Seasons, food supply and nutrition in Africa : contributions to a workshop held in Wageningen on December 14, 1988

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(Editors)

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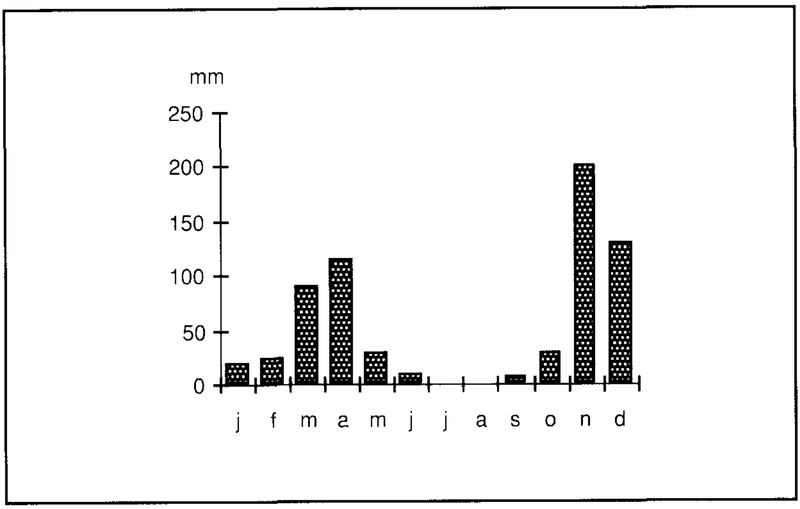

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Dick W.J. Foeken and Adel P. den Hartog
(Editors)

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1. Introduction

Dick W.J. Foeken*

During the late thirties the first publications appeared drawing attention to the fact that in many parts of rural Africa a so-called 'hungry season' existed (Fortes & Fortes, 1936; Lynn, 1937; Richards, 1939). Twenty years later, an FAO report again noted that pre-harvest food shortage was a problem, particularly in the drier parts of tropical Africa (FAO, 1958). The essential aspect of what nowadays is called 'seasonality' was recognized early on: rural people do not have enough to eat during the period that food is most needed, i.e. the period of intensive agricultural work. Over the years, separate studies have documented many seasonal dimensions of life in Third World countries: seasonal agricultural labour needs, differences in food supply and food availability, fluctuations in prices of crops and foodstuffs, variations in health and illnesses. The following description of an typical seasonality scenario gives an idea of the many different aspects of rural life that are involved:

> The scenario starts with a tropical environment where a wet season follows a dry season, and where cultivation is practised. Towards the end of the dry season, food becomes scarcer, less varied and more expensive. The poor people, who may be landless or have small plots of land, experience food shortage more acutely than their less poor neighbours. Some migrate in search of work and food. Others undertake non-agricultural activities near their homes in which the returns to labour are low. More work is involved in fetching water.
>
> When the rains come, land must be prepared, and crops sown, transplanted and weeded. If animals are used for ploughing, they are weak after the dry season. Delays in cultivation reduce yields. For those with land, food supplies depend on the ability to work or to hire labour at this time. For those without land, work in the rains and at harvest often provides the highest wages of the year. This is the time of year when food is most needed for work, but it is also the hungry season when food is shortest and most expensive.
>
> It is, too, a sick season when exposure to tropical diseases is at its greatest, when immunity is low, and when women are most likely to be in late pregnancy. So the rains bring crisis. Vulnerable to hunger, sickness and incapacity, poor people are undernourished and lose weight. (...) Stress is passed down to the weakest - women, children, old people and the indigent. Sometimes (...) an irreversible downward movement into deeper poverty occurs as assets are mortgaged or sold without hope of recovery. This is, then, a time when poor people are kept poor and a time when they become poorer.

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> With the harvest things improve. Grain prices are lower, a benefit to those who must buy food but a disadvantage to those small farmers who must sell their crops to repay debts or raise money for ceremonies. After the harvest, ceremonies, celebrations and marriages take place. Body weights recover. The dry season sets in. And then the cycle begins all over again. (Chambers, 1981: 5)

In general, there tends to be a "widespread tendency for adverse factors to operate concurrently during the wet seasons (...and...) these adverse factors tend to hit the poorer people harder" (Chambers et al., 1979: 3). It is only in recent years that seasonality has been studied as a more complex issue than the existence of a hungry season alone, playing an important part in rural poverty. This may be rather surprising, if it were alone for the fact that in 1980 an estimated one billion people in the tropics were living in areas with a clear climatological seasonality, of which over 200 million in Sub-Saharan Africa (Chambers, 1981: 6).

The reason that seasonality research started only recently can be explained in several ways. Firstly, during the 1960s and part of the 1970s, not the (farming) household but macro economic questions served as the main research focus. In many disciplines this caused a reaction towards research on a micro level, of which seasonality research is one type. Secondly, many researchers know 'their' area only from the dry season ('dry season bias'), not in the least because of the impassability of rural roads during the wet season ('tarmac bias'). Thirdly, statistics are usually aggregated as annual figures, thus concealing seasonal fluctuations ('statistical bias'). Fourthly, many researchers are highly specialized in one particular discipline and find it difficult to analyse the longitudinal relationships between climatological seasonality and rural poverty. Finally, the simple fact that seasonality research requires a lengthy stay in the field - for which time and money are often not available - may also be one of the causes for the neglectance of this type of research.

Why is seasonality research important? In the first place, it can offer an explanation for the persistent, if not growing, poverty in the rural areas of Third World countries. Each year millions of households are faced with one or two periods of seasonal stress. For instance, illness of one household member - as such not a very dramatic event - may have dramatic consequences if this means that an important worker is not available during the busy season or that the only draught animal the household possesses has to be sold in order to be able to pay for the costst of treatment. One must realize, of course, that the seasonality researcher does not pretend to offer *the* explanation for rural poverty. He solely offers an alternative analytical framework. However, this type of analysis differs from most other analyses because of its multidisciplinary character. That is the second reason why seasonality research is important. It offers a framework in which research questions originating from a variety of disciplines can be included. Seasonality is an integrating concept with which many kinds of processes in the rural areas of Third World countries can easier be understood. As such, the concept gives a hold not only to researchers, but also to policy makers and development workers.

Four topical conferences were held in recent years. The first in 1978, organized by the Institute of Development Studies (I.D.S.), Sussex: *Seasonal Dimensions to Rural Poverty* (Chambers, Longhurst & Pacey, 1981). A regional workshop on *Seasonal variations in the provisioning, nutrition and health of rural families* was organized by AMREF (1982). In 1985, a workshop was held by IFPRI, Washington: *Seasonal causes of household food insecurity: policy implications and research needs* (Sahn, 1989). I.D.S. organized a second conference in 1985: *Seasonality and Poverty* and a special issue of the IDS Bulletin (1986, vol.17, no.3) resulted from this meeting.

In December 1988 a one-day workshop on *Seasons, food supply and nutrition in Africa* was organized at Wageningen Agricultural University, The Netherlands. The purpose of the workshop was to provide more insight into the relationship between the alternation of the climatological seasons and fluctuations in the nutritional condition of rural people, the ways people cope with situations of season-bound food shortages, and the influence of external interferences on the seasonal rhythms of households in rural Africa. The workshop consisted of five lectures which are presented in this book. Some of the sections in the book consist of the actual given lectures, others are elaborations of what was presented.

First of all, *Dick Foeken* offers an overview - based on existing literature - of the aspects of seasonality in Sub-Saharan Africa, and as such his contribution can be considered as the general framework within which the other four contributions fit. The discussion starts with the alternation of climatological seasons and other seasonal fluctuations that follow (agricultural cycle, food supply, nutritional conditions, health, etc.).

One of the best ways to show the adverse effects of climatological seasonality is by looking at the fluctuations in nutritional condition of people. Especially young children and their mothers are vulnerable groups; young children because they are in a stage of rapid physical growth, and mothers because of their heavy labour duties (food production, home work, care of the children). *Rudo Niemeijer and Wijnand Klaver* present the seasonal fluctuations of the nutritional conditions of young children and their mothers in Coast Province, Kenya, and relate these fluctuations to ecotype and household welfare level. The children appear to have a spurt in height growth during the dry season and a spurt in weight growth during the rainy season. The mothers, on the other hand, clearly show a drop in weight during the rainy season, especially in the ecotype where food production dominates (heavy work during the rains).

Research on fluctuations in nutritional conditions can also be approached in a more physiological way, i.e. by means of an analysis of the energy balance. Energy balance is the difference between food energy intake (metabolisable energy) and energy expenditure (metabolised energy). *Joop van Raaij and Werner Schultink* discuss the usefulness of this approach with a survey held among rural Beninese women as illustration. For instance, the energy intake of these women during the long rainy season of 1985/86 was more than 300 kcal lower than three months earlier.

People adjust to seasonality in many ways. First of all, they will try to avoid situations of seasonal stress. A whole range of preventive coping mechanisms (one may use the term 'household strategy' here) in the agronomic, economic and socio-cultural sphere can be discerned (see the contribution of Foeken). Despite this, seasonal stress - i.e. food shortages of a more or less distinctive regular character - will often occur. Many so-called curative coping mechanisms are possible. Usually, adaptation of food habits will take place in first instance. *Adel den Hartog and Inge Brouwer* argue that, as long as food shortages are of a seasonal character, curative mechanisms will concern mainly food habits. When food shortages become more chronic, however, a variety of other adaptations may be necessary; adaptations that show a more or less hierarchical order.

Local communities are by no means closed socio-economic systems. All kinds of influences from the outside world affect local life. For instance, the policies of national governments or the activities of non-governmental organisations may influence the degree in which the adverse effects of seasonality are felt as well as the kind of coping mechanisms that can be used. Like seasonality, external interventions have their rhythms; rhythms that may coincide or collide with the seasonal pattern. *Ton Dietz* explores this aspect of seasonality, using data from surveys in Kenya, Zimbabwe, Togo/Benin and Morocco. For instance, two important external influences concern the fluctuations in government spending (i.e., the financial year of the government) and the school calendar.

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2. Aspects of seasonality in Africa

Dick W.J. Foeken*

This section discusses the many different aspects of seasonality and at the same time gives a differentiated picture of seasonality as present in (Sub-Sahara) Africa. Each discussion of seasonality must necessarily start with climatic seasonality.[1] Other seasonal aspects as they are derived from climatic seasonality are described next. Then follows a picture of how people, affected by adverse seasonal conditions, tend to cope with these problems.

2.1. Climatic seasonality and the agrarian cycle

Plants need sufficient quantities of three elements for growth : solar radiation, water and nutrients. Solar radiation which is the ultimate source of energy for all plants, is not a limiting factor in the tropics. Neither are soil nutrients, despite the fact that tropical soils tend not to be very fertile because of the low humus content; satisfactory yields are generally possible.[2] The main limiting factor, then, is rainfall, or more accurately: the availability of soil moisture. The quantity of moisture in the soil determines the growing season, the time when loss of moisture through evaporation and transpiration is met by sufficient rainfall.

Thus, whereas in the temperate regions of the world seasons are primarily defined by fluctuations in temperature and sunshine, in the tropics precipitation determines the nature of the seasons. On the basis of rainfall distribution throughout the year, three types of tropical climates can be distinguished (Walsh, 1981: 2-13):

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[1] There exist other forms of periodicity that do not coincide with climatic seasonality. A well-known example is the ramadan, the Islamic period of daily fasting. Also the "rythm of external interference" (see the section of Ton Dietz) often differs from the "rythm of wet and dry seasons".

[2] The low humus content, in turn, is due to intense bacterial activity made possible by high temperatures.

a) *Climates with no real dry season.* In Africa, regions with these climates are found around the equator (and in Eastern Madagascar), with the exception of East Africa.
b) *Climates with two rainy and two dry seasons.* These so-called 'bimodal' climates are concentrated in two zones, one north and one south of the equatorial zone, but adjoining in East Africa.
c) *Climates with one wet and one dry season.* These 'unimodal' climates form a further zone in the north (up to the Sahara) and in the south, up to the South-African deserts in the west and the temperate regimes in the south-east.

The distinction between bimodal and unimodal climatic regimes is an important one. In general, people living in a bimodal climate experience less seasonal stress than people living in regions with only one rainy season. In the former case, two annual harvests will often be possible, reducing not only the time-gap between harvests, but also reducing storage problems and food shortages. Schofield (1974: 24), using survey material from 25 African villages, noted that in villages with a unimodal climate, caloric requirements were met for 100 per cent during the dry season but for less than 90 per cent in the wet season. In the 10 villages with a bimodal climate no such difference was found.

The bimodal-unimodal distinction, however, is rather crude. It reflects the existence of one or two rainy season(s) and one or two dry season(s) in an average year. However, normal years occur rarely and the distinction does not allow for fluctuations in rainfall other than the the wet/dry season distinction. This brings us to three types of rainfall fluctuation that can be recognised:
a) *Seasonal variability* refers to the fluctuations of rainfall within one year. It is usually measured in one of two ways. Firstly, by simply counting the number of 'dry months' per annum. A dry month is defined as a month with insufficient rainfall to meet the potential needs of plants. This way of measuring seasonal variability is called *absolute seasonality* and offers a refinement of the uni/bimodal distinction. Walsh (1981: 15) uses 4" (102 mm) as cut-off point and Figure 2.1 shows the number of dry months per annum for different parts of Sub-Saharan Africa.

Relative seasonality, on the other hand, refers to the relative contrast between the amounts of rain at different times of the year. Walsh (1981: 13) has proposed an index to reflect this type of seasonality: the sum of the absolute deviations of mean monthly rainfall from the overall monthly mean, divided by mean annual rainfall. This index ranges from 0.00, if all months have equal amounts of rain, to 1.83, if all rain is concentrated in a single month. (In reality, these extremes do not occur anywhere). Figure 2.2 shows the spatial distribution of this seasonality index, as calculated for Sub-Saharan Africa.

