlands 1985/86						
Between... and...	*(N)*	*Year-round average (+ average s.d *)*	*Jul/Aug'85 Nov/Dec'85*	*Nov/Dec'85 Feb/Mar'86*	*Feb/Mar'86 May/Jun'86*	*May/Jun'86 Sep/Oct'86*	*max diff [+ % of av.]*	*NCHS Reference***
Age group (months)								
6-23	(111)	153 (201)	167	98	173	172	75 [49%]	260
24-59	(243)	134 (205)	124	64	202	144	137 [102%]	160
60-119	(347)	156 (249)	102	101	241	181	140 [90%]	225

Source: Niemeijer et al., 1991: Appendix 36
Notes: * Within each age group, standard deviations show some seasonal deviation from the year-round value (up to 25%).
** Incremental growth tables (Baumgartner, Roche and Himes 1986).

Figure 6.A Seasonal patterns in the prevalence rates of stunting, wasting and underweight (upper graph) and in growth velocity deviations below reference values (lower graph) - Babies (6 months -2 years)





Source: Appendix 3 (upper graph); Tables 10 and 11 (lower graph).

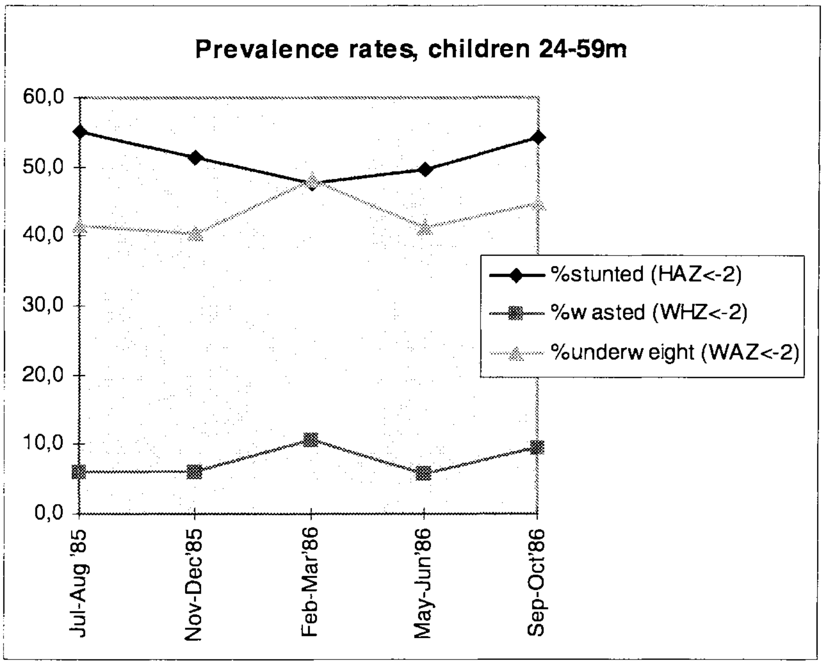
The babies also exhibited a high and rising trend of stunting (more than 20 percentage points over the whole 15-months study period - cf Fig. 5). Incidentally, this trend is not the same as the usual age-related increase in stunting between 6 and 23 months, because the seasonality study is not based on one cohort, but on a rolling sample ("semi-longitudinal" design: new children entering the study who had reached entrance age (i.e. 6 months), and old children being no longer considered beyond exit age (i.e. their 10^{th} birthday).
The high and rising trend of stunting among the babies was brought about by strongly depressed growth velocities (less than two-thirds of what they should have been according to the reference - see Fig. 6.A. Contrary to what was happening with the children of 2 years and

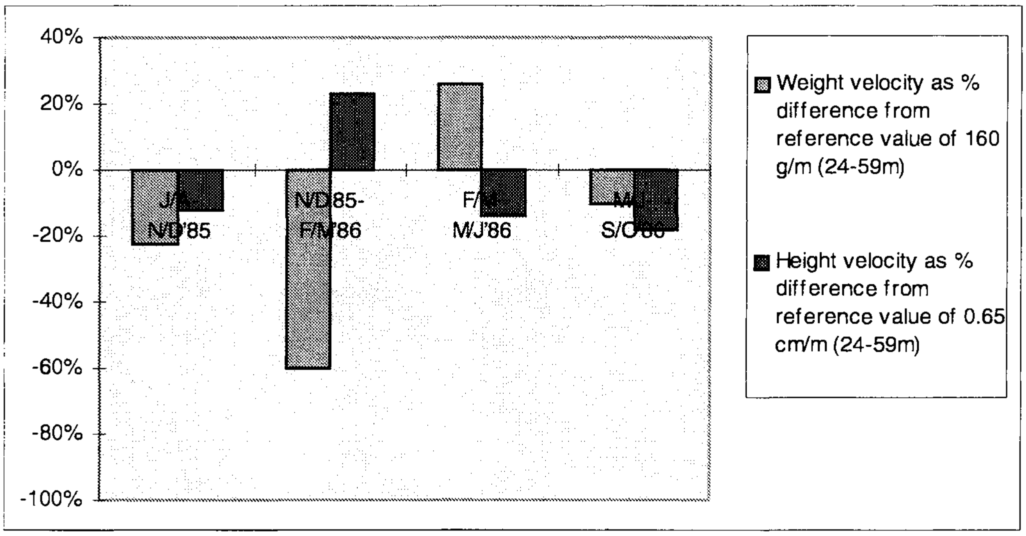
above, the growth velocities of the babies never improved so much as to reverse the downward trend; in other words, no catch-up growth occurred. Apparently, among the babies other determinant(s) of body growth were more dominant than seasonality. A likely candidate is illness, which is known to affect younger children more frequently and with more severe possible consequences. The FNSP study provides some evidence for a higher frequency of illness among the 0-1 year olds: 57% of them were reported ill for 3 days or more during the past 14 days, against 41 and 28% for the 2-4 and 5-9 year olds, respectively. There was not much seasonal variation in *reported* illness prevalence, by the way.

The toddlers (2-4 years old) showed no particular trend over the years, but there was considerable seasonal variation in all anthropometrical parameters. A surprising finding was, that the seasonal pattern showed a striking differential in the timing of height and weight growth: between December 1985 and February 1986 (the dry season), height growth was at its maximum and weight growth at its minimum (even less than half the reference value). In the ensuing period of March-May 1986 (the pre-harvest season of the long rains) it was the reverse. In both cases, the respective peak growth periods were the only time that that particular velocity was above the reference value, thus allowing some degree of catch-up growth. In the prevalence graphs this complementary relationship between height and weight growth is evident as well: the seasonal pattern in stunting is more or less the reverse of the seasonal pattern in wasting. A likely explanation is that when height (i.e. skeleton) growth occurs, it is 'subsidized' by body mass to the extent of temporarily accentuating the children's 'leanness'. This period of seasonal growth spurt was preceded and followed by a period during which length grows slowed down while body mass (reserve of energy and materials) was restored. Thus, a seasonal cycling in body growth was seen, with length growth spurts going hand in hand with some degree of (transitory) wasting. This same phenomenon can also be seen in the younger and older age groups. Comparing the velocity patterns it would seem that the school age children are slightly ahead of the preschool children in their seasonal height-weight cycling. The combined result in terms of weight-for-age followed the seasonal weight-for-height pattern, although it also picked up any longer term trend in height growth.
All this would mean that at least part of the wasting (and underweight) at the transition from the dry to the wet season (in February-March) does not have to be valued negatively, as it can be seen as a corrolary of the preceding length spurt. Whatever the exact mechanism behind the timing of the seasonal growth cycle, it fits in with the cyclein household energy intake, which was also found to be maximal in the pre-harvest period (see section 4). It is plausible that the children profited from this as well. Whether the height spurt in the dry season was (i) a late 'consequence' of weight (i.e. energy and nutrient) accumulation in the preceding wet season, (ii) the result of autonomous (e.g. hormonal) processes, or (iii) the result of more favourable growth conditions during the dry season, cannot be ascertained (see Hoorweg, Foeken and Klaver 1995). As mentioned above, the reported illness data were not specific enough (Niemeijer, Foeken and Klaver 1991).

While there was an increasing trend of stunting among the babies (see above), there was a decreasing trend of stunting (down by 8 percentage points) among the school age children. This points to catch-up growth from year to year in the latter group. Their residual seasonal variation in stunting around this trend was very low (± 1 percentage point) compared to the seasonal variation in stunting among the preschoolers (± 4 percentage points).

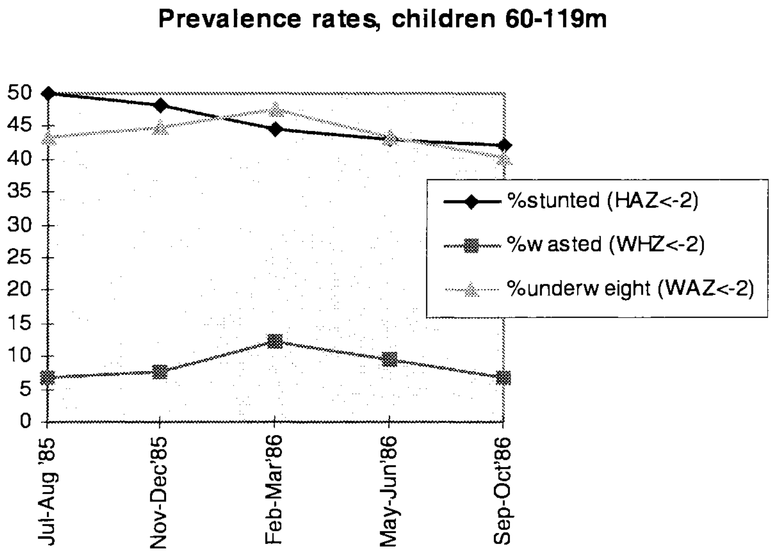
Figure 6.B Seasonal patterns in the prevalence rates of stunting, wasting and underweight (upper graph) and in growth velocity deviations from reference values (lower graph) - Toddlers (children 2-5 years)

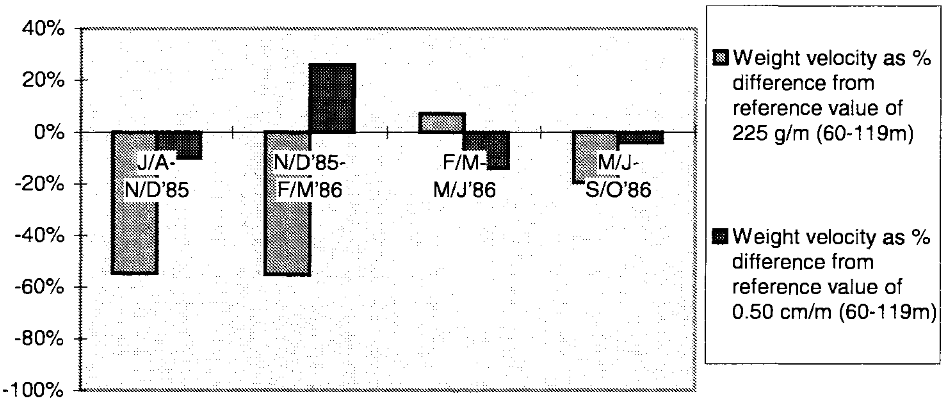




Source: Appendix 3 (upper graph); Tables 10 and 11 (lower graph).