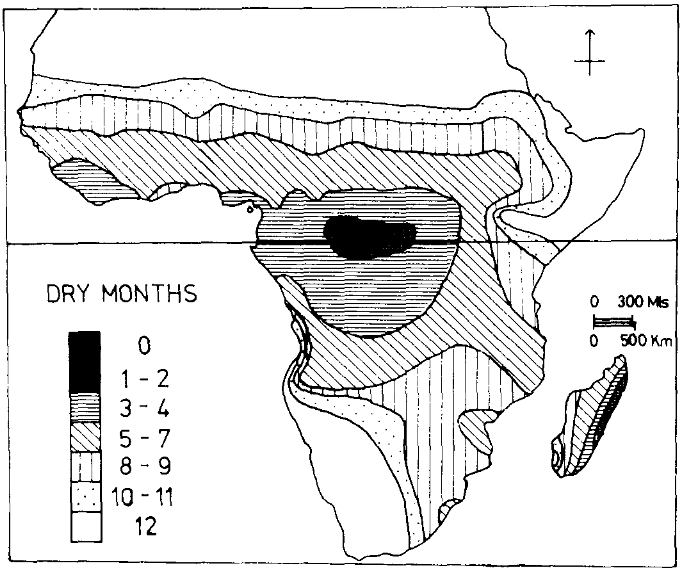

Figure 2.1: **Sub-Saharan Africa: dry months per annum**

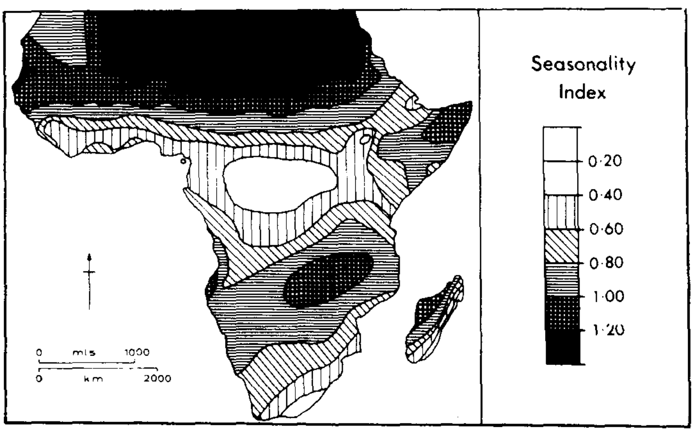

Figure 2.2: **Seasonality index for Sub-Saharan Africa**

N.B.: The formula of the seasonality index (si) reads as follows:

$$si = \frac{\sum_{m=12}^{m=1} \left| \frac{\overline{P}_j}{12} - \overline{P}_m \right|}{\overline{P}_j}$$

in which $\overline{P}_j$ = mean annual rainfall

$\overline{P}_m$ = mean monthly rainfall for month m.

Source: Walsh, 1981.

b) *Interannual and intermonthly variability.* The first can be measured as the yearly deviation from the average annual rainfall. In semi-arid climates this variability can amount to 30 per cent or more. In really dry climates the figure can even rise to more than 100 per cent. Equally important for the timing of agricultural activities if not more so is the monthly reliability of rainfall (= deviation from the mean monthly rainfall). Will there be enough rainfall to start planting? Will the rains, necessary for the ripening of the crops be in time? And if so, will these, again, be sufficient? In general, if mean annual rainfall is low, reliability - yearly and monthly - tends to be low as well. Seasonality tends to be inversely related to the annual level of precipitation, and the more marked the seasonality of rainfall, the less reliable the rainfall during the rainy season (Walsh, 1981: 17). This is the reason why three out of ten harvests are poor or fail completely for millions of people living in semi-arid areas .

c) *Spatial variability.* Although somewhat neglected in the literature, it is well-known that precipitation can differ greatly over short distances and that crop yields can vary substantially in nearby places. Again, if mean annual rainfall is low, spatial variability tends to be high. For instance, the distribution of rainfall in a relatively dry region in Mali was found to be highly localised. This factor, together with differences in soils and access to fertilizer results in considerable differences in harvests between neighbouring villages (Toulmin, 1986: 65).

As mentioned, the growing season in systems of rain-fed agriculture depends on, first, the quantity and distribution of rainfall and, second, the rate of moisture loss. The rate of moisture loss is dependent on soil characteristics, the type of crops cultivated and the methods of cultivation. Soil characteristics like texture, structure and porosity determine the infiltration capacity and storage capacity of the soil. Usually, the greater the infiltration capacity (e.g. of sandy soils), the less the storage capacity, but this can be overcome with cultivation methods favourable for conserving soil moisture, for instance by manuring or by mulching.

As a consequence of the moisture needs of plants during their growing cycle, normal or even above-normal rainfall as such is not sufficient for a good harvest. Equally important is the distribution of the rainfall over time. For instance if the late rainfall, necessary for the ripening of the crops, is insufficient, the harvest will still be poor, however good the first rains may have been. In regions with two rainy seasons, harvest failures are less likely to occur than in unimodal climatic regimes. Moreover, a much wider range of different crops can usually be cultivated which also tends to reduce the risks of poor harvests. The less the annual rainfall, the shorter the rainy season, the shorter also the agricultural cycle, and the more seasonally concentrated the harvest will be.

The potential of agriculture falls steadily as the number of dry months in the year increases (Bayliss-Smith, 1981: 33) and this applies not only to cultivators but also to the pastoralists who use regions where rainfall is insufficient for rain-fed agriculture.

Climatic seasonality and the ensuing agricultural periodicity affect many aspects of daily life. Some of these can be considered to be effects, notably changes in labour needs, food consumption, nutritional status, health, vital events as well as various aspects of social life. Others have to be regarded as being more in the nature of coping-mechanisms, notably adaptations in the economic sphere (trade, prices), the demographic sphere (migration) and the political sphere (government interventions).

2.2. Effects of seasonality

Labour

Seasonal concentration of the production cycle firstly implies seasonal concentration of productive labour, although seasonal labour for crop cultivation differs from that for livestock keeping. The main activities of cultivation are land preparation, planting, weeding (often in two rounds) and harvesting. The precise timing of the agricultural activities, however, depends on the ecological characteristics of the area concerned and on the kinds of crops that are cultivated. For instance, harvesting in certain valley areas in eastern Zambia occurs more than one month earlier than on the adjacent plateau, because of the higher temperatures in the valleys. Planting operations of the three main food crops in this region - maize, groundnuts and sweet potato - follow each other closely during the planting period from November to January. At the same time, the planting of cotton - the main cash crop here - can be spread evenly over this period (Kumar, 1985: 3-5). Nevertheless, overlap of some activities is usually inevitable :

> (...) the peak agricultural activity in the African tropics tends to be in the middle of the wet season. The single most demanding operation is usually weeding. It is this task, combined with harvesting the early food crop and perhaps sowing a late crop, that causes the midseason peak, particularly in the moist savanna region. (Cleave, 1974: 190)

In many parts of Africa, there is in fact a shortage of labour during these periods, the more so because school holidays tend not to coincide with peak labour seasons, as shown for six countries in East and Southern Africa. Generally, school holidays are national and do not take account of local conditions. Poorer farmers, who can not afford to hire labour, are thus forced to keep their children at home when their labour is needed (Fowler, 1982: 70).

Livestock herding comprises three major tasks: supervising (or pasturing), watering and milking. Of these, supervising and milking do not need much labour. Watering, on the other hand, "is an arduous, energy-consuming task (...) for which peak labour requirements occur in the dry season (...)" (Swift, 1981: 84). As surface water dries up, wells have to be dug in dry riverbeds and have to be maintained. With the duration of the dry season wells have to be dug deeper and deeper while at the same time more and more cattle return from outlying areas where standing water is exhausted (Ensminger, 1985: 2). This means that long distances have to be covered in great heat; on arrival at the wells the herdsmen have to hoist water into the watering troughs, which is generally regarded as back-breaking work (White, 1986: 20).

The labour bottlenecks that exist in crop cultivation and livestock herding therefore tend to occur in different seasons. In the first case peak labour requirements occur during the wet season; in the second case of pastoralists during the dry season. Where the two agricultural systems exist together, they may function supplementarily, at least in terms of labour requirements. An example can be found in Central Bagamoyo district, Tanzania, where pastoralists meet the labour shortages in the dry season by employing cultivators as herdsmen (Ndagala, 1981: 189). The reverse situation, pastoralists employed by cultivators during the wet season, does not seem to exist, however.

Traditionally, many of the tasks connected with crop cultivation or livestock herding were more or less allocated by gender. Men were expected to do the clearing and preparation of the land and to assist with the planting, women were responsible for the weeding, while both sexes usually participated in harvesting. (It must be kept in mind that the labour division of the sexes shows considerable variation according to the type of crop and the region of Africa.) Another division of labour has developed in respect of the cultivation of cash crops. In general, men tended to occupy themselves mainly with cash crop production, while women were given the responsibility for food crops. Nowadays, in many parts of Africa, women are expected to grow most of the family's food (Chambers, 1981). Similar divisions tend to occur among pastoralists, where women are often responsible for milking, dairy processing and selling, the care of young animals and whatever cultivation occurs, while men are responsible for the watering and grazing of livestock. The gender division of labour therefore also means that peak labour demands may fall at different times of the year for the sexes (Haswell in Cleave, 1974: 112).

However, the gender division of labour is breaking down rapidly and proving flexible in case of need, as examples of many different societies demonstrate. In many areas of Kenya, for example, but elsewhere in Africa as well, women had to fill in the labour gaps that inevitably occurred because of the growing need for off-farm employment of the men. In fact, many of the women in well-off households tend to function as farm managers in the absence of their husbands (Veldhuis, 1981; Hoorweg et al., 1983). Most agricultural tasks are now performed by men and women alike, with only a few specialized activities reserved for either sex as further examples from Machakos, Embu and Nyeri demonstrate.[3]

True as the above may be, it refers only to the sexual division of agrarian labour. There is a whole range of domestic tasks to fulfil and these still tend to be exclusively female activities. House-cleaning, food preparation, collecting of water and firewood, child care, etc. are highly time and energy consuming tasks. Moreover, these are year-round activities and some of them are also seasonally dependent. It means that an increase in agricultural work often goes at the cost of the domestic activities. This has consequences in the sphere of food consumption, nutrition and health (Schofield, 1974; Jiggins, 1986; Palmer, 1981), which will be dealt with in the next section.

Food Consumption, Nutritional Status and Health

Seasonality in crop production implies fluctuations in food supply and food availability. After the harvest, i.e. during the dry season, there is usually enough food for some time. But during the following wet season food stocks are slowly depleted with food becoming more and more scarce during the few months before the next harvest. This is especially the case in unimodal climates. Kumar (1985: 10) reported that in Zambia by the end of the planting season, only about 40% of the households had maize stocks remaining, only 15-20% of the households had sorghum and

[3] "The division between the sexes, with women responsible for cultivation and men looking after the cattle, is no longer in evidence anywhere in Masii [Machakos District]. There are no major agricultural operations which are not undertaken by men (...) and none is closed to women neither."

"In neighbouring Embu district the pull of outside employment for men has resulted in women taking over a wide range of tasks that were formerly a male prerogative (...), although few cases were noted of men performing tasks traditionally regarded as women's work."

"In Nyeri district the division of tasks between men, women, and children was found to be very variable, with only a few specialized processes reserved to any one category (...)." (Cleave,1974: 171-172) groundnuts, and almost no one had sweet potatoes left. At the time of harvesting, only 10% of the households still had any maize in stock. But even in bimodal climates food stocks are usually at a minimum level by the end of the rains. In Central Kenya, less than one-sixth of the households had any food items left in store by the end of the short rains, a figure that differs little from that for the unimodal Zambian situation.

In pastoral societies, milk production depends on the breeding cycle of the female animals which means that milk supply is largest during the rainy season (White, 1986: 21). Although the production cycle of milk also depends on the kind of animals, the fact remains that milk production is at its lowest during the dry season (Swift, 1981: 82).

For cultivators food shortages therefore tend to be highest during the wet season and just before the harvest; this is also the period during which hard work is required. Similarly for pastoralists, food availability is lowest during the dry season, which for them is the season in which peak labour requirements occur.

The amounts of food in household stores, however, do not offer a full picture of the food situation, because of the possibilities of food supply through other channels: purchases and gifts, not to mention famine relief. Earlier on, it was already mentioned that survey material collected by Schofield (1974) revealed that in villages with a unimodal rainy season, the percentage fulfillment of caloric requirements was 100% in the dry season and 88% during the wet season. It is not surprising that there is further variation as well, notably between families of different socio-economic levels. Reardon & Matlon (1985) analysed caloric intake levels in two communities in Burkina Faso: a mainly pastoralist community in the Sahel-zone (Woure) and a village of cultivators in the slightly less drier Sudan Savanna-zone (Kolbila). The authors did variate seasonal energy intake levels with the wealth levels of the households. There was little difference between the caloric intake of the 'poor' in Woure compared with the 'poor' in Kolbila but the intake of the 'middle' and 'rich' strata in Woure was much higher than in Kolbila. Consequently, in pastoralist Woure there was a large difference of caloric intake between the 'poor' on the one hand and the 'middle' and 'rich' on the other. Seasonal fluctuations in calorie intake were by far the largest among the 'poor' and during the hot season their energy intake was far below standard. In Kolbila, on the other hand, only the 'rich' enjoyed substantially higher intakes than the 'poor' and the 'middle' groups respectively. The two latter groups showed the same strong seasonal fluctuations in calorie intake as the 'poor' in Woure, be it during the rainy season instead of the hot dry season. The importance of differences in socio-economic level will be discussed further in the section on coping mechanisms.

In addition to the variations by social class, there are strong indications that the intra-household distribution of food is uneven, also in times of stress. Analysing data on energy intake from 10 African village studies, Schofield (1974: 25) concluded that

> in relation to their requirement, adults (excluding pregnant and lactating females) consume more than any other age group. Adult males fulfilled calorie and protein requirements at 101 and 231 per cent respectively, while adult females achieved lower levels of 96 and 136 per cent. Pre-school children fulfilled calorie requirements at a much lower level (80 per cent) than the per caput figure (94 per cent) but the differences were not significant.

Since then, several other studies have confirmed this picture: small children and pregnant and lactating women are the most vulnerable groups during periods of intensive labour and food shortages. Rowland et al. (1981: 170), for instance, found that in a Gambian village pregnant and lactating women had energy intakes considerably below the normally accepted range, and that this effect was most marked during the rainy season. The deficit was even greater if the high energy expenditure associated with farming activities during that period was taken into account. Niemeijer et al. (1985) also found that the energy intake of children (relative to requirements) was considerably less than that of adults during the lean season. As a consequence, weight fluctuations of these women showed the same seasonal pattern: "pregnant and lactating women lost weight during the middle of the rainy season, though the former group at least would have been expected to gain" (Rowland et al., 1981: 170).

It is not surprising, then, that birth weights and breast milk yields vary with season as well. Birth weights tend to be higher for children born in the dry season, while breast milk yields are lowest at the end of the rainy season (Rowland et al., 1981: 168; Onchere & Slooff, 1981: 42). Children born in the beginning of the wet period show slower growth progress than children born in the beginning of the dry season, at least during the first six months of life. From then on, breast milk is supplemented with other food from the recent harvest, so that from that age on babies born in the beginning of the wet season may be better off. More specifically, Bantje and Niemeijer (1984: 375) found in a rural area in Tanzania that birth weight falls by about 60 g in the course of the rainy season. Rainfall has a negative impact on birth weight after three months. Moreover, deviations from average rainfall show a positive correlation with birth weight after four months, but only in the months when rainfall is critical for food crop production. McGregor et al. conclude that season of birth as well as age dictate the average pattern of weight gain during the first year of life. Thereafter, average weights were unusually good during the dry months and poor during the wet months (cited in Longhurst & Payne, 1981: 46). Similar patterns can be seen in pastoral societies. For instance, Loutan (1985: 216) found that children of 1-5 years of age actually lost weight at the end of the dry season, i.e. the season of food shortage.

There are not many studies that include an analysis of changes in adult weight by season. One concerns Kumar's survey in eastern Zambia in which he found that during the wet season the weight for height ratios for adults were at a minimum, rising from the beginning of the dry season and reaching its highest level just before the next wet season (Kumar, 1985: 18-19). Longhurst & Payne (1981: 46) mention two other surveys, one in Gambia and one in Ghana, where the same seasonal pattern in body weight was found. In a pastoral society like that of the WoDaaBe in Niger, adult weights fall sharply during the hot dry season, men and women alike (Loutan, 1985: 213-215).

Many authors stress the prevalence of certain diseases during particular seasons (Bradley, 1981; Chambers, 1982; Chambers et al., 1979; Rowland et al., 1981; White, 1986). Respiratory tract diseases like pneumonia and bronchitis as well as measles occur significantly more often during the dry season in the Bagamoyo region in Tanzania (Goetz, 1981: 183). Tomkins (1981: 177) reports the same regarding the Zaria region in Nigeria, adding that serious epidemics of cerebrospinal meningitis occur each year at the end of the dry season.

'Typical' wet season diseases are, according to these two writers, gastroenteritis (diarrhoea, vomiting), guinea-worm, malaria, anaemia, typhoid and protein-energy malnutrition. Of these, malaria, diarrhoeal diseases and guinea-worm show the most marked seasonal patterns. And although all age groups are affected, "the brunt of the first two falls upon infants" (Bradley, 1981: 130).

This is the more so serious because gastroenteritis and malaria have negative effects on the growth of children (Rowland et al., 1981: 170). The same seasonal pattern occurs with severe forms of protein-energy malnutrition (PEM). Tomkins (1981: 178) reported a peak of admissions to hospital for clinically severe PEM during the rainy season in Zaria.

In general, the wet season is the time when the health situation is at its worst. At the same time, it is the season of the highest labour requirements and of food scarcity. Malnutrition is one of the main causes of the rise in morbidity during the rainy season because it makes people more susceptible to infections. There are other factors, like rainfall and temperature, that also determine the seasonal cycles of diseases (Chambers et al., 1979: 12; Bradley, 1981: 130). Many insect vectors depend on surface water for breeding, so vector-borne diseases like malaria and guinea-worm (and, to a lesser extent, schistosomiasis and sleeping sickness) prevail during the wet season. Still other causes are to be found in seasonal variations in behaviour. Close physical contact between people indoors during cold nights may facilitate the spread of some respiratory infections.[4]

What has been said about morbidity applies, to a certain extent, to mortality as well. Young children of poor households can be considered the most vulnerable group (Dyson & Crook, 1981: 139-141), especially during the wet season. Regarding diarrhoeal diseases, Onchere & Slooff (1981: 45) found that 80 per cent of deaths of under-fives in Machakos district, Kenya, occurred during the long rains, most before the age of one year. Other death-causes, however, were fairly evenly spread throughout the year.

Schofield (1974: 33) argues that children born in the first half of the wet season are the most vulnerable, as birth weights at this time of the year are low and breast-feeding and child care are inadequate due to the female agricultural labour inputs peak in the wet season. A similar, though seasonally reverse finding, comes from Eerenbeemt (1985: 102). In the pastoral Fulani society of central Mali, children born in early March, i.e. the beginning of the hot dry season, appear to have a higher risk of dying, especially during the first year of life. Children born in June, i.e. the beginning of the wet season, when food is abundant and labour requirements are relatively light, had significantly greater survival chances, up to the age of five.

Social Life

Seasonality also has a profound impact on social relationships within African rural communities. Some of these will be discussed in the section on coping mechanisms, for instance where labour and debt relationships between poor and rich households are concerned. Another example is the wide range of redistributive mechanisms that exist(ed) in many communities and that are/were destined to meet the adverse effects of climatic fluctuations.

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4 Waddy (1981:175-176) gives the interesting example of cerebrospinal meningitis (CSM) in north-west Ghana. CSM is an epidemic disease caused by an organism which is spread via the respiratory route. The organism concerned (meningococcus) can survive for only very little time in moist air and is killed by ultraviolet light. CSM is spread during the dry season, from one person to another in dark, interior conditions, i.e. during the cold nights when people sleep close to each other.

In former times people had no blankets, and in the cold nights of the dry season, they slept close together to keep warm. A slight rise in the level of living, however, reduced the incidence of CSM considerably. The development of a money economy, just enough to enable a man to buy blankets to keep his family warm at night, was enough to demote CSM from its former status.

Other aspects of social life that show seasonal variations concern such events as marriages, communal festivities and the functioning of certain social organisations during specific seasons. In central Mali, "most marriages take place in the period after the harvest when the hard work is over and life temporarily slows down" (Eerenbeemt, 1985: 89). This may explain the seasonal peak in births after the rainy season, which indicates a higher conception rate in January at the end of the cold period. Among the Nigerian Onicha Ibo marriages were rarely contracted during the hunger months, especially the last two months before harvest. Moreover, during the latter period "there are public rituals involving feasting and extensive hospitality". Most religious activities take place at the end of the new yam month (Ogbu, 1973: 323).

In the existing literature, little attention has been given to the seasonal dimensions of rural social organisations. Fortmann (1985) has suggested a continuum of rural social organisations related to the seasons. At the one end we find 'continuous organisations' which function on a year-round basis. The other end is formed by 'seasonal-functional organisations' which "operate at a specific time of the year and then disappear until the following seasons. Such organisations are typically tied to some part of the agricultural production cycle." (Fortmann, 1985: 384). Examples from Botswana are informal groups of women, who "organise themselves to weed or to harvest each other's plots and then disband" (Jiggins, 1986: 12); fencing groups, which "erect and maintain fences primarily when they are at the lands but when the need for labour for other agricultural activities is less pressing"; and, finally, so-called dam-groups consisting of farmers who agreed to maintain small dams for livestock and regulate their use. Both maintenance and regulation took place solely during the dry season (Fortmann, 1985: 378).

2.3. Preventing seasonal stress

People adjust to seasonal stress in many ways, showing diverse adaptations in the agronomic, nutritional, economic, demographic and social spheres. There comes a stage, however, when ordinary measures may prove insufficient and when food shortages occur. Most writers have concentrated on the ways people cope with the more severe forms of seasonal stress, as in the case of hunger, famine and other desperate circumstances (Messer, 1985; Apeldoorn, 1981; Longhurst, 1986; Jiggins, 1986; Dietz, 1987). It is important, however, to distinguish between measures to prevent seasonal stress and measures to meet actual stress. In the first case we are dealing with more or less structural strategies, in the second case with famine-related responses, although the latter are often extensions of the former and it is not always easy to draw a clear line between them.[5] We will first review the potential measures to prevent seasonal stress.

Agriculture

Possibilities for preventing seasonal stress lie, first of all, in agricultural practices. Longhurst (1986: 28-29) and Apeldoorn (1981: 59) mention different possibilities for cultivators to reduce the risk of harvest failures. Many of these have been practised since a long time back. A first adaptation consists of cultivation in different ecological zones, if land is available. Another adaptation concerns the choice of crops : mixed cropping of sorghum and millet is an example (see also Watts, 1981: 203). Millet has a shorter maturation period than sorghum, but is a lower yielding crop. Many farmers, furthermore, cultivate some cash-crops which are drought-resistant (cotton, groundnuts) in order to obtain some money that can be used to buy food (amongst others) during the next lean season. Secondary crops, moreover, often form an important supplement of the staple diet. In this respect, Longhurst (1986: 29) has distinguished the following types of crops:

a) Gathered crops, including wild vegetables occasionally cultivated (...). In a seasonal (...) context, such crops are important as relishes and salads (...).

b) Crops mixed into fields of staples, such as legumes, pumpkins and melons (...). In good years they may not be harvested, and are eaten as snacks in the fields (...).

c) Cultivated vegetables in home gardens near the compound (...). Such vegetables, being intensively watered and manured, can mature early and have a seasonal role (...).

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5 There is some debate concerning the term strategy as in 'survival strategy' which implies social behaviour that is consciously lined out regarding a future aim. The selling of jewelry, for example, in order to obtain some money to buy food can hardly be termed as a strategy. In our case the term will be used to refer to measures to prevent seasonal stress.

One of the most informative studies on coping mechanisms in Kenya is that by Dietz (1987) on the semi-arid district of West-Pokot. The Pokot traditionally lived a pastoralist way of life, many of them are cultivators as well and they avail of a wide range of adaptations to crisis situations. Although the study focuses on periods of sustained dryness and not on seasonal food shortages, many of the mechanisms described by the author can be found among the seasonal measures described in the present text.

d) Non-staple root and tuber crops grown as a contingency reserve and which do eventually get harvested (...).

Another type of crop can be added to this list. Tree crops, such as fruits, nuts, seeds and berries, can be harvested during the dry season or the whole year round, and can serve as a fall-back in bad years and during famines (Chambers & Longhurst, 1986: 46).

The choice of cultivation methods offers a third adaptive possibility for farmers. This can range from simple measures like reducing the distances between plants, the cultivation of entirely new crops, small changes in technology, to, ultimately, the one solution to overcome climatic seasonal stress: irrigation if water is available.

A fourth choice concerns the possibility of mixed farming, i.e. breeding livestock in addition to crop cultivation. Dairy products not only offer a good supplement to the daily diet but animals can serve as an insurance against bad times as well. When food is short, livestock can either be slaughtered or sold in order to buy food.

In pastoralist societies entirely different agronomic mechanisms exist to prevent seasonal stress. Sahelian pastoralists control the breeding of their camels, cattle, sheep and goats in such a way that the lactation periods of the different species of animals are spread as much as possible over the year. In this way, the Kel Adrar Twareg of north Mali spread their milk supply throughout the year, as far as the extreme climatic seasonality allows, although it appears to be impossible to accomplish this completely. This system is, of course, only possible if herds consist of several species of animals (Swift, 1981: 81).

Population Control

A totally different kind of adaptation lies in the demographic sphere. In societies where food supply varies widely and where acute food shortages may occur any year, it is important to keep human populations small. Although little literature exists on this topic,

> there is evidence that African nomadic pastoralists in general have low rates of natural increase compared to neighbouring farming people, and that these are due to low birth and death rates (...). These differences (...) seem to be the result of social regulation of the demographic processes. (...) in various African pastoral societies, such practices as generation grading coupled with a ban on child bearing in the junior grades, late marriages, and post-natal sexual abstinence are found. There is suggestion that Somali-pastoralists practice sexual abstinence during the dry season and in drought years (Swift, 1981: 85).

Evidently, such brakes on the demographic process may keep populations low in relation to resources, and could ease conditions at the time of the lean season.

Redistribution of Resources

Adaptations of a social and economic nature are equally, if not more important. In many African societies, there exist networks of social relations of a redistributive nature, or 'redistributive social matrices' as Watts (1981: 202) calls them. These networks serve as a kind of insurance against outright poverty (Longhurst, 1986: 30) and they take several forms. In Muslim societies, the grain tithe brings about immediate post-harvest distribution of food-grain production (Simmons, 1981: 78). Patron-client relationships are common in Muslim societies in which men provide regular farm labour for rich farmers in return for wages and food. These patrons are expected to give extra support in case of famine (Longhurst, 1986: 30). A third kind of network consists of the complex gift-giving relationships between men and between women. The gift, in this case, is an investment that serves "both as a means of gaining prestige and as a security to guarantee subsistence should hard times arise" (Watts, 1981: 202).

Similarly, in Sahelian pastoralist societies cattle-borrowing occurs widely among households. Among the Kel Adrar Twareg of north Mali, a network exists of

> traditional non-market transactions with animals which serves to mitigate seasonal or sudden unexpected food shortages. If a household does not have enough animals to provide a sufficient milk supply, it can go to a richer household and borrow animals according to one of a number of standard agreements, which include the seasonal loan of a lactating animal. In minor seasonal or other crises, these transactions serve as redistributive mechanisms by which the rich help the poor (Swift, 1981: 86).

With the onset of colonial rule, however, the rural communities have been incorporated more and more into the colonial economies. Growing monetisation (taxes) and commodity trade created new forms of dependence (middlemen) and the traditional social systems came under pressure (Watts, 1981: 204). As a result, in many societies, social and demographic coping mechanisms broke down or were adjusted to the new circumstances. In general, a shift took place to economic adaptations.

Income earning

Commercialisation of agriculture - notably the sale of cash crops, selling of livestock, and the sale of farm products - can potentially provide the means for a successful adaptation to seasonality apart from their other economic functions. That this is not always the case, is self-evident. Lump expenditures for school fees, weddings and funerals often mean that the money from these sources is only available at certain times of the year but not for the purchase of food during the lean season. Moreover, selling and buying prices often vary in such a way that people sometimes are forced to sell certain food crops at low prices, only to buy the same foods back at higher prices later on.

A wide range of further gainful activities can also serve to minimise the risks of climatic seasonality (Longhurst, 1986: 30; Apeldoorn, 1981: 60-64; Messer, 1985: 31-32). Three kinds of income earning are generally open to small-scale farmers: (a) home industry; (b) trading activities; and (c) wage labour.