Figure 6.C Seasonal patterns in the prevalence rates of stunting, wasting and underweight (upper graph) and in growth velocity deviations from reference values (lower graph) - School age children (5-10 years)





Source: Appendix 3 (upper graph); Tables 10 and 11 (lower graph).

To conclude, the babies were prone to a high level of wasting and an extra growth depressing effect in 1985/6 (cf the comparison with the CNS above). This is consistent with the generally known period of increased vulnerability during the weaning age. The children above 2 years seemed to have escaped from such chronic stress, but remained prone to a fair amount of seasonal variation. This seasonal variation has to a large extent the character of cycling in weight versus height spurts, the weight spurt being in the period of peak household energy consumption. Children above 5 years seemed to have escaped from the seasonal variation in stunting, and were in a trend of gradual catch-up growth in height; their seasonal variation in wasting remained considerable. Weight-for-age, which is the combined result of height-for-age and weight-for-height, captured any trends as well as the seasonal fluctuations in body weight.

The FNSP Coast Seasonality study found no differences in average growth rates between children from different income classes, despite differences in household energy intake (see section 4). The pattern of growth was also quite similar: in all income classes the largest height growth occurred during the dry season, between December and February, while during the rest of the year height growth remained substantially lower. During the long rains, in the period of March-May, average weight growth accelerated and in the two higher income groups (Ksh 2,000 or more per consumer unit per year) this continued during the June-September period. The relationship between income and seasonal *variation* was more pronounced. In the relatively prosperous households, the group of children grew quite evenly throughout the year (seasonal variation in average weight growth less than half that of the others). On the other hand, in the group of very poor households, both average weight growth and average height growth were uneven indeed; such children are usually considered to be more at risk of malnutrition. It has to be noted though, that at the end of the study overall attained growth (height-for-age) among the poorest children was comparable to the other income groups, thanks to a particularly high peak in height growth velocity during the dry season.

As yet, there is insufficient understanding of the mechanisms of growth. It is speculated that irregularity in growth can to some degree be a natural phenomenon of adaptation to fluctuations in external factors such as seasonal illness, food intake or possibly sunlight. The question of when the variation becomes harmful and what are the risks involved (malnutrition, delayed maturation, morbidity, mortality, etc.) is not resolved. There is more consensus on the negative effects of a substandard *level* (as against increased *variation*) of attained growth (Hoorweg, Foeken and Klaver 1995).

The ideas on what exactly causes growth retardation are still evolving. Although early studies since the 1930s identified deficiencies in certain nutrients as causes for growth retardation, in the 1960s attention settled on protein and in the 1970s it turned to energy and energy density (hence the term 'protein-energy malnutrition' or PEM). Recently, there is renewed interest in the role of the various nutrients. Golden (1995) proposes that one type of nutrients play a universal role in cell metabolism. Their deficiency does *not* lead to specific clinical signs (as opposed to the other type of nutrients, such as iron, iodine and the vitamins), but the only clinical sign is growth failure. The immune system is also affected. These 'growth nutrients' comprise potassium, sodium, magnesium, zinc, phosphorus and protein (both total protein and the essential amino acids *per se*). A deficiency of any of these nutrients gives rise to loss of appetite, which then leads to growth failure. One can only speculate to what extent the seasonal pattern of growth observed in the Coast is related to such hidden 'growth nutrient' deficiencies. In any case, the intake of all nutrients, and in particular vitamin A and vitamin C showed a dip at the end of the dry season, which corresponds to the time of the year when the strong conversion took place from the previous height spurt (with some wasting) to a spurt in body mass (with some stunting), as is shown above. For practical purposes, this theory again stresses the importance of dietary quality versus quantity. In a nutritional-economics study among coastal villagers in Msambweni (Kwale District), there was evidence that, at household level, variety in energy sources consumed was positively associated with higher household energy intake (Mwadime et al 1996b). This finding highlights the crucial role of appetite, which acts as a 'pull factor' at both individual and household level.

5.2 Nutritional status of adult women

The FNSP study provides data on weight and height of the resident mothers of the children studied; these were women mostly between 20 and 40 years of age. Their average weight was 48.0 kg and their average height 153.6 cm. These figures indicate women of relatively small posture who are also somewhat lean. The two measurements combined, the so-called body mass index[16], was on average 20.3 kg/m2. This average is close to normal. Yet, as regards the frequency distribution of individual values, it appeared that throughout the year almost 25%.of the women had values indicative of chronic energy deficiency (BMI<18.5 kg/m^2). This is more an indication of poor conditions throughout the year than of a seasonal emergency. The condition of the women was mostly stable, but in the long rains' peak labour period (May-June) there was an average weight loss of slightly more than one kg and a corresponding dip in BMI (towards 19.9 kg/m^2 on average). The percentage of undernourished women increased to 31.5%. Since these women were not reported to be more often ill at this time of the year the weight loss cannot be attributed to health factors. This time of the year is the period of planting and weeding during the long rains and as such a period of high labour requirements and high energy needs. It is likely that their energy balance became negative, notwithstanding the higher household food consumption (see section 4). Although the average weight loss is small, the prevalence of women with chronic energy deficiency was 7-12 percentage points higher than in the other seasons studied.

The largest seasonal fluctuation occurred in CL5, the zone with the least agricultural potential of the three agro-ecological zones and which is also the area with the comparatively lowest level of nutritional status as shown above. In that sense the results confirm the expectation that the women under the harshest circumstances will be most affected by seasonal energy stress (although the fluctuations as such were still in the modest range).

Surprisingly, although average BMI was similar across income groups, the seasonal fluctuation was minimal among the poorest (Ksh<1,000 per c.u. per year). They also showed hardly any drop in nutritional status in May-June. The same holds for the fluctuation in energy intake (see section 4). This suggests that they perhaps, unlike the women from the other income groups, avoided (or were forced to avoid) the seasonal energy peak. This probably means that they limited their labour expenditure, which in turn may well result in a low food production. And this again might be a reason why they belonged to the lowest income group. Could this be an example of the vicious circle ('energy trap') again pointed at recently by Latham (1993)?

As elsewhere in the world, the phenomenon referred to as "the double burden of malnutrition" occurs. Side by side with undernutrition, a certain degree of overnutrition exists in the population. There are no data available to quantify the extent of this problem (e.g. among the Arabs, Digo women, urban women...).

5.3 Micronutrient deficiencies

One of the micronutrients involved in the three major micronutrient deficiencies of public health importance is vitamin A (the other ones being iron and iodine). One of the first investigators to report on vitamin A deficiency (xerophthalmia) in Kenya was Philip, who found evidence of this disorder among the Digo at the Coast during the period 1928-1933 (Jansen, Horelli and Quinn 1987: 298). The prevalence was relatively low, which he attributed to the consumption at that time of yellow variety maize (which contains provitamin A in the form of carotenoids). Studies on vitamin A elsewhere in Kenya since then provided a mixed picture: clinical signs (eye signs and night blindness) could not always be observed, even in cases of diets very low in vitamin A (low in foods of animal origin, low in green vegetables and coloured fruits and gradual replacement of yellow maize by white maize). A

[16] Body mass index (BMI) = weight divided by height squared.

case in point is a study by Blankhart in Kwale around 1970: in four villages he did not observe any Bitot spots, one of the signs of vitamin A deficiency (Blankhart 1970). Until the 1980s vitamin A deficiency was not considered to be a problem of public health importance in Kenya (see Jansen, Horelli and Quinn 1987:305).

In the light of new scientific knowledge on the importance of vitamin A in reducing morbidity and mortality and stimulating child growth, the Government of Kenya and UNICEF recently organized a nation-wide assessment. Scrutiny of the records of a few government hospitals had already suggested that vitamin A deficiency was a problem of public health importance on the Coast: the percentage of clinical xerophthalmia cases in Kilifi and Malindi was of the order of 2% (the highest in the series), and in Mombasa 0.5% (Pertet 1992). The National Micronutrients Survey in 1994 in 14 selected districts, assessed not only clinical signs, but also the level of serum retinol in children 6-72 months and women 15-49 years (UNICEF/Kenya, n.d.) Clinical signs of vitamin A deficiency were highly prevalent in Mombasa (2.2% of the children had Bitot spots - the highest rate after Kitui District). In Kwale the prevalence was 0.7%. Both Mombasa and Kwale were declared areas where a severe vitamin A problem exists (more than 40% had moderately or severely reduced retinol levels). Possible causes are inadequate intake of vitamin A rich foods and lipids (necessary for the absorption of carotenoids), parasitic infections (malaria - very prevalent the Coast) and infestation with intestinal helminths, such as hookworm and ascaris.

Iron deficiency is another major nutritional problem. In Kenya the coastal region is the most severely affected by anaemia. A great majority, 70-90% of the anaemias at sea level are of the iron deficiency type, mainly attributed to excessive iron loss due to parasitic infections and a low content of iron absorption enhancers in the diet, notably vitamin C (Jansen, Horelli and Quinn 1987). Anaemia levels in Kwale District are estimated at 80% among pregnant women and 72% among children below 5 years of age (Mwadime 1995).

In Kenya the occurrence of goitre (a sign of iodine deficiency) is confined mainly to Rift Valley, Central and Nyanza Provinces. As seafoods (fish, crustaceans, etcetera) are rich in iodine, one expects less of this problem on the Coast. However, this is not the case: for instance, Kilifi district is categorized as having a moderate iodine deficiency level, with a goitre rate between 10 and 30% (Mwadime 1996). Iodine deficiency may be aggravated by the intake of goitrogens, e.g. from cabbages (*brassica*, species), cassava, or fecal bacteria (E. Coli).

6. Nutrition Programmes and Interventions in Kenya Coast

At district level, like in any other part of Kenya, the responsibility for the management of the nutritional problems is vested in the Ministry of Health. Nutrition being a multi-factorial problem, the activities of other sectors and non-governmental organizations also have a bearing on nutrition (see Table 12). For instance, the Ministries of Health and of Water address the health and sanitation aspects, the Ministries of Education and of Culture and Social Services address the "caring of children and women" and the Ministries of Agriculture, of Transport, of Labor and of Commerce and Trade address the food security issues. Various bilateral and multilateral donors are (or were) involved in the Coast in projects of cooperation with the Kenyan Government, such as the Danish Development Agency (DANIDA), the German Technical Development Agency (GTZ), the International Fund for Agricultural Development (IFAD), the World Food Programme (WFP) and others.

Table 12 **Responsibilities of different ministries for food security and nutrition**

Ministry of Health	Therapeutic nutrition services in hospitals, growth monitoring and promotion (both at facility level and - in selected divisions - community-based), supplementary feeding programme, micro-nutrient supplementation of young children (vitamin A) and of pregnant women (iron and folate), promotion of breast feeding, curative care, nutrition education and training, Bamako initiative in selected villages...
Ministry of Commerce	Monitoring of iodine fortification legislation, control of weights and measures...
Ministry of Agriculture, Livestock and Marketing	Crop and animal production, agricultural extension, home economics extension, marketing of foods, market price monitoring, seed distribution...
Ministry of Land Reclamation, Regional and Water Development	Water quality monitoring
Ministry of Education	Nutrition education in schools, school lunch programme, growth monitoring of pre-school children for the National Centre for Early Childhood Education, youth activities, adult education...
Ministry of Culture and Social Services	Institutional (FLTC) and community rehabilitation of severely malnourished children, community mobilization, gender programmes (women groups and income generating activities), adult education, programmes targeted to the absolute poor...
Ministry of Planning and National Development	Coordination of food security and nutrition activities: District Food and Nutrition Committee, Food and Nutrition Surveillance Committee; periodical child nutrition surveys (by CBS)
Office of the President	Food relief and rehabilitation programme, chairing the District Food and Nutrition Committee

Source: Adapted from Owuor and Okello 1995.

The coverage of the services of the different programmes and their accessibility, quality and utilization by the population are different across and even within the coastal districts. For instance, community-based growth monitoring and implementation of the Bamako initiative for community health financing are more extensive in Kwale District than in the other districts in the Province. The coverage of services is dependent on the population density among and within the districts. Where population is sparse, the coverage is low. There may also be a 'roadside bias': it has been noticed that most children admitted to the Family Life Training Centres in the Coast come from areas along the main roads or from areas with transport facilities (Mwadime 1995).

Table 13 **Non-governmental organization active in food security and nutrition improvement in Kilifi and Kwale Districts (1995/6)**

	Type of activities (nutrition-related)	**Areas covered**	**Coverage (people)**
KILIFI DISTRICT			
Institute of Cultural Affairs (ICA)	food security, income generating activities (IGA), women in development (WID)	1 administrative location	1,000
Kilifi Development Project (German Technical Development Agency - GTZ)	water and sanitation, agricultural development, community development	6 administrative locations	10,000
Plan International	food security (seeds and other agricultural inputs)	1 administrative location	2,000
African Medical Research Foundation (AMREF)	primary health care (PHC), women in development (WID), water	1 administrative location	10,000
Christian Health Association of Kenya	distribution of agricultural inputs	through a few churches	n.a.
Kenya Red Cross Society	primary health care (PHC), water and sanitation, youth programmes	2 administrative locations	8,000
KWALE DISTRICT			
Institute of Cultural Affairs (ICA)	nutrition and food security, women in development (WID)	n.a.	n.a.
Plan International	child sponsorship, food security, environmental health, educational programmes	Kubo division	2,000
Family Planning Association of Kenya	child survival programmes	3 administrative locations	6,000
Aga Khan Foundation	health and nutrition, family planning, child development programmes	3 administrative locations	10,000

Source: Information collected in the context of field work in the area (Mwadime 1995, 1996).

The activities of non-governmental organizations (NGOs) are very intense in the coastal area, most of them subsidizing government and community efforts towards the provision of basic needs within various sectors. Table 13 shows the major NGOs/agencies operational in the two Districts of Kwale and Kilifi.

Even though a number of programmes thus exist that address food security and nutritional problems, there is little collaboration between the responsible agencies or sectors, and little integration of the activities at community level. Under the Kwale-Kilifi Development Programme of the International Fund for Agricultural Development (IFAD), a District Nutrition Committee (DNC) was established in Kilifi to foster inter-sectoral coordination between the sectors of Agriculture, Health, Culture and Social Services, Education and Local Government. While the IFAD programme ended in July 1995, a new impetus was given since August 1994 by the Food and Nutrition Studies Programme (FNSP) of the Ministry of Planning and National Development: the Kilifi DNC was upgraded into a District Food and Nutrition Committee (DFNC) and equipped with nutrition planning and surveillance skills (Owuor & Okello 1995). A first Kilifi District Food and Nutrition Surveillance and Planning Bulletin (1992-1994) was published in November 1995 (Owuor & Okello 1995 - Annex 15). Two district officers were trained in food and nutrition programme management in The Netherlands. Unfortunately, central support under the FNSP came to an end in early 1996.

Since the Coast was classified as a high risk area for vitamin A deficiency and anaemia, there is also a need for community based interventions to mitigate micronutrient malnutrition.

7. Conclusion

Traditionally, in the past centuries, the Mijikenda coped with seasonal food shortages or famines in many ways: collecting wild plants, hunting, collecting and selling forest products, trading, and with the help of social networks and exchange with neighbouring tribes. In particular, trade was an important element in the Mijikenda economy. In good years, the Mijikenda were able to produce important maize surplusses with which the coastal towns were fed. In poor years, which occurred on average once a decade, forest products were exchanged for grains which the Swahili traders imported from other places along the East African coast. In this century, however, opportunities in both agriculture and trade have seriously declined. Heavy hut taxes (especially from 1921 onwards), that had to be paid shortly after the harvest, forced many Mijikenda to sell maize when prices were low and to buy maize for food later on when prices were high.

The results of these and other developments have been that the two districts are unable to feed themselves, despite the expansion of cassava production since the 1940s and the growing importance of rice, which can be grown on wet land unsuitable for maize.

At present, in terms of food production, the coastal region less than 50% self-sufficient. Thus, a large proportion of the food consumed in the region has to be 'imported' from other districts.The proportion of food purchased by households is concomitantly high. The household food consumption data collected during 1985/86 (Niemeijer, Foeken and Klaver 1991), as part of the seasonality study of FNSP in 6 areas of Coastal Province (Foeken et al 1989) indicates that on average only 34% of actual food intake (i.e. 30% of requirements) of rural households was met by their own production (see section 4.1). In the Kenya Coast Seasonality Study (1985/86), about 25% of the households are estimated to have had a chronically too low food intake (see section 4).

Households seek a balance between their resource base and their consumption needs. In terms of nutrition, this means that the level of food consumption is determined by the demand for food on the one hand and the supply of food on the other. The former is a function of the physical needs and fluctuates along with the amount of labour to be done. Labour fluctuations during the agricultural cycle are an important cause and since agricultural labour is mainly done by women (especially food production), women are usually expected to show the largest fluctuations regarding food requirements. The supply of food is determined by two factors: the household's own food production and the amount of food that can be bought. The latter is a function of the monetary income that can be realized.

Studies in Kwale and kilifi Districts showed that the rural population has developed fairly successful strategies to cope with diminishing food stocks at the end of the agricultural year (despite the fact that household income levels are generally low and that a large percentage of households falls below poverty levels), so that household energy intake is comparable to that of groups of peasant smallholders elsewhere in Kenya. The coping mechanisms are (i) a high level of food purchasing while spreading consumption of the home-produced food as much as possible over the year and (ii) consumption of cassava during the rainy season when the cereal stocks are depleted. Nevertheless, the nutritional status of children is below that of other districts.

The potential for increasing agricultural production remains limited given soil and climatic conditions. Future development policy and efforts to promote food security should consider wage employment an important priority.

The high dependence on food purchases also means that any serious distortion in food supply or food prices can seriously upset the balance because they cannot easily be compensated by subsistence cultivation or extra employment. At the time of the Coast

Seasonality Study (1985/6), maize pricing and maize movements were officially regulated by the Kenyan Government. Food prices were kept low for many years and maize movements were the responsibility of the National Cereals and Produce Board and its appointed wholesalers. The recent liberalization policy is generally expected to result in better food distribution by private wholesalers, but also in higher maize prices. Consumer maize prices did indeed rise strongly since 1992 and it is important to find out what has actually happened in this area under these conditions. Malnutrition rates in the Coast showed a slight decrease in the 1990s, about half a decade later than in the rest of Kenya, where the trend had started to be reversed in the 1990s. Moreover, it has to be remembered that food (security) is not the only factor in nutrition security: care and health factors play a role as well.

Apart from general policy measures, targeted interventions are necessary. Income class appears to be a more important factor for targeting purposes than agro-ecological zone. The low-income households show little seasonal variation but also show a low energy intake during cultivation time which raises concerns about the ability of this group to put sufficient effort into food cultivation – a possible 'energy trap'. The children in those households tend to have a very uneven ('ratchet') growth pattern; all the more reason to intensify growth monitoring activities as part of nutritional surveillance. Another option for targeting is selecting particularly vulnerable or affected communities and starting with them a participatory process to develop appropriate community-based food security and nutrition improvement activities.