In general, people are quite ready to seize any (local) opportunity in the productive and/or trading sphere. These can be farm-related, like the processing and selling of agricultural products (leather, weaving products) or directed towards the exploitation of natural resources. Examples of the latter are hunting, fishing, firewood-cutting, selling of charcoal, selling of craft products made of grass and wood, etc. All these activities can be regarded as sideline activities in order to have some sort of income beside their main occupation of farming. Apart from these, there is a group for whom the situation is reversed: owners of shops and cafes, as well as people who are in the trading business on a more professional basis and who often cultivate as well, although one can not speak of adaptive behaviour regarding seasonal stress in this case. All depends on the scale of business compared with the farming activities.

Wage labour is another option open to small farmers suffering from seasonal incertitudes. If this occurs intermittently, it can be considered a measure to prevent the adverse effects of seasonality by securing an income from which food can be purchased. The most extreme form is permanent migration by the head of the household for employment purposes, leaving his family behind. Again, it is questionable whether this should be regarded as coping with seasonality, although it is certainly part of the survival strategy of the household.

Migration of men, however, can have quite negative effects on the work-load of women, although this seems to be more associated with the longer-term circulation than with the truly seasonal labour migration (Rempel, 1981: 213). In a study of the effects of migration of men on the position of their wives who stayed behind on the farms in Machakos District, it was reported that the work-load of these women had considerably increased: apart from their 'traditional' tasks in the household and in food cultivation they had to take care of the coffee cultivation as well and they generally found it difficult to cope with so many tasks (Veldhuis, 1981: 106).

2.4. Meeting acute seasonal stress

Food Consumption

Once the adaptive mechanisms to prevent seasonal stress are exhausted and food shortages do occur, the range of possible adaptations is narrowed. There remain, of course, possible adaptations in respect of food consumption, notably the consumption of alternative foods and the rationing of daily meals. Certain foods are usually designated as 'famine foods'. These are foods growing wild such as vegetables, nuts, berries and parts of trees. In normal times they are consumed only by the very poor and their consumption is usually a sign of shame (Longhurst, 1986: 32). Not all 'famine foods' necessarily grow wild. In the section on agricultural adaptations we have seen that some farmers have plots with cassava, only to be harvested in times of food shortage. In some instances, treecrops are a significant source of alternative food. All local surveys in the Sahel and in Northern Nigeria are reportedly agreed on the importance of this (Apeldoorn, 1981: 61). Rationing of daily meals implies a reduction in the number of meals per day, the quantity of food per meal, and the types of food consumed (Messer, 1985: 30-31). This is one of the more drastic ways of coping with hunger but all the same quite common in large parts of Africa and the more severe because, as we have seen, the period of food shortages is also the period of heavy labour.

Community Support

During such times, people also rely heavily on the help of their relatives and on other social relations. In the previous section we noted the existence of such social patterns as patron-client relationships, gift-giving and borrowing of animals. During periods of food shortages those who suffer most have to call on such support most often. Usually, this places the weaker party - the 'client', the 'giver', the 'borrower' - in a position of dependence and if conditions do not change for the better during the next season, he/she may be forced to turn to more drastic measures such as the sales of assets and farm land. With food stocks depleted and without other sources of income, it may become necessary to sell personal possessions, such as women's jewelry. At the same time, mortgaging of the farm land will take place. Often, this is the forerunner of outright sale, as Longhurst (1986: 33) observed in northern Nigeria. Among pastoralists, sales of livestock may become inevitable. The richer herders profit from these forced sales, because during the dry season cattle prices are low. As a result, "with each drought year, an increasing number of poor people may be forced out of their pastoral lifestyle" (Swift, 1981: 86).

Household Migration

When all possible means of obtaining food are exhausted, a final option remains: leaving the homestead to try and find a living elsewhere. In some cases this is a regular option where people have plots of land in other areas, or in the case of moving cattle to other, better watered, pastures. However, 'elsewhere' usually means a place where relief food is distributed. This type of migration is entirely different from regular migration, i.e. for economic and employment purposes. Another difference is that forced migration concerns whole families, not just one or two single members of the household. Moreover, the chances of returning home are much smaller than in cases of voluntary migration (Apeldoorn, 1981: 62-63; Longhurst, 1986: 32-33).

External Assistance

In exceptionally grave circumstances, it is also possible that relief from outside is offered, for instance by missionary organisations or governments, although this is usually not offered until two consecutive years of drought have occurred. A recent study in the Pokot area, Kenya, offers an historical overview of the ways in which the government as well as missionary organisations dealt with periods of food shortages. The author concludes that the effects of these interventions can be very different. On some occasions, the organisations undermined local adaptations and directly contributed to the food crisis. On the other hand, in several cases they played a positive role and offered valuable additions to the indigenous coping mechanisms (Dietz, 1987: 232-238).

2.5. Conclusions

Seasonality is a common phenomenon in Africa. One should realize, however, that its impact is not equally felt in each region and by each household or individual. At least four factors - on different levels of analysis - seem to determine the degree to which adverse effects are felt and, consequently, what coping mechanisms can be used. These are: climate, i.e. rainfall deciding agro-ecological conditions; form of productive organization; resource level, which further determines household conditions; and finally, within households, gender and age, giving individual differentiation.

1) The dryness of the climate is usually expressed in terms of rainfall per year. According to the existing literature, there is a negative correlation between this figure and the several forms of rainfall variability, i.e. the yearly variations in total precipitation, the variations between the same seasons in different years, and spatial variations. In general, the drier the climate the more seasonality is felt, which in turn implies that agricultural production is more risky and food shortages more likely to occur.

Obviously, coping mechanisms will vary with the dryness of climate. In drier regimes, strategies designed to prevent seasonal stress are less likely to have the desired results and people will have to resort to famine-related responses earlier. Mbithi & Wisner (1973: 124) found some evidence for this in Kenya. They compared adjustments to seasonal droughts in three neighbouring ecological zones. Farmers in the high potential zone were able to tackle seasonality mainly by agronomic measures, i.e. measures to prevent food shortages. Farmers in the low potential zone, on the other hand, most frequently mentioned famine-related responses like buying food and selling livestock.

2) As regards the form of productive organisation, the following observations can be made. In more or less 'traditional' rural societies agricultural production is mainly devoted to household self-subsistence. Specialisation is limited and so is the exchange of produce. Moreover, there is no private ownership of land, and land is not scarce.

The strength and viability of such communities depends to a large extent on the number of people and thus the labour at its disposal. There are therefore good reasons to redistribute labour and produce, in order to maintain as production units those households most vulnerable to misfortune, including seasonal stress (Raikes, 1981: 70-71).

In societies with greater economic specialisation of the production process, households sell part of their produce in order to buy goods (and pay taxes).[6] In other words, people are subject to price fluctuations: crop prices tend to be low just after the harvest and high during periods of food shortages. A trading-class in agricultural products is emerging, buying at harvest time and selling in the lean period. As 'modernization' proceeds, the traditional forms of coping with seasonality - based on social networks - have to give way to more economically defined adjustments.

3) Poor households experience the effects of seasonality more severely than rich households. Reardon & Matlon (1985) demonstrated this by comparing the nutritional status of poor and well-off households. Campbell & Trechter (1982) showed the same by comparing the coping mechanisms of poor and rich households in north Cameroon. People in relatively poor villages responded to the yearly drought period by slaughtering and selling livestock. People in a better-off village had the possibility to resort to adjustments in the nutritional sphere (eating less did not necessarily mean eating too little) or earn some money through trade or wage labour. In cases of more severe food shortages, poor families collected wild foods, while richer farmers, regarding this an onerous and unattractive measure, relied more on borrowing food and/or money (Longhurst, 1986: 30). In other words, poor people have to resort to famine-related responses at an earlier stage than richer families and they are the ones with the smallest margins to cope with climatic variability (Ndagala, 1981: 191).

4) The impact of seasonality on individuals, and the available coping mechanisms, are age- and gender-specific. Because of their responsibilities for food production combined with their domestic tasks, women are more seriously affected by seasonality than men; the more so when they are pregnant or lactating. Because of the separation of tasks, coping mechanisms for women lie more in the spheres of agriculture and nutrition (Jiggins, 1986), while men's adjustments to food shortages lie more in the economic sphere (wage labour, for instance). In north Cameroon, coping with the

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6 The need for cash explains why storage of food - one of the most obvious ways to prevent seasonal stress - is no longer a feasible coping mechanism for many African rural households.

'normal' food shortage period was almost entirely a women's responsibility (Campbell & Trechter, 1982). In cases of more severe drought situations, men and women were equally involved in trying to overcome the stress (Longhurst, 1986: 30). Young children are also quite vulnerable, they often experience considerable consumption deficits at times of food shortages and show serious weight loss at such times (Niemeijer et al.,1985). In case of famine, morbidity and mortality are first to increase among young children.

It is evident that the various factors mentioned are interrelated. For instance, in drier climates there are more poor households, while women in poorer households may be hit harder by seasonal stress than women in richer households. 'Traditional' rural societies have almost ceased to exist because of growing monetisation, growing populations, and growing pressures on the land. Consequently, the finding that, for instance, in Kenya more and more people migrate to marginal areas with marked seasonality is an ominous one and there is every reason for planners and politicians to be conscious about these relationships and their implications for future development (Kliest, 1985: 78-80).

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3. Climatic seasonality and growth; longitudinal research in Coast Province, Kenya

Rudo Niemeijer & Wijnand Klaver*

3.1 Introduction

As part of the Food and Nutrition Studies Programme, a series of nutrition surveys has been carried out in Coast Province, Kenya, between July 1985 and September 1986. The objective of these surveys was to record, describe, and analyze the effects of climatic seasonality on food production and nutrition among the rural populations in the coastal lowlands, together with the coping mechanisms utilized by different population groups in order to deal with these seasonal variations. A second objective was to collect information on food practices and nutritional conditions among the rural populations in the Districts concerned (Hoorweg, Kliest & Niemeijer,1988). The present paper is concerned with only one aspect of these wider objectives, namely the analysis of the anthropometrical survey results in terms of climatic seasonality, the succession of wet and dry seasons in tropical climates.[1]

Seasonality of nutritional status is not an easily studied subject; especially not when the data-set is small and only covers a single agricultural cycle, instead of the long sequence of observations necessary for time-series analysis methods. In most surveys, such large longitudinal data-sets are out of the question. Still, careful analysis based on comparative methods with data from different ecologies or resource base levels may lead to interesting results, later to be tested more rigorously with the proper statistical models. This paper is meant to provide a kitchen perspective of this type of analysis. It is hoped that its example will lead to publication of similar studies of data on child growth obtained through population surveys.

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1 This paper is a preliminary presentation of some of the available material and has the status of a working paper as this material will be presented in a more final form at a later stage, including a detailed statistical analysis.

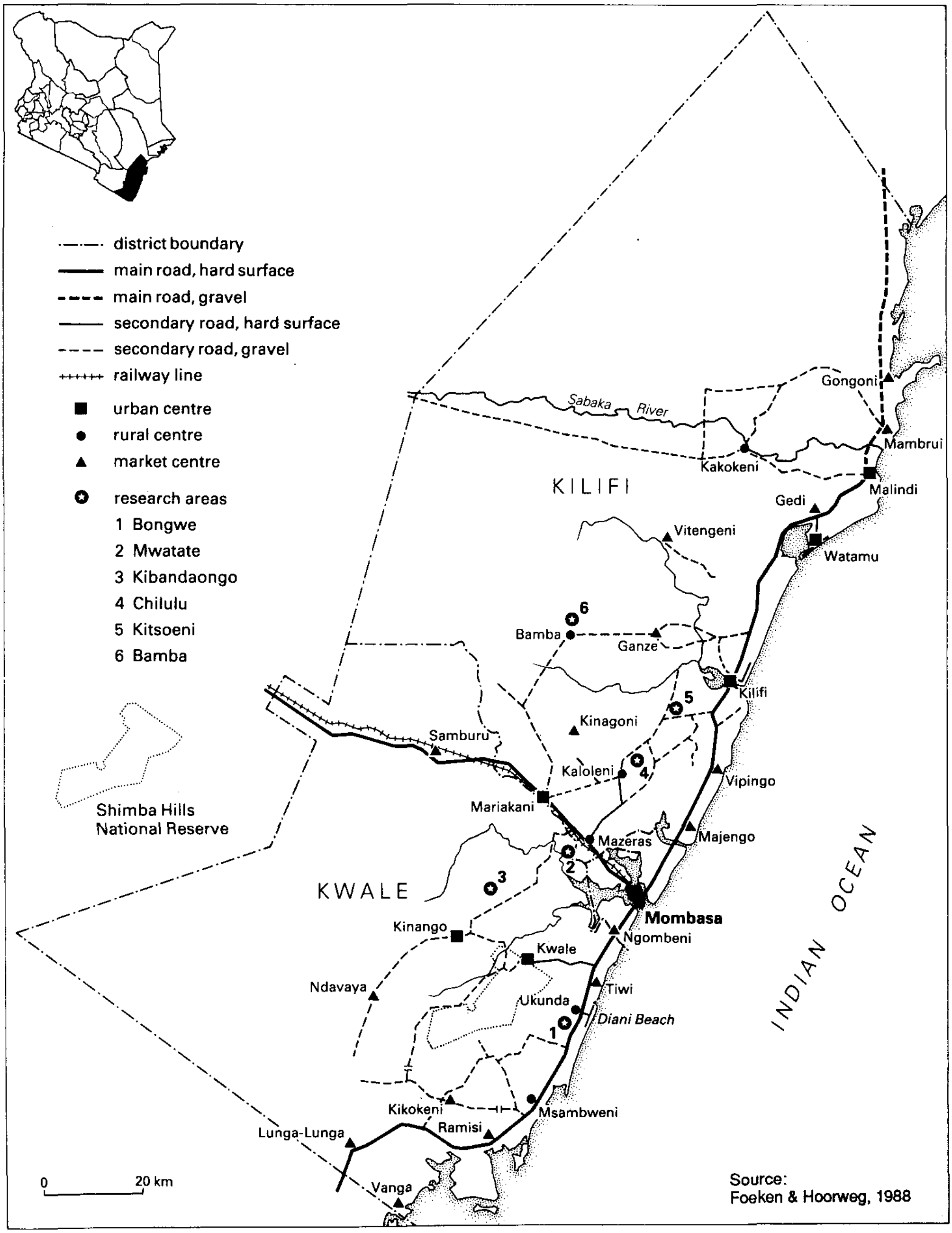

Figure 3.1: **Map of survey locations**

Design and indicators

The surveys took place in the two most populous districts of Coast Province: Kwale and Kilifi. In each district three communities were included in the survey. To cover a wide range of ecological variation these six communities were selected from the three most populated agro-ecological zones, with precipitation averages from 700 to 1300 mm/year: the coconut-cassava zone (CL3), the cashewnut-cassava zone (CL4), and the livestock-millet zone (CL5). Bongwe and Chilulu are located in CL3, Mwatate and Kitsoeni are located in CL4, Kibandaongo lies on the boundary between CL4 and CL5, and Bamba is located in CL5.