Appendix 1: NUTRITIONAL REQUIREMENTS

SUMMARY

The discussion of food needs and the 'adequacy' of food supply or food intake involves several technical considerations. To start with, nutritional requirements are primarily described in terms of amounts of energy and nutrients (not amounts of foods) [section a]. A convenient way to estimate requirement figures is to use published reference data from the literature [section b]. The application of energy requirements [sections c and d] is more straightforward than nutrient requirements, due to the existence of an appetite-satiety mechanism for energy. This makes it possible to use mean (average) figures for energy requirements and intakes.

In the case of the nutrients, a margin has to be added to the average requirement in order to account for the normal variation in nutrient requirements [section e]. For any *individual* there is uncertainty about the actual requirements; fortunately, the limits of the 'normal range' are known with enough precision and it is one of these limits (the upper limit in this case) which is used as the recommended figure. For a *group*, another margin has to be added [section f] in order to account for the normal variation in nutrient intakes (which is considered to be independent from the normal variation in nutrient requirements).

The analysis of nutritional adequacy for mixed groups (such as a household or a population) requires some form of 'weighting'. This weighting can be incorporated either in *per capita* requirement figures, or alternatively by using *consumer units* [section g]. One may wish to express the nutritional adequacy in a group in terms of a prevalence rate, using a cut-off value [section h]. Nutrient adequacy can be expressed in a way which makes it independent of the quantity of food, by using nutrient-enery 'density'ratios [section i].

a. Nutritional needs are not primarily expressed in terms of food

There exist no physiological requirements for specific foods. Rather, the human body requires energy and nutrients that are contained in the different foods (and drinks). For planning purposes, and taking into account the local food pattern, one may wish to formulate a food basket that would meet the average physiological requirements *of energy and nutrients*. One has to realize, that such a 'food guide' is just one example out of an infinity of possible permutations of foods. Poverty studies often use a very rudimentary 'food guide' by focussing on the staple foods only, expressed in cereal equivalents. They can be assumed to represent roughly three quarters of food energy, although the way of expression can make a significant difference (see for example section 4.1: *73%* of requirements, but *84%* of actual intake).

b. Requirements of energy and nutrients are conventionally estimated by calculation from data in the literature

The real physiological requirements of an individual, let alone a population (group) are very hard to measure in a direct way, as they would require carefully conducted and very expensive metabolic studies. Fortunately, requirement figures for well-defined groups (e.g. for a given age, sex, body size and activity level) are fairly predictable within a rather well defined range, given appropriate assumptions and/or choices. Thus planners and practitioners generally use requirement *estimates* based on the technical literature (e.g. WHO/FAO/UNU 1985). Some selected examples are shown in Table 2 of the main text.

c. Energy first

The requirement of energy comes 'first' in two ways. It is the basic requirement that determines the quantitative need for food (to appease appetite c.q. hunger); and without quantity there can be no quality. In another vein, the application of energy requirement estimates to individuals or groups is more straightforward (see section d.) than is the case for nutrients (see section e.).
Energy requirements are estimated on the basis of body size, age and level of physical activity and of (socially desirable) 'discretionary activity' of the population group concerned (see Appendix 2). For the seasonality study of Kenya Coast (Hoorweg, Foeken & Klaver 1995), the nominal adult male was estimated to require on average 2,960 kcalories per day[17]. This 'adult equivalent' (=1 'consumer unit' – see below) can be conveniently rounded to 3,000 kcal per day[18].

d. The application of estimated *energy* requirements is more straightforward than requirements of *nutrients*

By convention, requirement figures have to consider two components: (i) mean (average) requirements and (ii) between-person (='interindividual') variation in requirements.
In the case of energy, the best estimate of an *individual*'s energy requirement based on literature data is the mean value [component (i)]. Of course - [as per component (ii)]- the true value for that individual may be above or below that mean value. This represents an 'uncertainty' in the estimate; curiously enough, we can be quite certain that the mean as an estimate is uncertain (i.e. different from the unknown true value) by some amount. Nutritionists can live with that uncertainty for two reasons: (a) on the long run, intakes below requirements are undesirable (leading to undernutrition), but so are intakes consistently above requirements (leading to overnutrition); (b) the appetite-satiety mechanism is considered to attune individual intake to individual requirements, at least under otherwise ideal (i.e. unconstrained) conditions.
The best estimate of the energy requirement of a *group* of otherwise similar individuals is also the mean value. Here nutritionists concur with statisticians: in the group average the 'uncertainties' about individual true requirements are leveled out and disappear. Under

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[17] This estimate holds for an assumed moderate activity pattern throughout the year (which was set at 1.76 times the basal metabolic rate plus 5% extra allowance). See Appendix 2.
This calculation is based on the WHO/FAO/UNU (1985) methodology for international use, assuming that an average male adult of 165.5 cm and 60.3 kg, a moderate physical activity level for subsistence farmers (1.76 times the basal metabolic rate), and an arbitrary 5% extra allowance for (i) diseases and (ii) reduced biological utilization due to the relatively high fibre content of the diet. It must be admitted, that the body size figures chosen were not based on direct evidence. In the FNSP Coastal Seasonality Study, the average height of adult women was 6.4% below the international NCHS reference; a same percentage was assumed for adult men. Body weight was then calculated on the basis of figures from the international literature (i.e. a desirable body mass index of 22 kg/m^2 for men). To give an idea of the 'robustness' of this estimate: a deviation of the energy requirement figure as low as 1% would require a deviation in body weight of about 1 kg, or a deviation in body height of 1.4 cm or a deviation in the physical activity level of 1% (which might for instance correspond with about 20 minutes more or less rest in 24 hours).

[18] For purposes of comparison, the spreadsheet programme of James and Schofield (1990) produces a value of 2,945 kcal for an adult male with a body weight of 59.1 kg (Kenyan national data), physical activity level for rural areas of developing countries of 1.86 and no extra allowance. With the arbitrary 5% extra allowance, the estimate would be 3,092 kcal. In the absence of better data to support one or the other assumption, for practical purposes the figure of 3,000 kcal per adult equivalent per day has been retained here.

unconstrained conditions, the (unknown, but undoubtable) individual variations from the mean requirement will be directly translated into individual variations in energy *intake*, through the appetite-satiety mechanism. Individual energy intakes are more easily assessed than individual energy requirements, through the use of a variety of food consumption methodologies.

In summary, for estimating the adequacy of *energy* intake of an individual or of a group, component (ii) is disregarded: the appetite-satiety mechanism is considered to attune individual intake to individual requirements under unconstrained conditions.

e. Recommended *nutrient* intake figures for individuals

The range of *essential nutrients* (proteins, essential fatty acids, vitamins and minerals) represent a nutritionally different 'family' of biological substances. Energy intake needs to be carefully balanced to avoid deficiency or excess; the body can not get rid of an excess of stored energy otherwise than by increasing energy expenditure, mainly through increased physical activity (thereby increasing 'requirements'). In the case of nutrients, for practical purposes[19] storage does not readily become a problem, either because excess intakes are readily excreted (in the case of the water soluble vitamins like vitamins B and C), or because a large quantity can be stored before it ultimately would become toxic (in the case of the fat soluble vitamins like vitamins A , D, E and K). So in the case of the *nutrients*, the main concern is not perfect attuning (equilibrium), but rather the avoidance of deficiency[10]. Moreover, we cannot rely on an in-built mechanism (or instinct) that attunes *nutrient* intake to requirements. So in the case of nutrients, component (ii) – the inter-individual variation – cannot be ruled out. In fact, the 'uncertainty' about the *real* requirement of an individual does matter now. Thus, any statement about the adequacy of an observed *nutrient* intake for an *individual* compared to his/her (unknown) *nutrient* requirement thus becomes in essence a 'probability' statement.

Nutritionists with the support of statisticians have nevertheless found a way to come up with a more or less convenient figure. Using probability theory, the likelihood of deficiency can be reduced by adding an identifiable margin to all members of the well-defined group, that takes care of most (e.g. 95%) of the 'uncertainty'. This amount (mean plus margin) that every group member should minimally take is referred to as 'recommended' or 'safe' intake[20]. Some selected examples are shown in Table 2 of the main text.

These figures are intended to evaluate the observed *individual* intakes of any member in the well-defined group[21].

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[19] I.e. within the context of 'applied nutrition' when dealing with population groups under usual circumstances. For clinical work, these generalizations may not be warranted: excess intakes of some nutrients can interfere with the utilization of other nutrients; occasionally patients are seen whose intake has reached the toxical range. These notions have started to be considered more prominently in the recent literature on requirement estimates for population groups. The method to define a recommended or safe *minimum* level of intake to prevent *deficiency* is now applied *mutatis mutandis* to the other end of the acceptable range in coming up with recommended or safe *maximum* levels of intake to avoid *toxicity*. See the case of vitamin A in FAO (1988).

[20] In the more recent literature (e.g. FAO 1988), various requirement levels are indicated, depending on the objective one aims at, for instance (i) a minimum level to prevent overt signs of deficiency, or (ii) a higher amount to allow for maintaining an adequate body store of the nutrient. The reader will appreciate that different assumptions and choices result in different figures.

[21] Caveat: there is a widespread notion, that the figures for recommended intake are intended for planning purposes only and for groups (not: individuals). Unfortunately, this notion does not do justice to how the figures were constructed and intended. In fact, the notion of a group was only necessary to work out the *range* of normal

f. Levels of recommended *nutrient* intake for well-defined groups

Interpretation of the adequacy of the average nutrient intake of a *group* of free-living individuals is more complicated, both for planning and assessment purposes. It requires that a second 'probability' margin be added, because not only each group member's nutrient *requirement*, but also his/her individual nutrient *intake* tends to deviate from the group average[22]. These two deviations are largely independent in the case of nutrients (due to the absence of a mechanism that attunes nutrient intake to nutrient requirements). Therefore, one has to deal with two "components (ii)", which means that two independent statistical margins of "safety" have to be added when comparing average nutrient intake of a well-defined group with its average nutrient requirement. An example of this 'probability approach' in applying nutrient requirement estimates is found in WHO/FAO/UNU (1985).

g. Energy requirements of a population (group): consumer units

The nutritional requirements for a population or another mixed group can be expressed in two ways:

(i) requirement per capita *times* the number of persons in the population or mixed group, or

(ii) requirement per adult equivalent *times* the number of adult equivalents (also known as 'consumer units') in the population or mixed group.