Besides representing the three most important ecological zones of Coast Province, the communities vary also with regard to their location vis-à-vis the major economic centres, in particular Mombasa and the tourist hotels along the coast. Three areas have a relatively high proportion of off-farm employment, mostly resulting from a favourable access to the labour market. Bamba is a rural administrative centre, Mwatate is on the main Nairobi-Mombasa road with frequent transport to and from town, and Bongwe lies in the coastal strip with employment opportunities in the tourist industry (see Figure 3.1).

During a period of approximately 14-15 months between July 1985 and October 1986, a total of 300 households (a random sample of 50 households from each area) were visited at intervals of about three months. Four teams of two research assistants each, together with two supervisors, conducted home visits to all households covered by the survey. It took about two weeks to complete the full research schedule in a single area.

All households were visited five times. The visiting dates were selected to obtain a representative picture of the yearly variation and to cover all seasons. Table 3.1 summarizes this for each cycle and presents some information on the conditions of food supply from home produced staples in the period preceding the visit.

At the start of the survey, that is during the first cycle, the 300 households had 2650 members, of which 2314 were full-time residents. Anthropometric observations were obtained for all full-time resident children between 6 months and 10 years of age. During each cycle the inventory of all children resident in the household was remade and measures were taken of all eligible children. Table 3.2 presents the age distribution of all children participating in the survey during the five cycles. The age distribution in the first cycle shows an apparent over-representation of children of 2 and 5 - 6 years old and an under-representation of children of 4 and 9 years of age. This suggests a tendency to estimate age in round numbers (2, 5 - 6, and 10 years - children of this latter age were not included). In later cycles the effects of this tendency of course shift slowly to older age groups.

Table 3.1

Survey cycles

Survey cycle	Date of cycle	Season during cycle	Food supply in period before visit
First cycle	July - August 1985	Before long rains harvest	Early crops, perennial foodcrops, cereals short rains (if still available)
Second cycle	November - December 1985	Short rains land preparation	Cereals long rains (if enough harvested), perennial foodcrops
Third cycle	February - March 1986	End of dry season	Cereals short rains, if harvested
Fourth cycle	May - June 1986	Long rains	Cereals short rains, if harvested Early crops, perennial foodcrops
Fifth cycle	September - October 1986	Long rains harvest completed	Long rains harvest completed

Table 3.2

Number of children included in the anthropometric observations

	6-11 mths	1 year	2 year	3 year	4 year	5 year	6 year	7 year	8 year	9 year	Total
First cycle	50	90	122	89	60	104	100	83	94	56	848
Second cycle	48	91	119	97	94	106	96	82	95	52	880
Third cycle	56	85	114	105	103	112	98	83	90	54	900
Fourth cycle	66	88	100	122	91	121	93	90	87	53	911
Fifth cycle	61	107	78	109	86	84	98	93	81	89	886

Anthropometric measures included in the study were height, weight, mid-upper arm circumference and age. Height was taken in supine position for children up to 24 months. Older children were measured standing against a portable measuring pole specially developed for the survey. Weights were obtained with electronic weighing equipment with a precision to 100 grams. Reinforced household measuring tapes were used to measure mid-upper arm circumference. The anthropometric data were checked by members of the research team during frequent field visits on a more or less random basis. When data collected in the field was inconsistent (after comparison of weight, height, mid-upper arm circumference and age) or when data collected in consecutive cycles were suspect, further field checks were made. Because a low incidence of birth registration was observed, most age estimates were checked by members of the research team during the second cycle.

Table 3.3

Number of adult women included in the anthropometric observations

First cycle	Second cycle	Third cycle	Fourth cycle	Fifth cycle
346	349	325	324	315

If the mother of children included in the survey also was a full-time resident, anthropometry was collected for her as well. The number of women for whom observations are available is shown in Table 3.3. Although this selection procedure allows to correlate the findings for the children to the condition of their mothers, it should be noted that the data on adult women exclude women without children, or whose children are outside the age group of 6 months to 10 years of age. The same equipment that was used for the anthropometry of the children was used for the adult women.

To standardize the anthropometric data obtained for the children, the usual indicators such as Weight-for-Age, Height-for-Age, and Weight-for-Height were calculated using the WHO tables. No standardization was attempted for mid-upper arm circumference. Growth figures were obtained by taking the difference of observed values at consecutive visits to the household and dividing the result by the number of months of the interval. To standardize growth data one may express the difference in terms of the standard deviations of the reference population. In this way a child growing along a particular percentile of the reference population will have zero relative growth, a child moving from a lower percentile to a higher percentile will have positive relative growth, a child moving towards a lower percentile will have negative relative growth. In this way growth of children of different ages or at different percentiles of the reference can be compared.

Because of this standardization method it is necessary to use true longitudinal comparisons, that is, when children are absent during a cycle, the growth since the preceding and up to the following cycle should not be used in the calculations. It was however not judged necessary to remove the data of such children completely from the analysis: children are included for each pair of consecutive cycles for which data are available. Nevertheless, an effort had been made to keep the number of missing data as small as possible. As long as a child remained resident in the household, and was not absent for several weeks, return visits were made to obtain the lacking data.

The anthropometric data for the adult women were standardized using a table for Weight-for-Height published by Jelliffe (1966). It is not usual to standardize height measures in the case of adult women. Pregnancy, although recorded during the survey, was not taken into account in the calculations. This means that the estimated Weight-for-Height is slightly biased and presents an over-estimate, but it is unlikely that this bias also influences the differences between survey cycles. Because residence is far less stable for the adult women than for the children, it was decided to estimate changes in Weight-for-Height of the adult women by cross-sectional comparisons only. Otherwise the number of observations, already small for seasonal comparisons, would have been reduced further.

During the survey, a considerable quantity of material was collected regarding housing circumstances and living conditions, demographic characteristics of household members, farm characteristics, off-farm employment, and food consumption.[2] Although the present paper concentrates on growth, the next two sections present in some detail the agricultural and economic characteristics of the survey population. This then provides the background for the analysis of the anthropometric results that follows.

3.2 Background description

Climate and agriculture

Precipitation is the dominant factor in the ecology of Coast Province. Along the coastal strip and on the ridges bordering this strip precipitation ranges between 1100 and 1300 mm annually. This relatively humid zone has a fair agricultural potential for food and cash crops (the coconut-cassava zone). Going inland, precipitation becomes less with levels between 900 and 1100 mm, and a lower potential for food and cash crops. Further to the interior, annual rainfall diminishes in the livestock-millet zone (700-900 mm) and the ranching zone (rainfall below 700 mm annually).

As shown in Figure 3.2, the six areas included in the present study represent this range in precipitation levels. Annual rainfall is highest in Bongwe and Chilulu.

[2] See Hoorweg, Niemeijer, and Kliest, 1988, and Foeken et al., 1989 for a detailed description of the survey and a presentation of the socio-economic data collected during the survey.

Kitsoeni, Mwatate and Kibandaongo follow with rainfall figures between 900 to 1100, while Bamba has an annual precipitation slightly below 700 mm annually.[3]

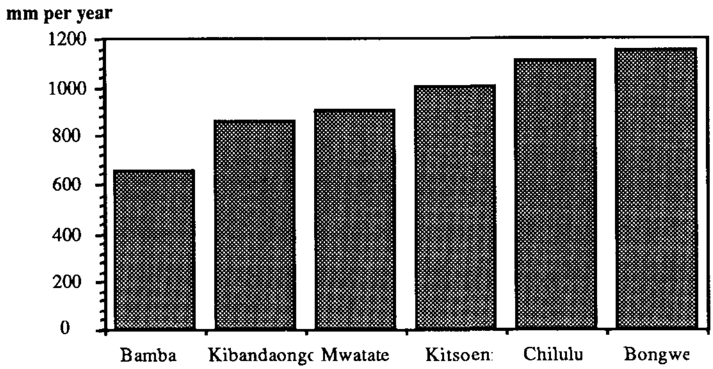

Figure 3.2 : **Average annual rainfall by research location.**

Basically, the Kenya Coast is characterized by a uni-modal distribution of rainfall (i.e. one wet and one dry season annually), but there is a tendency towards a more bi-modal (two wet and two dry seasons) distribution towards the interior. There is a marked dry period in January and February and a rainy season in April and May (the so-called long rains). More inland, a second, moderate, peak of rainfall occurs in October and November (the short rains) after a relatively dry period from July onwards. Nearer to the coast rainfall is more evenly distributed throughout the remaining part of the year.

These differences have important consequences for the type of crops cultivated, the harvests obtained, and the timing of the agricultural cycle. In general, agricultural production levels per acre vary with the level of precipitation. Figure 3.3 presents the value of agricultural production per acre for the six areas included in the study.[4]

While production levels steadily increase with rainfall in five of the six areas included in the study, Bongwe in the coastal strip has a much lower production per acre than expected for its high level of precipitation. As is shown in Figure 3.4,

3 The average annual rainfall data of the six research areas are estimated on the basis of the average recorded at the nearest weather station and corrected for topographical differences. The number of recorded years at the weather stations range from 10 to 42 years (see Foeken & Hoorweg, 1988: 44).
4 The agricultural data in this figure, like all in all others that concern agriculture, are based on one agricultural year (1985-86) only. However, conditions during that year were close to average. The rainfall data are averages over 10 - 42 years (see note 3).

Bongwe has also a relatively low agricultural labour force per acre, resulting from a low population density and high off-farm employment rates due to opportunities in the tourist industry of the coastal strip. These two factors may have resulted in a more extensive type of soil utilization in an area with otherwise a high agro-ecological potential.

The contribution of different agricultural activities to total production also varies significantly with climatic conditions. In the dry areas inland, livestock (cattle and small stock) contribute significantly to the total agricultural production. In the wetter intermediate zone, cereal and pulses cultivation (mostly maize) is the main activity, while in the humid areas perennial cultivation (cassava, banana, coconut and cashew) is dominant.

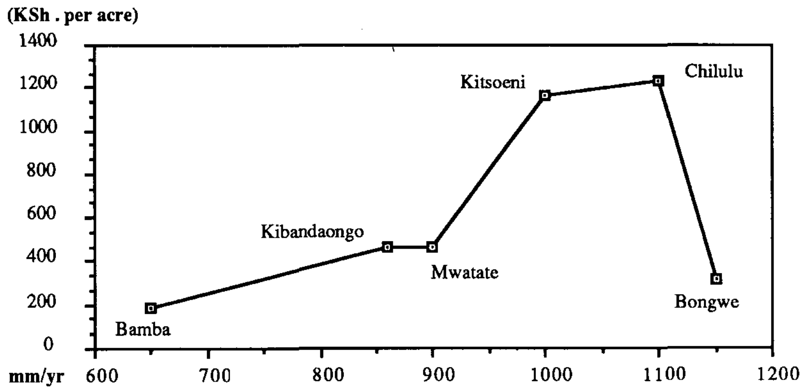

Figure 3.3: **Total agricultural production by annual rainfall.**

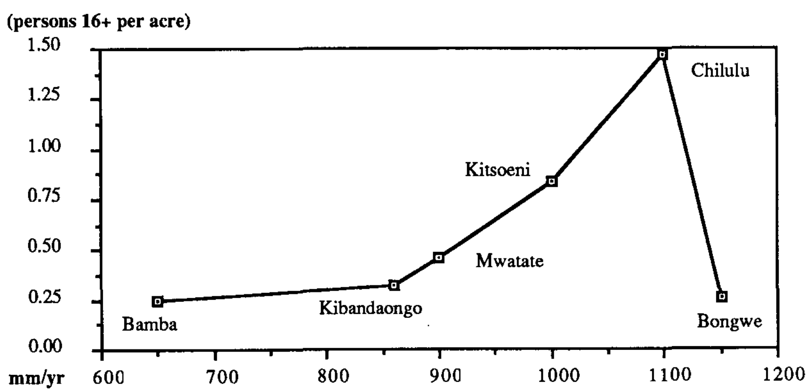

Figure 3.4: **Available agricultural labour force by annual rainfall.**

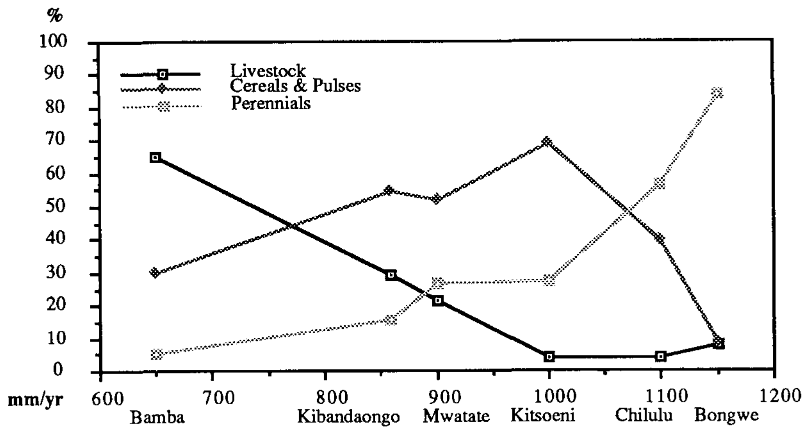

Figure 3.5: **Contribution of different activities to total agricultural production by annual rainfall.**

Figure 3.5 presents the composition of agricultural production (in terms of value) by activity type for the six areas included in the study. Precipitation indeed appears to be a strongly determining factor. In the lower range of precipitation, between 600 to 1000 mm annually the relative proportion of animal husbandry decreases linearly with rainfall, while crop production increases; however, the relative ratio of cereals and pulses to perennial crops remains roughly constant. From 1000 mm onwards, livestock keeping stabilizes at a level of about 6 % of total agricultural production and the cultivation of perennials rapidly increases to replace the cultivation of cereals and pulses as the major activity. Taking all six areas into account the proportion of production contributed by perennial cultivation appears to grow exponentially with rainfall.

The data presented so far suggest a classification into three different ecological types (eco-types) according to the dominant agricultural activities: Livestock (Bamba), Cereals & Pulses (Kibandaongo, Mwatate, Kitsoeni), and Perennials (Chilulu, Bongwe). This classification further coincides with a shift in the seasonality of cereal production that occurs between the Cereals & Pulses eco-type and the Livestock eco-type. As noted above, there is a shifting pattern of rainfall seasonality from a uni-modal type on the coast to a more bi-modal type with a distinct short rainy season inland. The significance of these short rains is further strengthened because more inland they also become more reliable than the heavy but erratic showers of the long rainy season. Figure 3.6 illustrates the effect of this shift on cereal cultivation in the six areas included in the study. Although there is some cereal harvest from the short rains in nearly all areas, there appears to be a reversal of the importance of the seasons in Bamba. There, the short rains - although precipitation during these rains is less than in the long rains - are more reliable amongst others because they stretch over a period of three months.

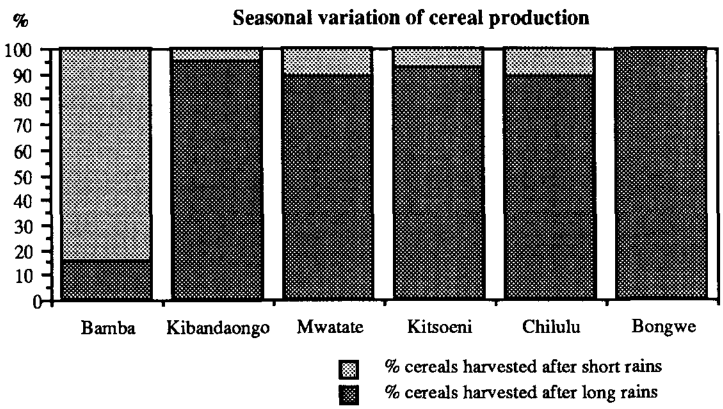

Figure 3.6: **Seasonal variation in cereal production.**[5]

Resource base

Agricultural production by itself is not sufficient to support the population of the communities included in the survey.[6] Figure 3.7 shows the average composition of the resource base of the households in the survey. Off-farm employment provides a major share of the resource base with an average value of 62% of the total resource base. It ranges from about 55% in the Cereals & Pulses eco-type to about 75% in the Livestock eco-type.

[5] It should be pointed out that the data represent the value of the cereal harvest, not the area planted in each season.

[6] The household resource base is the value of all economic activities carried out by the members of the household on a regular basis and is expressed in Kenya Shilling per consumer unit. Expressing household figures per consumer unit serves to correct the data for differences in household size. One consumer unit is equivalent (in terms of energy requirements) to a reference adult male. For a discussion of "consumer units" see Foeken et al., 1989: 143.

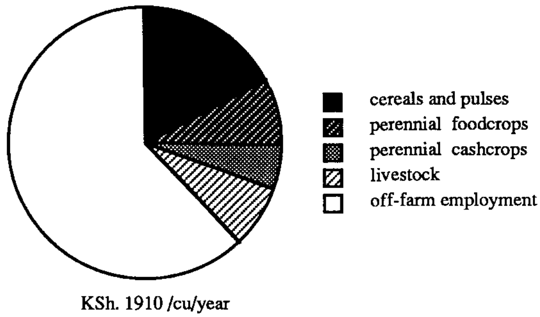

Figure 3.7: **Composition of average household resource base.**

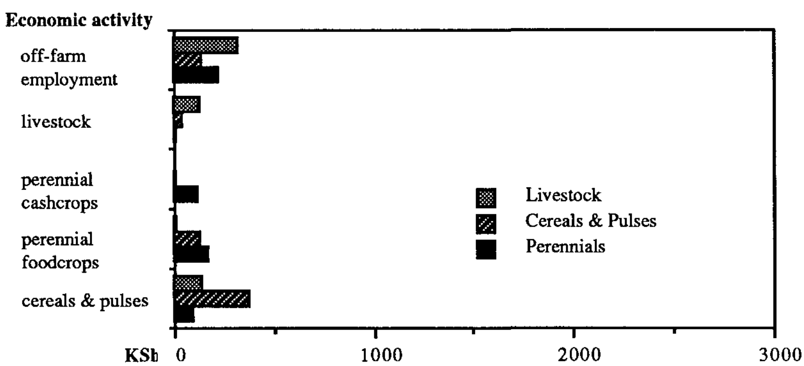

Figure 3.8: **Households with resource base below KSh. 1500 composition of resource base, by eco-type.**

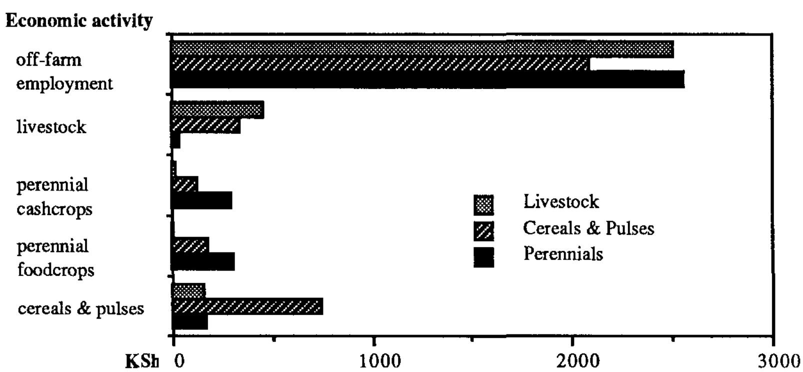

Figure 3.9: **Households with resource base over KSh. 1500 composition of resource base, by eco-type.**

The average household covered in the survey had a resource base valued at KSh. 1910 per consumer unit per year, but about 54% of the households had a resource base of less than KSh. 1500 per consumer unit. That is, their total annual income can be estimated at below the minimum existence level of KSh. 1500/cu/yr that would garantee them 75% of their total energy requirements at normal activity levels.[7] Figures 3.8 and 3.9 show that households on either side of this boundary have very different resource bases.

On average, households with a low resource base have nearly equal contributions to their resource base from employment and annual food crops. Cash crops and livestock contribute a similar share to the household resource base, depending on the eco-type concerned. Agriculture plays the strongest role in the Cereals & Pulses eco-type where cereals and pulses contribute a relatively large share to the total resource base, even in comparison to off-farm employment.

The main distinction between households with a low resource base and households with a high resource base is related to off-farm employment. In households with a high resource base off-farm employment dominates completely. In general, households with a high resource base also have higher incomes (in absolute terms) from other sources of income compared to their counterparts with a low resource base, but the differences concerned are relatively small (roughly double compared to a tenfold difference for off-farm employment).

A further conclusion that can be drawn from these findings is that the differential between households with a low resource base and households with a high resource base is generally independent of the eco-type in which they reside.

Labour, food supply and health

The effects of climatic seasonality on the nutritional status of women and children are mainly channelled through a number of intervening variables. The most important of these variables are seasonality of workload, food supply, and health. Workload seasonality, i.e. seasonal changes in labour requirements of the agricultural system and other household duties, influence the energy expenditure and hence the energy requirements of those involved. Variations in food supply from home produced food influence the availability of food to the individual. And seasonal variations in health conditions influence growth regardless of food intake (as for instance during a diarrhoea episode) or do reduce food intake by affecting appetite.

[7] For a discussion of "minimum existence level" and the relevant calculation procedures see Foeken et al., 1989: 54 and 146.

Taking the foregoing description of the three eco-types into account, a number of working hypotheses can be formulated regarding these intervening variables, which are summarized in Tables 3.4 and 3.5.

Effects of climatic seasonality on health are often mentioned. Two health aspects of life at the Kenya Coast that show evident climatic seasonality are malaria and diarrhoea, both with peak periods at the onset of the long rains and the first month after (Boerma 1989a). This period is similarly timed in all three eco-types, the only difference of significance might be the somewhat stronger impact of the short rains in the Livestock eco-type.

Table 3.4

Working hypotheses: expected seasonality effects by eco-type

	Effects mediated by:		
Eco-type	**Health**	**Labour requirements**	**Food supply**
Perennial	shift from dry season to long rains (more illnesses)	small seasonality (perennial food crops require less labour input, rains spread out during large part of year)	small seasonality (because of perennial food crops)
Cereals & Pulses	shift from dry season to long rains (more illnesses)	strong seasonality (long rains crops require heavy input during soil preparation and planting, possibly offset by fetching water during dry season)	strong seasonality (dependence on long rains cereal harvest)
Livestock	shift from dry season to long rains, possibly a secondary effect at onset of short rains (more illnesses)	medium seasonality (short rains require more labour input, but cereals are less important, possibly offset by fetching water during dry season)	medium seasonality (dependece on short rains cereal harvest, but food crops less important)

Seasonal labour requirements can be expected to differ for the three eco-types. The strongest seasonality would be expected in the Cereal & Pulses eco-type where land preparation for the long rains cereal crop requires peak labour input from the women during the early part of the rains. In the Perennial eco-type much less seasonality of labour requirements is expected. While this factor directly involves only the mothers, some indirect effects may be present in the younger children who depend on maternal care and breast-feeding.

Table 3.5

Working hypotheses: expected seasonality effects by resource base

	Effects mediated by:		
Resource base	**Health**	**Labour requirements**	**Food supply**
Low **(below 1500 Ksh/cu/yr)**	none	none	strong seasonality (depend mainly on cultivation of food crops)
High **(above 1500 Ksh/cu/yr)**	none	none (women are not involved in off-farm employment: almost all women are farmers)	small seasonality (off-farm employment is stable source of income)

Food supply follows similar seasonal trends as labour requirements, although with a delay of the growth period of the cultivated staple foods. Small seasonal effects can be hypothesized in the Perennial eco-type, in particular because cassava, which is an important food crop in that eco-type, can be harvested over a long period.

In general, seasonality effects of food supply are expected to be much stronger among the poorer households (Table 3.5). In the previous section it was shown that households with a small resource base depend for a larger share of their income on food crop cultivation than their richer counterparts. In terms of labour requirements and health no differences in seasonality are expected. Almost all rural women are involved in crop cultivation and the women of the richer households are no exception in this regard.

3.3. Adult women: the mothers

The nutritional condition of the adult women in the survey population is not very good. Figure 3.10 presents the observed average Weight-for-Height[8] for the adult women in the survey population. As noted before, the data collected during the survey refer to the mothers of children below 11 years of age only. Mothers without children in that age group are excluded (this means mostly young women without children and women over 55). The averages are cross-sectional, that is some women may be included in all cycles while others are included only once.

[8] A similar graph could be presented for body weight expressed in kilograms rather than presenting Weight-for-Height. The disadvantage is that results from different survey cycles are less comparable that way. The meaning of a weight loss of 1 kg differs from person to person.

Average Weight-for-Height ranged between 92% and 88% during the survey, with a low point in May 1986 and a relatively high point at the start of the survey (July 1985). These averages are low and indicate the presence of a public health problem. The poor condition of the mothers in the sample may also have ramifications for the condition of the younger children. A study of breast-feeding among the Akamba in Eastern Province demonstrated that breast-milk production of mothers with a Weight-for-Height below 90% was lower than that of mothers with a higher Weight-for-Height (Steenbergen et al. 1984, while a similar finding was reported by Kigutha et al.(1987). If this also applies to the present sample, the total food intake of many of the younger children may have been relatively low, too.

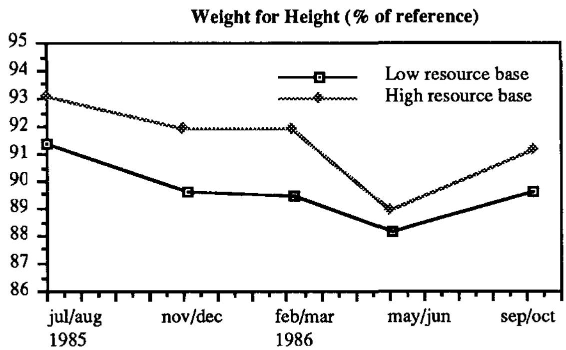

Figure 3.10: **Development of Weight-for-Height over time by household resource base level.**

As expected, mothers from households with a low resource base have a lower average Weight-for-Height than their counterparts from households with a higher resource base. At all five occasions that the homes were visited during the survey, the average Weight-for-Height of the women from low-resource base households was lower than that of their counterparts from high-resource base households (Figure 3.11). There is, however, no indication that the women from households with a lower resource base experience greater seasonal stress. The Weight-for-Height fluctuations in this group are even relatively small (with just under 3% difference between the highest and the lowest averages) compared to those of more wealthy households (about 4% difference). It is, as if the women from the poorer households recuperate less upon the harvest and have consequently less to lose in the period of seasonal stress.

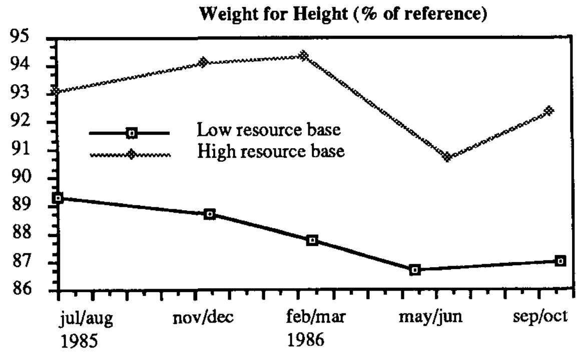

Figure 3.11: **Development of Weight for Height over time: the Perennial eco-type.**

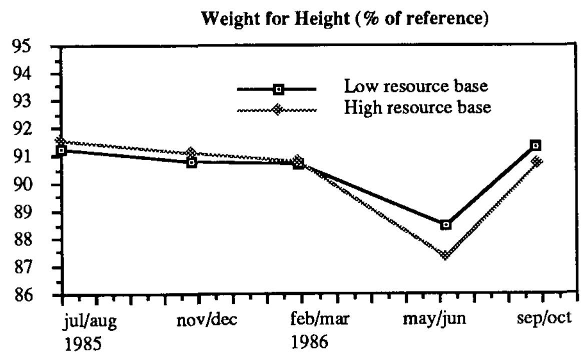

Figure 3.12: **Development of Weight for Height over time: the Cereals & Pulses eco-type.**

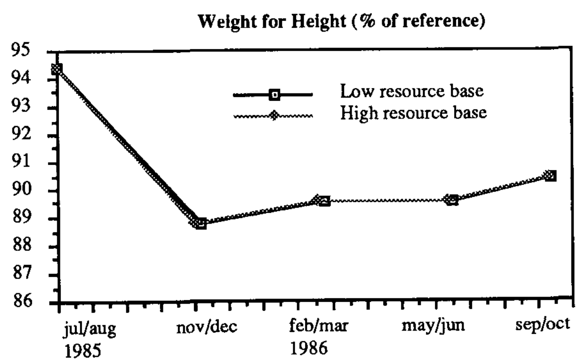

Figure 3.13: **Development of Weight for Height over time: the Livestock eco-type.**

A closer look at the data, however, reveals that resource base is only a relevant factor in the Perennial eco-type (Figure 3.11). In that eco-type mothers from households with a low resource base show a consistently lower average Weight-for-Height (a difference of 4-6%). In the other two eco-types no difference at all was found between the mothers from low-resource base and high-resource base households (Figures 3.12 and 3.13). The averages found were in fact virtually the same for both groups of mothers.