For requirement figures, an expression per capita is not straightforward, because smaller or younger individuals have lower requirements (thus lower expected intakes) than bigger or older ones. So the calculation should take into account the demographic composition of the mixed group: the calculation involves 'weighting' by age-sex group. Once this calculation has been done, the application is easy: all that one has to do is a head counting of the population or mixed group. This ease of application has a dark side, though: if the demographic composition of the group changes, the result may no longer be correct.

The second method more properly allows to account for the particular demographic composition of the population or mixed group by avoiding the construction of the composite 'per capita' figure of the first method, in which the demographic composition is made fixed. The 'trick' is to express the nutritional requirements of different age/sex groups as a ratio of the requirement of a reference person. The reference person is said to be equivalent to one 'consumer unit' (c.u.). Each individual then counts for as much of a consumer unit as its ratio indicates. The conventional reference person is arbitrarily chosen as a so-called 'nominal adult male', but another choice can be allowed (e.g. a nominal adult female), as the overall result of the calculation would be the same. The consumer unit method is conventionally

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variation in requirements. Using that normal range, a value at the upper end of the distribution was selected as the recommended value for all and every *individual* group member, just to be statistically on the 'safe' side. So the conventional recommended intake figures are intended for individuals and primarily to assess the likely adequacy of observed intakes (as far as they are based on dietary assessment). They can be used for planning *individual* diets, but not simply for planning diets or even the food supply of a *group*. The latter case involves dealing with group averages and is even less straightforward (see section f).

[22] Only in the case of spoon- or force-feeding the standard recommended amount to all group members there would not be such individual variation in intake, but this case is rather hypothetical. Even in institutions where standard amounts are given to the interns, these amounts are most probably not finetuned to their individual characteristics (such as age, sex, activity pattern, etcetera); besides some members may not finish the whole dish (left-overs that are not consumed).

applied to energy requirements, but in theory it can also be used for any nutrient; only the ratios (energy *versus* nutrient or one nutrient *versus* another nutrient) will not be the same, i.e. will be nutrient-specific.

For Kenya Coast, the average energy requirement of an adult male is estimated to be around 3,000 kcal per day. This represents one adult equivalent (= 1 'consumer unit'). The estimates of energy requirements for other age/sex groups depend on various other assumptions, the main ones being the body weight (desirable as opposed to actual) and, for those 10 years and above, the physical activity level. As explained above, they can be expressed as 'consumer units'. The set of rounded figures used in the seasonality study is given here for reference purposes.

Table A-1
Energy requirements by age/sex group
(consumer units [a])

Age group (years)	*Sexes combined*	*Male*	*Female*
0	0.3		
1	0.4		
2-4	0.5		
5-7	0.6		
8-10	0.7		
11-16		0.8	0.7
17-19		0.9	0.7
20-29		1.0	0.8
30-39		1.0	0.8
40-59		0.9	0.7
60+		0.7	0.6
pregnant (extra)			+0.1
lactating			[b]

Source: Niemeijer, Foeken & Klaver 1991, Appendix 1. The detailed calculation is reproduced in Appendix 2.
Notes:
[a]: The 'consumer unit' is the ratio obtained by dividing the estimated average energy requirement for that age/sex group by the one for a young adult male. The figures for children in this table are based on international reference body weights; if one would use actual body weights, the rounded consumer units would be 0.1 lower for most child age groups.
[b]: Extra maternal requirements for lactation are here incorporated in the requirement of the infant (i.e. the 0 year old).

For the seasonality study of Kenya Coast (Hoorweg, Foeken & Klaver 1995), an aggregate energy requirement figure of 2,075 kcal per capita per day was derived. It is based on requirement estimates for different age-sex groups, and reflects the composition of the population under study. This per capita value is roughly two-thirds of the requirement of one consumer unit. This can be explained by refering to the table above: for example, 2 children may count for only 1 adult.
Although the sample of the Coast Seasonality study is slightly younger in composition than the general population (1% more children below 20 years and 4% less people over 40), calculations show that this does not affect the aggregate per capita requirement in any way, because their lower requirements are completely offset by the 3% more people in the 20-39 year bracket, who have the higher requirements. So for the general population the same figure holds, which can be rounded to 2,100 kcal per capita per day.

h. Cut-off points for chronic undernutrition

Results of nutritional adequacy for a group can be expressed as an *average* percentage (e.g. average of individual adequacies), or as the prevalence (percentage) of values below a lower limit. The latter expression is the result of a combination of average level *and* variation around this average in the group studied. In comparing prevalence rates, this has to be kept in mind.

There are several internationally accepted lower levels of energy intake. They are expressed as a multiple of the basal metabolic rate (BMR): a conventional cut-off point for mere survival is 1.2 times BMR and for very restricted living 1.4 times BMR. Rounded percentages such as 60% and 80% of requirements are roughly equivalent to the former rates, albeit slightly lower.

i. Nutrient figures in terms of nutrient-energy 'density' ratios

In the total intake of any nutrient one can distinguish two components: (i) the quantity of food eaten and (ii) the nutrient quality (concentration, density) per amount of food. Energy intake is *the* preferred way to represent component (i). Any variations/differences/fluctuations of total nutrient intake within or between consumers (individuals, groups) are bound to reflect the combined result of quantity (i) and quality (ii). So to a large extent the pattern/profile that was already seen in energy intake is observed again and again for each nutrient. This 'redundancy' in the information can be avoided by expressing nutrient intakes (and requirements for that matter) in terms of a truely independent dimension: a nutrient-by-energy 'density' ratio.

The most common representative of this class of expressions is protein, fat and/or carbohydrate intake as a percentage of total energy. In fact, these three macronutrients are the ones that, together with alcohol, make up the total of food energy, according to the following formula: 4 kcal * g of protein + 9 kcal * g of fat + 4 kcal * g of metabolizable carbohydrate + 7 kcal * g of alcohol. In this case the ratios by energy are truly percentages.

But even micronutrients (vitamins, minerals) can be expressed as a ratio of a reference amount of energy. In Table 2 of the main text, an arbitrary reference amount of 350 kcal is used; other reference amounts that one may encounter are, for instance, 100 kcal or 1000 kcal.

Appendix 2: TECHNICAL NOTE ON CONSUMER UNITS

Introduction

For the processing of certain survey findings at household level it is important to relate them to household size. The construct of 'household size' not only depends on the definition of 'household', but also on the way of construing 'size'. The focus of this technical note is on the latter aspect.

There are various possible ways of defining household size. They have in common that household members are somehow added up. The definition of 'household' that one uses will tell, what corrections have to be made for absent household members and/or for guests present at the time of survey; these corrections are outside of the scope of this technical note. The focus is here on the way to 'add up' the household members. A very common way to 'add up' household members is by merely counting their number. It has to be realized, that this means implicitly that each member receives an equal weighting factor. For certain (e.g. demographic) purposes this is quite appropriate. There are other intended purposes however, for which weighted summation is more indicated. In the area of household food supply and consumption one often resorts to giving a kind of 'physiological' weighting factor to each household member according to his or her stage in the life cycle: a baby will get a low weighting factor compared to a school child and a school child will get a low weighting factor compared to an adult. The rationale behind this is, that the consumption level of a child is generally less than that of an adult. This applies of course to all kinds of consumption (food, shelter, clothing, transport...). One could imagine then to attribute to each household member a 'weight' proportionate to his or her age (in years) or body weight (in kg). Both have the disadvantage that they do not well reflect the real relative consumption levels, as a woman of 50 years old does not consume 50 times, nor 10 times, respectively, more than a baby (in food, shelter, clothing etc.). A better approximation of relative consumption requirements is offered by weighting according to the estimated nutritional requirements of the household members. It is conventional (and reasonable) to base this weighting on the estimated energy requirements, although weighting for one of the nutrients (e.g. protein) may be chosen for certain specific purposes (see below).Weighting according to nutritional requirements is known under the term 'consumer units'. As will be explained below, this procedure takes various biological aspects into account: age, sex, physiological status and physical activity level. It is a fair approximation of overall consumption in as far as food consumption is a large part of overall consumption. It is a most appropriate estimate for use in more narrowly food-related calculations.

Consumer Units

Nutritional requirement estimates can be made for energy (in kcal or in kJ) and for a series of nutrients (e.g. protein, vitamins, minerals). For certain specific purposes one may wish to construe 'consumer units' for a certain nutrient; for general purposes however, and as a first approximation, the conventional 'consumer units' are based on estimated energy requirements. There is a special rationale for this, because the physiological regulation of overall food intake relies on the hunger-satiety mechanism, which is based on energy. As a first approximation, many nutient requirements will be met as long as the energy requirement is satisfied.

It is conventional to choose a reference adult male as 1 unit, and to express all individuals with other sex,age, activity (etcetera) characteristics as a ratio of this unit on the basis of their estimated nutritional requirements (in the case of energy) or recommended intake levels.(in the case of the nutrients).

Nutrition science has developed estimates of energy requirements and recommended intake levels of nutrients (note: for the difference in terminology, see the technical literature and Appendix 1) on the basis of existing experimental and observational data. Although many countries have developed their own sets of reference values, the existing expertise in the world has been pooled in a constructive way by successive international expert consultations convened over the years by the relevant international organizations (FAO and WHO and more recently also the United Nations University). The most recent publication (Energy and protein requirements. Report of a Joint FAO/WHO/UNU Expert Consultation. WHO Technical Report Series Nr. 724. WHO, Geneva, 1985) provides a basis for the estimation of energy requirements that can be adapted to different situations.

The values are referred to as 'estimates', as they represent average values for the relevant population groups. Applied to individuals, they must be interpreted in a probabilistic sense (e.g. for an individual who meets the criteria for that estimate, there is a 50% chance that his or her real energy requirements will be met. Applied to a group of individuals who meet the criteria, the requirement estimate reflects their mean energy requirement. (Note: in the case of nutrients, the 'recommended intake levels' are set at a level well above the mean nutrient requirement, so that the probabilistic statement will be that for an individual who meets the criteria there is a 97% chance that his or her real requirements of that nutrient are met).

Requirement estimates are given separately for the two sexes, for a large number of age groups and for the various physiological states of women (pregnancy, lactation). For each of these groups, estimates are further based on body weight (for all age groups) and on the estimated level of physical activity (in the case of adolescents and adults).

CALCULATION OF CONSUMER UNITS FOR KENYA-COAST

In the following pages a spreadsheet calculation is shown which follows the most recent international recommendations (WHO/FAO/UNU, 1985), while including a number of assumptions made in order to apply the reference data to the situation of Kenya Coast.

1. Assumptions on body size.

Average body weight by age group has been estimated as follows. For the ages of 0 to 9 years, internationally accepted reference values for body weight (i.c. NCHS references, adopted by WHO, 1983) have been taken. This implies, that no deduction is made for decreased energy needs when growth is retarded due to malnutrition. Conversely, this implies, that for growth retarded children up to 9 years of age, there is some extra allowance for catch-up growth. From 10 years of age onwards, body weights for the purpose of estimating energy needs are based not on actual weight, but on actual height attained and then applying a reference weight for that height (by means of the so-called 'body-mass index = weight in kg divided by height in cm squared). For the case of Kenya-Coast, the amount of overall growth retardation has been estimated from the height of adult coastal women, which is 93.6% of the international reference height. This means that the consumer units (CU) calculated herafter accept a shorter stature in the coastal population.

2. Assumptions on the prevalence of pregnancy and lactation

These assumptions have been made on the basis of data from the Kenya-Coast survey itself.

3. Assumptions on the activity pattern

The WHO/FAO/UNU Consultation of 1985 has proposed a new basis for the construction of energy requirements: as a first step the 'basal metabolic rate' (BMR, that is - briefly said - the ongoing energy expenditure of the body while in complete rest) is estimated from fomulas that are age- and sex specific and that are a function of body weight.; next the level of physical activity during a 24-hour period is calculated from a breakdown of the time spent in various different activities, applying energy expenditure figures to this breakdown and then summing this up over th 24 hour period; it is expressed as a multiple of the BMR. In the present calculation, representative BMR-factors have been taken from the WHO/FAO/UNU (1985) publication for lack of local information.

4. Allowance for diseases

An arbitrary allowance of +5% has been made for the existence of diseases, which are considered to decrease energy absorption (from the gut) and increase energy expenditure (through fever and increased losses of body materials).

5. Resulting CU estimates

On the basis of the above, daily energy requirement estimates have been derived for the various age and sex groups. For children 0 to 9 years old, the international requirement per kg was multiplied by the reference body weight for age (as discussed above) and for the ages above 10 years, BMR was estimated using international reference formulas applied to reference weight for actual height and multiplying these by a BMR factor which assumed a certain plausible activity pattern and an arbitraty allowance for diseases. The reference adult male of 20-29 years of age is estimated to need 2960 kcal per day. This is made equivalent to 1 CU. The estimated energy requirements of the other age groups have been expressed in terms of these CU, aggregated over both sexes for children up to 10 years of age and rounded to one decimal (see Appendix). One may appreciate, that there were quite a few assumptions that had to be made. Changes in these assumptions would cause some changes in the resulting CU values, but these changes are not great and influence the results obtained by adding up CUs within households only in a minor way.

CALCULATION OF ENERGY REQUIREMENTS AND OF "CONSUMER UNITS" IN TERMS OF ENERGY EQUIVALENTS (applied to a research population in Coastal Kenya)

Basic values:
Local growth retardation accepted from age 10 years: 93.6% HF/
(basis: height coastal women= 153.5 cm)
(NCHS female reference ht (18 y.) 164.0 cm)
Local height of adult man:
(taken as 93.6% of reference ht (see below): 165.5 cm)
(NCHS male reference ht (18 y.) 177.0 cm)
Reference body mass index (FAO/WHO/UNU'85: pg 183)
adult woman 20.8 kg/m2
adult man 22 kg/m2
Deduced local weight woman(153.5 cm): 49.0 kg
man (165.5 cm): 60.3 kg
Prevalence of pregnancy 4-9 months
(coast:) 43 out of 387 women 17-39 yrs [representing the bulk of WRA]
so 1st trimester 8.3% (incl. 50% allowance for pregnancy wastage
2nd trimester 5.5%
3rd trimester 5.5%
Extra allowance for pregnancy (FAO/WHO/UNU'85: pg 84)
8.3% times 150 = 12 extra kcal
5.5% times 350 19 extra kcal
5.5% times 350 19 extra kcal
Total for the population of WRA 50 extra kcal
[WRA = Women of Reproductive Age]
Allocation of extra pregnancy allowances (pregnancy may not be publicly apparent in the 1st trim.):
- 1st trimester; "population" allowance allocated to all women 17-39 12 extra
- 2nd and third trimester: individual allowance allocated to evidently pregnant 350 extra
Extra allowance for lactation is calculated on the basis of
half the infant's energy requirement in the first year, assuming
mother's energy efficiency in "producing" milk to be 80%
This allowance is allocated to the infant's figures
Activity pattern expressed as multiple of the Basal Metabolic Rate (BMR)
for a rural woman in a developing
(FAO/WHO/UNU'85: pg 78) 1.76 * BMR
+ allowance for diseases: 5%
Total 1.85 * BMR
Activity pattern of adult man taken as the same
value (cf FAO/WHO/UNU'85: pg 77 = 1.78 * BMR) 1.76 * BMR
+ allowance for diseases: 5%
Total 1.85 * BMR
Activity pattern of adults over 40 years
taken as 'light' activity (FAO/WHO/UNU'85: pg 78) 1.55 * BMR
+ allowance for diseases: 5%
Total 1.63 * BMR

Calculation of energy requirement estimates for 'Kenya-Coast 1985/6'

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Basis of calculations

Age (years)	Weight (kg)			Energy expend. (multiple of BMR)	Estimated energy requirement (kcal/ kg/day)	(kcal/ day)
0-9	NCHS ref. WFA ('85 pg 91, 94)			n.a.	(85p92,5)	('85p94)
10-19	Ref W * (93.6% squared)			('85: pg 98)		
			plus	5%		
20+	Ref W for 93.6% of adult height				(see above)	

Results

Age (years)	Height (cm)	Weight (kg)	BMR equation ('85p71)	BMR (kcal/d)	Energy expend. (multiple of BMR)	Estimated energy requirement (kcal/ kg/day)	(kcal/ day) rounded 5 kcal
MALE							
infant		7.3				103	750
+ allowance for lactation							95
-----							---
total	0						845
1		11.5				104	1200
2		13.6				104	1410
3		15.7				99	1560
4		17.7				95	1690
5		19.7				92	1810
6		21.8				88	1900
7		24.1				83	1990
8		26.7				77	2070
9		29.8				72	2150
10	131	28.2	17.5W+651	1145	1.85		2120
11	137.6	32.4		1220	1.82		2220
12	143.2	35.8		1280	1.77		2265
13	149.8	41.2		1370	1.75		2400
14	155.4	46.1		1460	1.73		2525
15	160.1	50.8		1540	1.70		2620
16	163.8	54.9		1610	1.68		2705
17	165.5	56.9		1645	1.68		2765
18	165.5	58	15.3*W+679	1565	1.68		2630
19	165.5	59.1		1585	1.68		2665
20-29	165.5	60.3		1600	1.85		2960
30-39		60.3	11.6*W+879	1580	1.85		2925
40-59		60.3		1580	1.63		2575
60+		60.3	13.5*W+487	1300	1.63		2120

Results

FEMALE

	Age (years)	Height (cm)	Weight (kg)	BMR equation ('85p71)	BMR (kcal/d)	Energy expend. (BMR multiple)	Estimated energy requirement (kcal/ kg/day)	(kcal/ day) rounded to 5 kcal
infant			6.8				103	700
+ lact.								90
- - - - -								- - -
total	0							790
	1		10.8				108	1140
	2		11.9				102	1310
	3		14.1				95	1440
	4		16				92	1540
	5		17.7				88	1630
	6		19.5				83	1700
	7		21.8				76	1770
	8		24.8				69	1830
	9		28.5				62	1880
	10	132.9	29.5	12.2*W+746	1105	1.73		1910
	11	138.5	33.9		1160	1.71		1985
	12	145.1	38.5		1215	1.68		2040
	13	148.8	42.8		1270	1.66		2110
	14	150.7	45		1295	1.65		2135
	15	151.6	46.4		1310	1.62		2120
	16	152.6	47.3		1325	1.61		2135
	17	153.5	47.7		1330	1.60	)	2140
	18	153.5	48.1	14.7*W+496	1205	1.60	)	1940
	19	153.5	48.6		1210	1.60	)	1950
+ pregn. 17-19y	1st trimester (for all 17-19 y old women)						+12)	
	20-29	153.5	49		1215	1.85	)	
+ pregn 20-29y	1st trimester (for all 20-29 y old women)						+12)	2260
	30-39		49	8.7*W+829	1255	1.85	)	
+ pregn 30-39y	1st trimester for all 30-39 y old women)						+12)	2335
	40-59		49		1255	1.63		2045
	60+		49	10.5*W+596	1110	1.63		1810
extra for those pregnant (2nd or 3rd trimester)								350

CONSUMER UNITS

Unity (=1 adult equivalent) is the adult male's (20-29 y) energy requirement estimate: 2960 kcal

Age (years)	CU (male)	CU (female)	Rounded Consumer Units male	female	two sexes
0	0.28547	0.266891892			0.3
1	0.40541	0.385135135			0.4
2	0.47635	0.442567568			0.5
3	0.52703	0.486486486			0.5
4	0.57095	0.52027027			0.5
5	0.61149	0.550675676			0.6
6	0.64189	0.574324324			0.6
7	0.6723	0.597972973			0.6
8	0.69932	0.618243243			0.7
9	0.72635	0.635135135			0.7
10	0.71622	0.64527027			0.7
11-16	0.82967	0.705236486	0.8	0.7	
17-19	0.90766	0.679054054	0.9	0.7	
20-29	1	0.763513514	1	0.8	
30-39	0.98818	0.788851351	1	0.8	
40-59	0.86993	0.690878378	0.9	0.7	
60+	0.71622	0.611486486	0.7	0.6	
pregnant (2nd/3rd trim)					
17-19		0.793243243		0.8	
20-29		0.877618243		0.9	
30-39		0.902618243		0.9	

Appendix 3: **NUTRITIONAL STATUS**

The classical method to determine nutritional status relies on anthropometric measurements (such as body weight and height). They reflect the state of nutriture of the body of individuals, as a cumulative result of the balance between intake and requirements of energy, protein and other (micro)nutrients. Population data on growth can come from two types of studies: (i) cross-sectional studies and (ii) longitudinal studies. The former can only give figures on attained growth at the moment of the survey; the latter can give figures of both attained growth and growth velocities. International reference figures are available as a yardstick (WHO 1983; Baumgartner, Roche and Himes 1986).