Also the time trends differ between the various eco-types. The Perennial eco-type and the Cereals & Pulses eco-type show similar time trends, with stable average Weight-for-Heights during most of the survey, and a temporary low average in May 1986. In the next observation cycle, the average Weight-for-Height had again returned to that found in the first three cycles. Although this pattern is most evident in the Cereals & Pulses eco-type, the time trend in the Perennial eco-type is more or less similar.

The time trend found in the Livestock eco-type was different, however. Here, the average Weight-for-Height was relatively high during the first visit to the households in July-August 1985. The average Weight-for-Height found during that visit was about 94.5% or between 3.0-3.5% higher than in the other two eco-types. This difference should probably be interpreted as an effect of an exceptionally good maize harvest during the short rains of 1984/5 which lasted many households till at least June 1985,[9] but which was then followed by a series of relatively poor harvests (long rains 1985, short rains 1985/6, and long rains 1986). This resulted in relatively low Weight-for-Height scores during the remaining part of the survey, compared to the other two eco-types.

The dip in the Weight-for-height curve observed during May 1986 in the two other eco-types was also not present. This different time trend of the three eco-types suggests an interpretation in terms of seasonality labour requirements. In the total agricultural cycle plot preparation requires a heavy labour input of especially women during a time that food stocks are at their lowest.The low points in the time trends coincide with the period of plot preparation during the rains. In the Perennial and Cereals & Pulses eco-types, plot preparation is most important during the long rains which provide most of the cereal harvest in these eco-types, while in the Livestock eco-type plot preparation during the short rains, i.e. October-November, is much more important (the short rain crop usually gives the better harvest).

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[9] At the time most people at the Coast consumed imported maize (which was disliked because of its slightly bitter taste). In the Livestock eco-type the home produced variety was still available.

Discussion

It is difficult to draw conclusions about seasonality from a single 14-15 months cycle of observations. The comparison between the eco-types suggests two different links between rainfall seasonality and Weight-for-Height for the women included in the survey. The first of these links is a non-cyclic (not annual, that is) succession of relatively poor harvests in the Livestock eco-type during the period of the survey, and the second a cyclic effect related to the timing of the main cereal harvest. According to the suggested interpretation, this latter link would be a combined effect of seasonal labour requirements and food supply factors, but the data do not confirm the expectation (see Table 3.5) of a stronger seasonality among women from low-resource base households. If anything, the indications are that seasonality in this group is less evident. A possible explanation of this finding could be that these women recover less by post-harvest food intake or that they offset seasonal effects of labour requirements by higher incomes from rural casual labour during peak periods. Although the survey data do not permit a true test of this explanation, further investigation into sources of income and food consumption may clarify this issue.

There are several ways in which seasonal factors influencing the condition of the mothers may have effects on the nutritional condition of their children. One effect might be that the labour requirements of the agricultural cycle during peak periods compete with child care. This would affect the younger children more, as these require the attention of their mothers most. Another effect might result from the poor nutritional conditions of the mothers themselves, which is passed on to their children through inadequate breast-feeding, and, possibly, also through low birth weights and/or a high number of prematures.

The survey did not include data on pregnancy outcome and lactation performance but data from other sources for Kwale and Kilifi Districts as a whole confirm seasonal effects on child birth. Birth weights in May-July are reported to be slightly lower than those in the remainder of the year, while the number of births is particularly high in that same period. The number of stillbirths shows a much weaker seasonality (Boerma 1989b).[10] While it is not clear whether this type of seasonality is also linked to the labour effort of women[11], it is very likely so. The possible link between maternal nutritional status and young child growth will be discussed below in section 3.4.

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10 Birth weight and birth frequency data covered two annual cycles (1986-1987). Frequency data covering a ten year period (Ferguson 1987) show the same pattern. Both studies concern the whole of Kwale and Kilifi Districts and therefore include all three eco-types. A breakdown of data per eco-type would have been useful, as District averages cancel out local variations.

11 Alternative explanations would be the effect of malaria or behavioral patterns influencing fertility. Neither possibility, however, seems a sufficient explanation (Boerma 1989b: 11-13).

3.4. The children

Growth rates

By comparing the anthropometric measurements taken of the same children during different visits, it is possible to calculate gross growth rates; gross rates, because the visits took place at intervals of several months, and the growth rates obtained this way may conceal accelerations and decelerations during each interval.[12] Figure 3.14 presents the averaged observed growth rates for height as obtained during the survey. Length growth velocity clearly decreases with age, starting at about 0.85 cm per month for children close to 6 months of age to about 0.45 cm per month for the nine year olds. There is a noticeable dip in the curve around the age of 18 months.[13] Growth quickly slows down between 6 and 18 months, to regain some speed in the next period, up to about 30 to 36 months of age. From 36 months onwards growth gradually decreases.

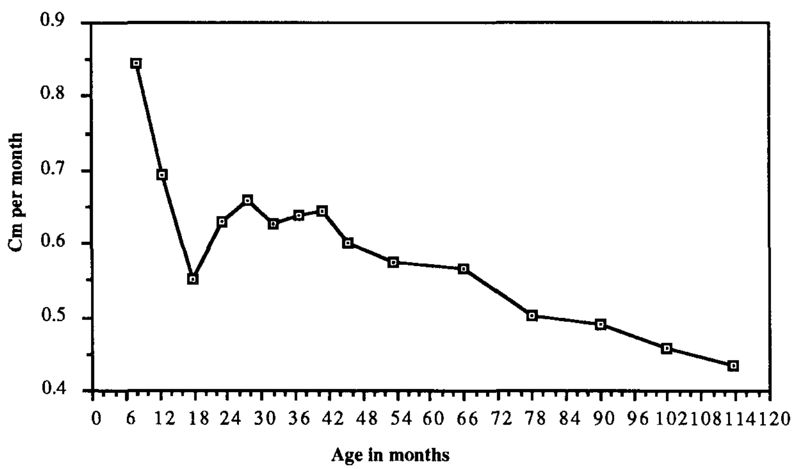

Figure 3.14: **Height growth rates in cm per month (longitudinal data: all intervals pooled).**

The pattern of average weight change starts similar to that of length growth, but there is no regular decrease of weight growth among the older children. Instead, children of

[12] Usually difference scores have a lower reliability than the original scores, but in this case these rates have the advantage that they depend less on the estimated age of the children - one of the weaker components in the available data - as the exact length of the interval is known.

[13] This dip can not be explained by a shift from supine measurement to standing measurement. That shift was made at the age of 24 months.

four years and older show an increasing growth of weight: after a low 120 grams per month of the four years old, weight growth increases up to 170 grams per month among the nine year olds (Figure 3.15).

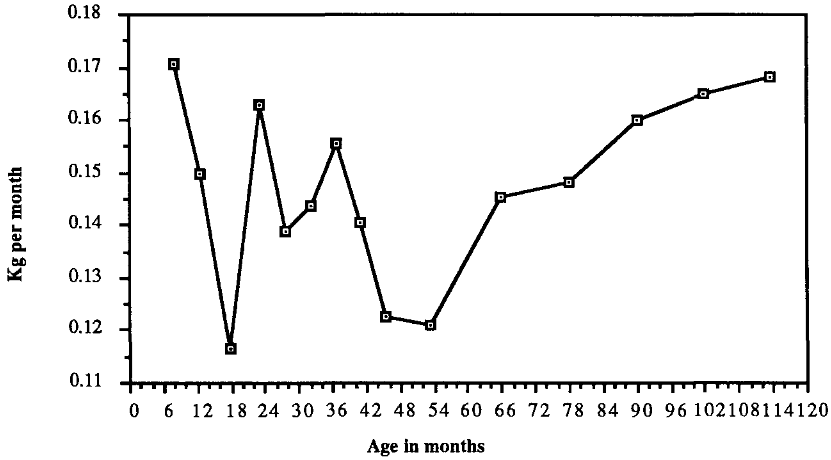

Figure 3.15: **Weight growth rates in kg per month (longitudinal data: all intervals pooled).**

It is possible to calculate these rates straightforwardly as centimeters growth per month and kilogram change per month, but it is also useful to standardize these rates in terms of a reference population for the purpose of comparisons between children of different ages (and at different levels of attained growth). Thus, it is possible to compare the observed rates to those of other children and to establish whether the children of the survey population are growing at speeds comparable to the reference population. When the growth rate for a group children expressed in terms of the standard deviation of the reference population is negative, the group concerned is lagging behind compared to the children of the reference population of the same age. A growth rate of zero means that the observed children grow at the same speed as the reference population, and a positive growth rate means that the children concerned are growing at a faster speed than reference group children of the same age.[14]

[14] These figures should not be taken as absolute value judgements about growth, however. The standardization used is based on age, while another standardization could have been based on age and stature. For example, it may be argued that catch-up growth requires stunted children to grow at a speed comparable to at least that of children of the corresponding stature in the reference population.

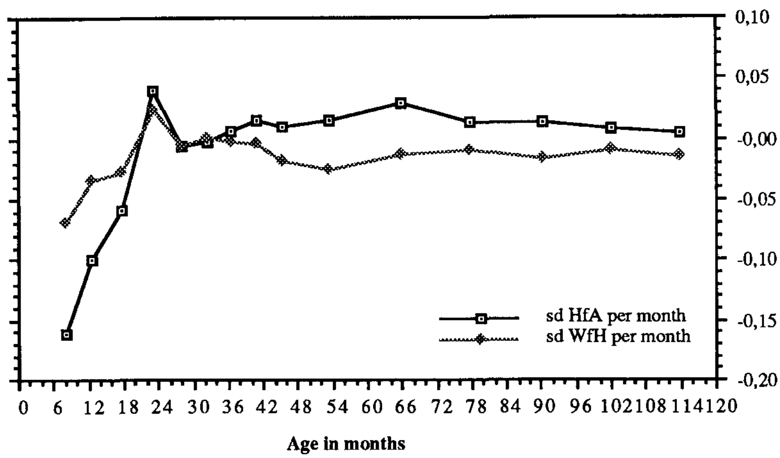

Figure 3.16: **Growth rates per month compared to reference population (longitudinal data: all intervals pooled).**

Figure 3.16 presents the results of such calculations for the children included in the survey. The growth rates observed during the five visits to the households have been averaged to obtain two curves, one for Height-for-Age growth velocities and one for Weight-for-Height changes. The resulting curves are very similar: young children up to about 21 months in the survey population generally grow at a slower speed than the reference population. The difference is less among the older children, however. Height-for-Age growth settles at around the same speed as the reference population among the children of 30 months and older. Weight-for-Height change shows a slight decreasing pattern after that age. Interestingly, both curves show a peak of growth rates at the age of 24 months. The fact that this peak occurs for both Height-for-Age and Weight-for-Height indicates that this age group grows exceptionally well. There are several alternative explanations possible for this finding. An obvious explanation is that after a period of relatively slow growth the body has regained growing speed and a short period of catch-up follows before growth returns to the normal reference population level (shown as zero in the graph). It is also possible to relate this peak to a similar phenomenon in the data concerning perceived morbidity which are presented in Figure 3.17.

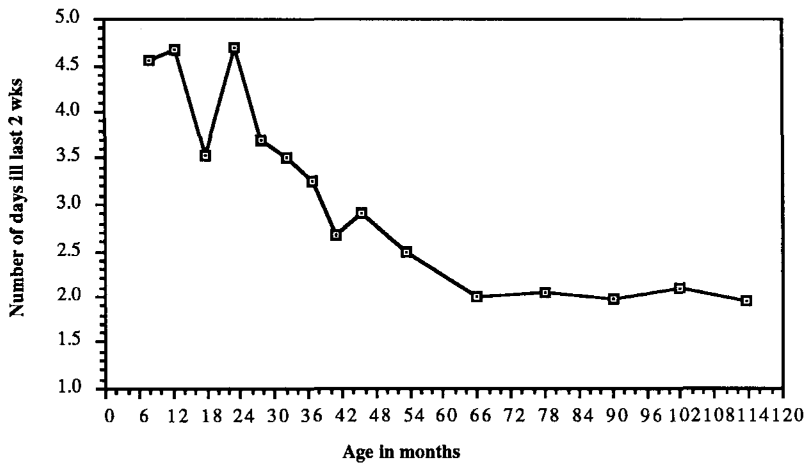

Figure 3.17: **Reported health (cross-sectional data, all visits pooled).**

As expected, perceived morbidity of children, measured as the number of days the mother of the child considered the child to be ill during the two weeks prior to the visit to the household, shows a clear downward trend. The average number of days the children were ill was highest among the younger age groups (4.5 days per 2 weeks) and decreases with age to about one day per week among the older children. However, at around 18 months the mothers perceive their children as more healthy than one would expect from the values before and after that age, and this could be connected to a small growth spurt in the subsequent period.

Seasonal differences

Average growth rates as presented in the previous section hide the variation that was observed over time. Just as Weight-for-Height of the mothers of the children varied from visit to visit, growth rates were not stable but differed over time. Figure 3.18 shows the growth rates for Height-for-Age as observed for different intervals during the survey.[15]

[15] All curves presented in this paper were produced using a lowess (locally weighted regression scatter plot smoothing) technique followed by a twice repeated robust absolute deviation estimation (Chambers et al. 1983). Martijn Leopold wrote a computer programme for this purpose using algorithms published in Press et al. (1988).