Cross-sectional assessment can give an indication of so-called attained growth at a given moment in time. The following anthropometric indices are conventionally calculated, expressed in relation to international reference figures:

- height-for-age (HFA or H-A): a measure of long term linear growth; low H-A is called 'stunting';
- weight-for-height (WFH or W-H): a measure of body proportions, which reflects recent processes and the acuteness of the situation; low W-H is referred to as 'wasting') and
- weight-for-age (WFA or W-A): a measure that reflects the combined effect of the previous two processes; low W-A is referred to as 'underweight' (the overall result of 'chronic' and/or 'acute' malnutrition).

The individual anthropometric indices were (and are) expressed in essentially two different systems, each with their own cut-off points. The classical mode of expression is as a percent of the median value of the reference population, with cut-off points conveniently (and by convention) at 90%, 80% (sometimes 75%), and 60%, respectively. The more modern and preferred mode of expression is in terms of the standard-deviation score (see WHO 1983): each individual value is converted into a score that expresses its deviation from the median value of the reference population; the size of the deviation is expressed in units of the corresponding standard deviation (from the reference population), while the sign of the deviation reflects its position above or below the median value.

For a group of children, one can present, for any of the indices:

- the average score of attained growth (and a measure of distribution such as the standard deviation observed in the sample)[23].
- the prevalence rate of subnormal nutrition (be it chronic [H-A], acute [W-H] or chronic and/or acute malnutrition [W-A])[24]. Being a purely cross-sectional figure, this 'point prevalence' does not reveal what proportion of the children were ever subject to malnutrition. The episodic nature of malnutrition implies that many more children suffered from it up to that point in time than are identified at the time of the survey. The figure is also likely to vary at different times of the year. The reader is further cautioned that the resulting prevalence rates have different magnitudes according to the system of expression used (see above). Some (but not all) of the Kenyan survey figures reported have been expressed in both systems.

Data collected in a longitudinal study can be expressed as attained growth (like in the case of cross-sectional data), but in addition as growth velocities (e.g. cm or kg per month) or as changes in standard deviation score per time unit[25]. Also for growth velocities international reference values exist (Baumgartner et al., 1986).

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[23] See for example table 9 of the main text and tables 8.b-d on the next page.

[24] See for examples tables 6-9 and figures 3-5 and 6.A-C (upper part) of the main text and tables 8.b-d.

[25] See for example tables 10 and 11 and figures 6.A-C (lower part) of the main text.

Prevalence data presented graphically in Figures 6.A-C (upper part) of the main text are based on the following tables, which also present the average standard deviation scores.

Table A-3.1 [=Table 8.b expanded]
Attained height growth among children by age groups (FNSP, 1985-1986): average standard-deviation score (Z_{H-A}) and prevalence of children with a height for age below -2 sd of the NCHS reference (% stunted)

FNSP study on seasonality in the coastal lowlands, 1985/86

	N	Jul-Aug '85		Nov-Dec'85		Feb-Mar'86		May-Jun'86		Sep-Oct'86		Average	
Age group (m)		Z_{H-A}	% stu	Z_{H-A}	% stu	Z_{H-A}	% stu	Z_{H-A}	% stu	Z_{H-A}	% stu	Z_{H-A}	% stu
6-23	127	-1.92	50.8	-2.17	56.7	-2.26	60.0	-2.29	57.9	-2.56	71.1	-2.24	59.3
24-59	263	-2.11	55.1	-2.09	51.4	-1.97	47.7	-1.95	49.5	-2.16	54.3	-2.06	51.6
60-119	386	-1.94	50.0	-1.96	48.2	-1.84	44.5	-1.88	42.9	-1.77	42.1	-1.88	45.6

Table A-3.2 Attained body proportionality among children by age groups (FNSP, 1985-1986): average standard-deviation score (Z_{W-H}) and prevalence of children with a weight for height below -2 sd of the NCHS reference (% wasted)

FNSP study on seasonality in the coastal lowlands, 1985/86

	N	Jul-Aug '85		Nov-Dec'85		Feb-Mar'86		May-Jun'86		Sep-Oct'86		Average	
Age group (m)		Z_{W-H}	%was	Z_{W-H}	%was	Z_{W-H}	%was	Z_{W-H}	%was	Z_{W-H}	%was	Z_{W-H}	%was
6-23	127	-0.74	11.9	-0.72	9.5	-1.10	14.3	-1.03	12.9	-0.88	15.6	-0.89	12.8
24-59	263	-0.62	6.1	-0.65	6.0	-0.95	10.7	-0.78	5.9	-0.75	9.5	-0.75	7.6
60-119	386	-0.79	6.8	-0.89	7.5	-1.10	12.1	-0.98	9.3	-0.94	6.8	-0.94	8.5

Table A-3.3 Attained weight growth among children by age groups (FNSP, 1985-1986): average standard-deviation score (Z_{W-A}) and prevalence of children with a weight for age below -2 sd of the NCHS reference (% underweight)

FNSP study on seasonality in the coastal lowlands, 1985/86

	N	Jul-Aug '85		Nov-Dec'85		Feb-Mar'86		May-Jun'86		Sep-Oct'86		Average	
Age group (m)		Z_{W-A}	%uwt	Z_{W-A}	%uwt	Z_{W-A}	%uwt	Z_{W-A}	%uwt	Z_{W-A}	%uwt	Z_{W-A}	%uwt
6-23	127	-1.77	40.5	-1.95	47.6	-2.27	63.9	-2.25	61.6	-2.30	64.7	-2.11	55.7
24-59	263	-1.77	41.5	-1.77	40.3	-1.91	48.1	-1.78	41.2	-1.86	44.8	-1.82	43.2
60-119	386	-1.75	43.3	-1.84	44.7	-1.90	47.7	-1.84	43.2	-1.76	40.3	-1.88	43.8

REFERENCES

ACC/SCN (1993),
"**Second Report on the World Nutrition Situation, Vol. II: Country Trends, Methods and Statistics**" Geneva: Administrative Committee on Coordination-Subcommittee on Nutrition

ACC/SCN (1994),
"**Update on the nutrition situation, 1994**" Geneva: Administrative Committee on Coordination-Subcommittee on Nutrition

ACC/SCN (1998),
"Corrigendum". **ACC/SCN News**, No. 16, July 1998, pp. 33. Geneva: Administrative Committee on Coordination-Subcommittee on Nutrition

Baumgartner, R.N., A.F. Roche, & J.H. Himes (1986),
"Incremental growth tables: supplementary to previously published charts",
American Journal of Clinical Nutrition, vol. 43, pp. 711-722.

Blankhart, D.M. (1970),
"Four villages survey in the coastal area Kwale" Amsterdam: Royal Tropical Institute (mimeo)

Boerma, J.T. & Bennett F.J. (1999),
"Health and illness", in: D. Foeken, J. Hoorweg & R.A. Obudho, eds., **The Kenya Coast: problems and perspectives**, chapter 18, Münster: Lit Verlag.

Bradley, D. (1981),
"Seasonal variables in infective disease: a summary", in: R. Chambers, R. Longhurst & A. Pacey, eds., **Seasonal dimensions to rural poverty**, pp. 127-131, London: Frances Pinter (Publishers) Ltd.

Chambers, R. (1981),
Introduction. In R. Chambers, R. Longhurst and A. Pacey, eds., **Seasonal dimensions to rural poverty**, pp 1-8. London: Frances Pinter (Publishers) Ltd.

FAO (1988),
Requirements of vitamin A, iron, folate and vitamin B12. Report of a joint FAO/WHO Expert Consultation. FAO Food and Nutrition Series, No. 23. Rome.

Foeken, D & J. Hoorweg (1988),
Seasonality in the coastal Lowlands of Kenya. Part 2: Introduction to seasonality. Nairobi/Leiden: Ministry of Planning & National Development/African Studies Centre, Food and Nutrition Studies Programme. Report no. 28.

Foeken, D., J. Hoorweg & R.A. Obudho (eds),(1999),
The Kenya Coast: problems and perspectives,
Münster: Lit Verlag.

Foeken, D., P. Leegwater, R. Niemeijer, W. Veerman & J. Hoorweg (1989),
Seasonality in the Coastal Lowlands of Kenya. Part 3: Socio-economic profile. Nairobi/Leiden: Ministry of Planning & National Development/African Studies Centre, Food and Nutrition Studies Programme. Report no. 28.

Garine, I. de, Harrison, G.A. (1988)
Discussion and conclusions. In: :I. de Garine & G.A. Harrison, eds., **Coping with uncertainty in food supply,** pp. 469-475. Oxford: Clarendon Press.

Golden, M.H.N. (1995),
"Specific deficiencies versus growth failure: Type I and Type II nutrients", **SCN News,** nr. 12, pp. 10-14. (Geneva: Administrative Committee on Coordination - Subcommittee on Nutrition)

Herlehy, T.J. (1983)
An historical dimension of the food crisis in Africa: surviving famines along the Kenya Coast, ca. 1880-1980.
Boston University: African Studies Center (mimeo)

Hoorweg, J., D. Foeken & W. Klaver (1995),
Seasons and nutrition at the Kenya Coast. African Studies Centre Research Series 7/1995. Aldershot: Avebury.

Jaetzold, R. & H. Schmidt (1983),
Farm management handbook of Kenya, Vol II: Natural conditions and farm management information, Part C: East Kenya). Nairobi: Ministry of Agriculture.

James, W.P.T. & E.C. Schofield. (1990)
Human energy requirements - A manual for planners and nutritionists.
Oxford: Oxford University Press; 1990.

Jansen, A.A.J, H.T. Horelli & V.J. Quinn (1987)
Food and Nutrition in Kenya. A Historical Review. Nairobi: Department of Community Health, University of Nairobi.

Kenya, Republic of (1977),
"The Rural Kenyan Nutition Survey", **Social Perspectives**, vol. 4, nr. 2. Nairobi: Central Bureau of Statistics.

- (1979),
Child nutrition in rural Kenya. Nairobi: Ministry of Economic Planning and Development. Central Bureau of Statistics.

- (1980),
Report of the Child Nutrition Survey 1978/79. Nairobi: Ministry of Economic Planning and Development. Central Bureau of Statistics.

- (1983),
Third Rural Child Nutrition Survey 1982.
Nairobi: Ministry of Finance and Planning. Central Bureau of Statistics.

- (1988),
Economic Survey 1988.
Nairobi: Ministry of Planning and National Development. Central Bureau of Statistics.

- (1991),
Fourth Rural Child Nutrition Survey 1987.
Nairobi: Ministry of Planning and National Development. Central Bureau of Statistics.

- (1996),
Fifth Nutrition Survey 1994.
Nairobi: Office of the Vice-President and Ministry of Planning and National Development / UNICEF Kenya Country Office .

Latham M.C. (1993),
“The relationship of nutrition to productivity and well-being of workers. In P. Pinstrup-Andersen, ed., **The political economy of food and nutrition policies**, pp. 133-148. Baltimore: Johns Hopkins University Press.

Maritim, H.K. (1982),
"**Maize marketing in Kenya: An assessment of interregional commodity flow patterns".**
Berlin: Technische Universität, Institut fur Sozialökonomie der Agrarentwicklung. Ph.D.thesis.

Meilink, H. (1999),
"The Kenya Coast in national perspective", in: D. Foeken, J. Hoorweg & R.A. Obudho, eds., **The Kenya Coast: problems and perspectives**, chapter 2, Münster: Lit Verlag.

Mwadime, R.K.N. (1995),
"**Community based nutrition rehabilitation. A baseline report for the Kilifi and Kwale FLTCs**" (draft report for the Family Life Training Programme, Danish Development Agency & Ministry of Culture and Social Services).
Nairobi: University of Nairobi, Applied Nutrition Programme (mimeo).

- (1996)
"**Non-farm employment in rural Kenya: micro-mechanisms influencing food and nutrition of farming households**"
Wageningen: Wageningen Agricultural University. Ph.D.thesis.

Mwadime, R.K.N., J.C. Hoorweg, W. Klaver & J.G.A.J. Hautvast (1996a),
"Links between non-farm employment and child nutritional status among farming households in rural coastal Kenya", in: Mwadime, R.K.N,. **Non-farm employment in rural Kenya: micro-mechanisms influencing food and nutrition of farming households**, pp. 93-110.
Wageningen: Wageningen Agricultural University. Ph.D.thesis.

Mwadime, R.K.N., J.C. Hoorweg, W. Klaver & J.G.A.J. Hautvast (1996b)
"Relationship between household income and food accessibility in Coastal Kenya. Is there a trade-off between quantity and quality of food?", in: Mwadime, R.K.N,. **Non-farm employment in rural Kenya: micro-mechanisms influencing food and nutrition of farming households**, pp. 55-72.
Wageningen: Wageningen Agricultural University. Ph.D.thesis.

Mwadime, R.K.N., W. Klaver, S. Cherop, J.C. Hoorweg & J.G.A.J. Hautvast (1996c),
"Maternal factors in child care and safe-living conditions in coastal Kenya: what are the consequences of maternal occupation?", in: Mwadime, R.K.N,. **Non-farm employment in rural Kenya: micro-mechanisms influencing food and nutrition of farming households**, pp. 73-92.
Wageningen: Wageningen Agricultural University. Ph.D.thesis.

Mwakubo, S.M., E.C. Sambili & H.K. Maritim (1996),
"**Food insecurity in Kwale District, Coast Province, Kenya: a case of inappropriate government policies.**"
Egerton University: Department of Agricultural Economics & Business Management *[mimeo]*. Paper presented at the 14th International Symposium on Sustainable Farming Systems, 11-16 November, 1996, Colombo, Sri Lanka .

NCPD/REPUBLIC OF KENYA/MI (1994),
"**Kenya Demographic and Health Survey 1993**",
Calverton, Maryland: National Council for Population and Development, Ministry of Planning and National Development/ Central Bureau of Statistics and Macro International Inc.

Niemeijer, R. & W. Klaver (1990),
"Climatic seasonality and growth: longitudinal research in Coast Province, Kenya", in: Foeken, D.W.J. & A.P. den Hartog (eds.), **Seasons, food supply and nutrition in Africa**, pp. 30-65. Leiden: African Studies Centre, Research Report 43.

Niemeijer, R., D. Foeken & W. Klaver (1991),
Seasonality in the Coastal Lowlands of Kenya. Part 4/5: Food consumption and anthropometry. Nairobi/Leiden: Ministry of Planning & National Development/African Studies Centre, Food and Nutrition Studies Programme. Report no. 38.

Oosten, C. van (1989),
Farming systems and food security in Kwale District, Kenya. Nairobi/Leiden: Ministry of Planning & National Development/African Studies Centre, Food and Nutrition Studies Programme. Report no. 30.

Owuor, J.O. & W.O. Okello (1995),
Food and Nutrition Surveillance and Planning in Kilifi District, Kenya - A Model for District Based Multi-Sectoral Policy Formulation and Planning.
Nairobi/Leiden: Ministry of Planning & National Development/African Studies Centre, Food and Nutrition Studies Programme. Report no. 56.

Paolisso, M., M. Baksh & J.C. Thomas (1990),
"Women's Agricultural Work, Child Care, and Infant Diarrhea in Rural Kenya", in: J. Leslie & M. Paolisso, eds., **Women, Work, and Child Welfare in the Third World**, pp. 217f-236, AAAS Selected Symposia Series 110. Boulder: Westview Press.

Périssé, J., Sisaret, F., François, P. (1969)
The effect of income on the structure of the diet. **Nutrition Newsletter (FAO)**, 7, No.3.

Pertet, A. (1992),
Vitamin A deficiency in Kenya: a review of the literature. Cited in: UNICEF Kenya Country Office & Government of Kenya (n.d.), *A Report of the National Micronutrients Survey (1994)* Nairobi; unpublished second draft. *[mimeo]*

Peters, C. & R. Niemeijer (1987),
Protein-energy malnutrition and the home environment: A study among children in Coast Province, Kenya. Nairobi/Leiden: Ministry of Planning & National Development/African Studies Centre, Food and Nutrition Studies Programme. Report no.22.

Rowland, M.G.M., A. Paul, A.M. Prentice, E. Müller, M. Hutton, R.A.E. Barrell & R.G. Whitehead (1981), "Seasonality and the growth of infants in a Gambian village", in: R. Chambers, R. Longhurst & A. Pacey, eds., **Seasonal dimensions to rural poverty**, pp. 164-175, London: Frances Pinter (Publishers) Ltd.

Sehmi, J.K. (1993), **National food composition tables and the planning of satisfactory diets in Kenya.** Nairobi: Ministry of Health & National Public Health Laboratory service.

Test, K., J. Mason, J. Haaga, L. Wasonga, F. Omoro & V.Quinn (1984), **Changes in child nutrition in rural Kenya, 1977-1982.** Ithaca, N.Y.:Cornell Nutritional Surveillance Programme.

Thiuri, B.N., W. Gemert & S.N. Kinoti (1984) Nutrition status, breastfeeding and feeding practices of 0-23 months old children in Kilifi district. Proceedings of the Fifth Annual Medical Scientific Conference, Nairobi, 1984. Nairobi: University of Nairobi.

UNICEF Kenya Country Office & Government of Kenya (n.d.), *Vitamin A deficiency in Kenya. A Report of the National Micronutrients Survey (1994)* Nairobi; unpublished second draft. [mimeo]

Vervoorn, M. & H. Waaijenberg (1986), *Een boerenbedrijf in Kaloleni, Kenia* ("A farm in Kaloleni, Kenya"). Wageningen: Agricultural University, unpublished thesis."

Waaijenberg, H. (1987), "Agriculture in the Kilifi area (mapsheet 198), Kenya", in: H.W. Boxum, T. de Meester & E.M.A. Smaling, eds. **Soils of the Kilifi area, Kenya.** Wageningen: PUDOC.

Waaijenberg, H. (1999), "Agriculture", in: D. Foeken, J. Hoorweg & R.A. Obudho, eds., **The Kenya Coast: problems and perspectives**, chapter 12, Münster: Lit Verlag.

Wakajummah, J.O. (1999), "Population dynamics", in: D. Foeken, J. Hoorweg & R.A. Obudho, eds., **The Kenya Coast: problems and perspectives**, chapter 6, Münster: Lit Verlag.

West, C.E., F. Pepping & C.R. Temalilwa (eds) (1988),
"**The composition of foods commonly eaten in East Africa".**
Wageningen: Agricultural University, on behalf of Technical Centre for Agricultural and Rural Cooperation (CTA) & ECSA Food and Nutrition Cooperation.

White, C. (1986),
"Food shortages and seasonality in WoDaaBe communities in Niger", in: R. Longhurst, ed., **Seasonality and Poverty**, IDS Bulletin (special issue), vol. 17, nr. 3, pp. 19-26.

WHO (1983),
Measuring change in nutritional status: Guidelines for assessing the nutritional impact of supplementary feeding programmes for vulnerable groups. Geneva: World Health Organisation.

WHO/FAO/UNU (1985),
Energy and protein requirements. Geneva: World Health Organization. Technical report 724.

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