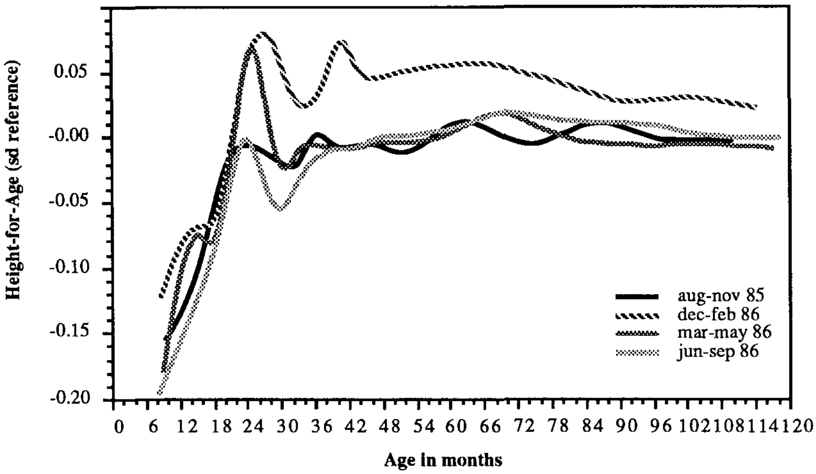

Figure 3.18 **Height-for-Age seasonal growth rates**

The same pattern as noted before - i.e., growth rates of Height-for-Age are low among the younger children, then increase up to the age of 24 months, to level out among the older children - was found for each observed interval. However, there was a remarkable difference between length growth during the period form December 1985 to February 1986, when growth rates were on the average about 3 mm per month higher than at other times during the survey. In standard deviations of the reference population this difference varied from 0.05 to 0.10 standard deviations per month. This suggests a typical dry season peak in length growth during that interval, which, judging by the appearance of the curves, occurs at all ages but with the exception of the children between 12 and 18 months. In the period immediately following, March 1986 to May 1986, the younger children (again with the exception of the children between 12 and 18 months) still continued to grow at a faster rate, while the older children showed average growth during that period. A further inference that can be drawn from these data is that outside the short interval from December to February, and for the younger children also March to May, growth is either lagging behind that of the reference population or at most at the same speed as the reference population.[16]

[16] In the discussion of the pooled results it was possible to relate a peak in height growth among the 24 months old children to the perceived health of the 18 months old children. The data do not permit this type of analysis for a comparison of periods. The data concerning perceived health are point observations of time immediately before the visit to the household, while growth-rates always apply to the whole interval between visits.

At first sight, one would expect that a spurt in height growth would correlate with high weight increases. This is not the case, however. On the contrary, the period of increased growth in stature is also a period of relatively low weight growth. This combination of fast growth in stature and low weight increases results in Weight-for-Height losses (compared to the reference population) among the children of all ages during the period of December 1985 to March 1986. Figure 3.19 shows the combined effects of height growth and weight changes on the development of Weight-for-Height for the four periods covered by the survey.

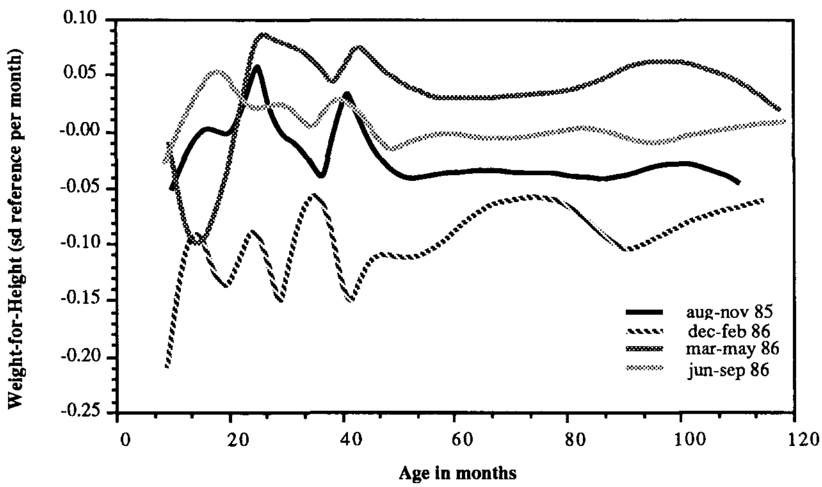

Figure 3.19: **Weight-for-Height seasonal change rates**

Comparing the curves of Weight-for-Height change rates during these four intervals suggests a cyclic process. As noted above Weight-for-Height change rates are low in the period from December to February, when height growth takes place with weights lagging behind. In fact, the height growth spurt occurs in a period when food stocks from own production are relatively low in all eco-types: about 4 to 6 months after the main harvest in the Perennial and Cereals & Pulses eco-types and about 9 to 12 months after the main harvest in the Livestock eco-type. In the next period, height growth slows down for most age groups while weight growth catches up with height growth. This results in an increased Weight-for-Height and therefore in positive change rates (it should be noted however, that this general pattern of increasing Weight-for-Height is only valid for the children of 24 months and over, i.e. for those who depend less on maternal care and breast-feeding and who also may be more affected by health problems during the long rains). When weight growth slows down too in the next period (June to September), and falls back to a level comparable to that of the reference population, Weight-for-Height stabilizes at the level obtained and change rates are close to zero. The period of August to November partly covers the same interval. In this period height growth still remains stable, but weight growth slows down further to arrive at rates comparable to those of the period following. Consequently, Weight-for Height starts to fall and the change rates become slightly negative.

Discussion

Interpreted in this manner, it would seem that the children show a different seasonality pattern than the adult women. While the women tend to have low weights during the long rains (most clearly in the Cereals & Pulses ecology), the children seem to have a spurt in height growth during the dry season coupled to weight losses because of low food supply and a spurt in weight growth during the long rains. This would suggest that weight growth of children is food related (a spurt occurs in a period of good food supply[17], losses occur during period of low food supply) while height growth is mainly health related (its velocity increases during the dry season, which is a relatively healthy period).

The difference in seasonal patterns of children and adult women further supports the contention that the seasonal shifts in weight among the adult women do not reflect health or food supply fluctuations, but seasonal variation of labour requirements. Work load peaks would at most affect the children indirectly (less time for child care, less breast milk for the breast-fed children), and would mainly affect the younger children. Seen in this light, the absence of a weight growth spurt during the long rains among the younger children - although such a spurt is clearly present for the older children - fits the picture well.

Resource base and ecology

Figure 3.20 presents detailed information on height growth of the children included in the survey by eco-type and resource base. The left hand side of the figure shows separate cross-sectional Height-for-Age curves for children from "poor" and "rich" households in each of the three eco-types. To obtain these curves, the data of the five

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[17]Analysis of household food preparation data later confirmed this hypothesis. Energy intakes are highest during the long rains, probably also because farming households increase energy intakes in response to the higher energy expenditure during the peak season. The children appear to profit from this increased household intake.

cycles in the survey where pooled, i.e. the curves represent the average Height-for-Age of children of a particular age during the 15 months covered by the survey.[18] The right hand side of Figure 3.20 presents pooled growth rates per month, similar to those presented in Figures 3.16, for the same six sub-groups.

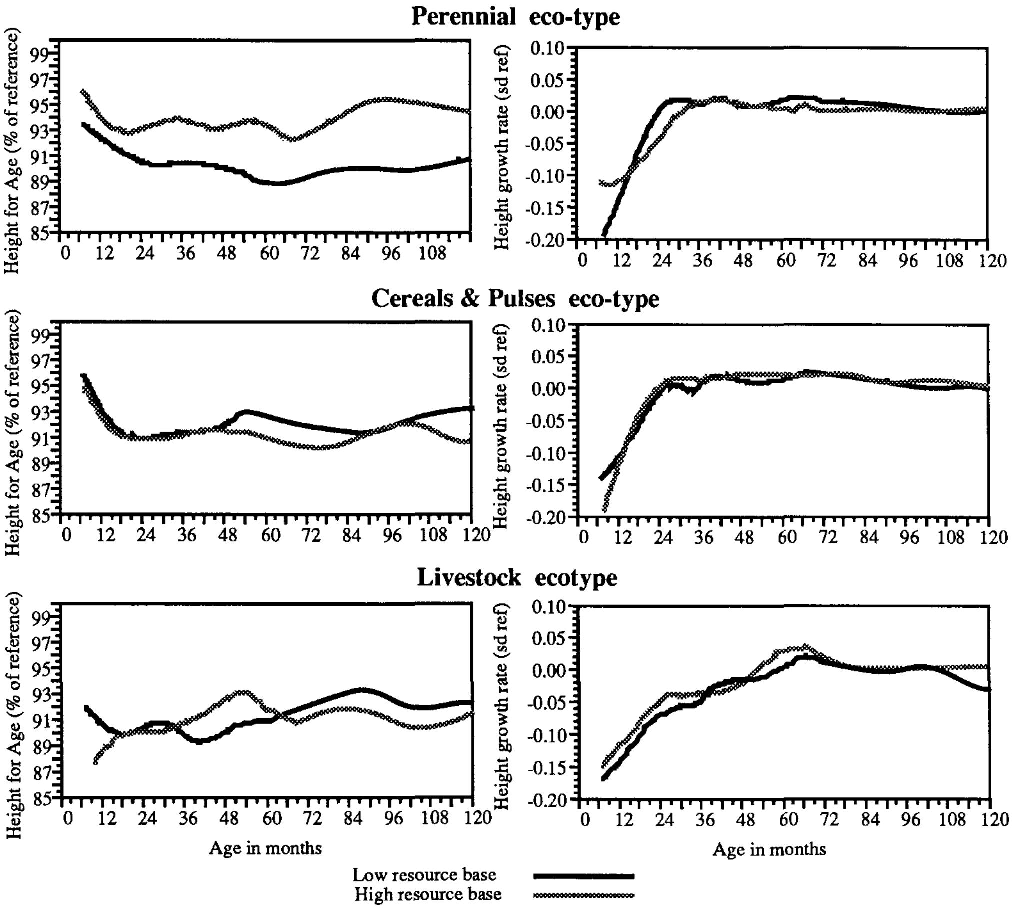

Figure 3.20: **Height for Age and Height for Age growth rates by eco-type and by resource base**

Comparing the Height-for-Age data obtained for children in the three eco-types there appear to be three variants of height growth. Height growth of the children in the Perennial eco-type - the first variant - shows a clear effect of resource base, just as for the adult women. The eco-type average (about half way between the separate curves

[18] Technically, this means that both seasonal and cohort differences are at least partially filtered out.

for each resource base level, moves from about 95% of the reference among the six moths old children to about 92.5% children of 2 year and older. The average Height-for-Age of children from high resource base households in this eco-type is significantly higher than that of their poor counterparts. The difference is about 2.5% among the youngest children and reaches nearly 5% among the older children. That the younger children from low resource base households already show lower Height-for-Age scores suggests early stunting, in the first six to nine months of life, or even an effect of low birth weights. This tallies with the growth rate curves of the two groups which are very similar regardless of resource base level, but which show a small, albeit significant, difference in growth speeds among the children under ten months of age, the children from "poor" households having a poorer start than the children from "rich" households.

The children in the Cereals & Pulses eco-type lack the consistent difference between children from low resource base and high resource base households found in the Perennial eco-type, but, otherwise, like the children in this latter eco-type, have a "usual" Height-for-Age curve. Usual, in the sense that the curve starts off at a level of about 96% at six months to decrease to a stable level at approximately 92%, from 18 months of age onwards. Similar curves have been found in surveys elsewhere in Kenya,[19] and it also is the kind of curve that is expected when small children experience a relatively tough weaning period, with regular spells of diarrhoea and relatively low food intakes.

The data for the Livestock eco-type, however, indicate a different situation. As in the Cereals & Pulses eco-type, there is no difference between children from households with a different level of resource base, but the growth rates of children show that, at least during of the survey period, children under five were growing relatively poorly in the Livestock eco-type, compared to the children in the two other eco-types. These low growth rates are also evident in the Height-for-Age curve, which is significantly lower in the younger age groups, in particular among the children below 2 years of age, while there is a slight gradient of Height-for-Age with age in the Livestock eco-type. As there is no difference in Height-for-Age among the older children, it is likely that the special situation of the children in the Livestock eco-type is a cohort effect, i.e. the result of a temporary period of stress which may be connected to the similarly low Weight-for-Height averages of the adult women in this eco-type during four of the five cycles of the survey. Explained in this way, the low height growth velocities of the children in the Livestock eco-type would also seem to be food

[19] For instance, see Niemeijer et al. 1985 and Hoorweg, Niemeijer & Steenbergen 1983.

related, that is, as resulting from direct effects of food shortage on household food consumption and child food intakes as well as from indirect effects through maternal nutritional status. Height growth in this eco-type could thus be influenced by both health related factors (i.e. the yearly seasonal cycle with its dry season growth spurt) and food related factors (i.e. the stress resulting from a series of relatively poor harvests), some of which are actually passed on from mothers to children through maternal nutritional status. To verify whether this is actually so requires a more detailed analysis of the growth rates during different seasons in each eco-type.

Seasonality and Ecology

Figure 3.21 presents the interactions of age, season, ecology, as well as height and weight growth. The top four graphs concern the Height-for-Age growth rates and the Weight-for-Height change rates obtained for the Perennial eco-type and the Cereal & Pulses eco-type. These four graphs closely follow the general pattern already outlined before for the children group as a whole: uni-modal seasonality with a height growth spurt between December and February accompanied by Weight-for-Height losses, and followed by Weight-for-Height increases in the period from March to May. The height growth spurt was considered linked to fluctuations in health conditions, while the Weight-for-Height increases were linked to changes in the food supply situation.

According to the working hypotheses, the strongest seasonal fluctuations are expected in the Cereals & Pulses eco-type, because of a large seasonal variation of food supply. This appears to be confirmed by the data: the children in the Cereals & Pulses eco-type display Weight-for-Height increases during March to May 1986 while a similar increase is nearly absent in the Perennial eco-type. With regard to height growth, if in fact health related, the working hypotheses are not leading to a specific prediction concerning the size of the effect in the different eco-types.Looking at the graphs, there is some indication that height growth fluctuations are slightly stronger in the Perennial eco-type than in the Cereals & Pulses eco-type. The spurt in height growth in the period December 1985 to February 1986 is more pronounced in the Perennial eco-type. This would suggest that fluctuations in health conditions are stronger there, or else that the positive effect of the healthy dry season is partly offset by the stronger effect of poor food supply conditions in the Cereal & Pulses eco-type where the seasonal scarcity of food from own production during the dry season is more pronounced. This needs further investigation.

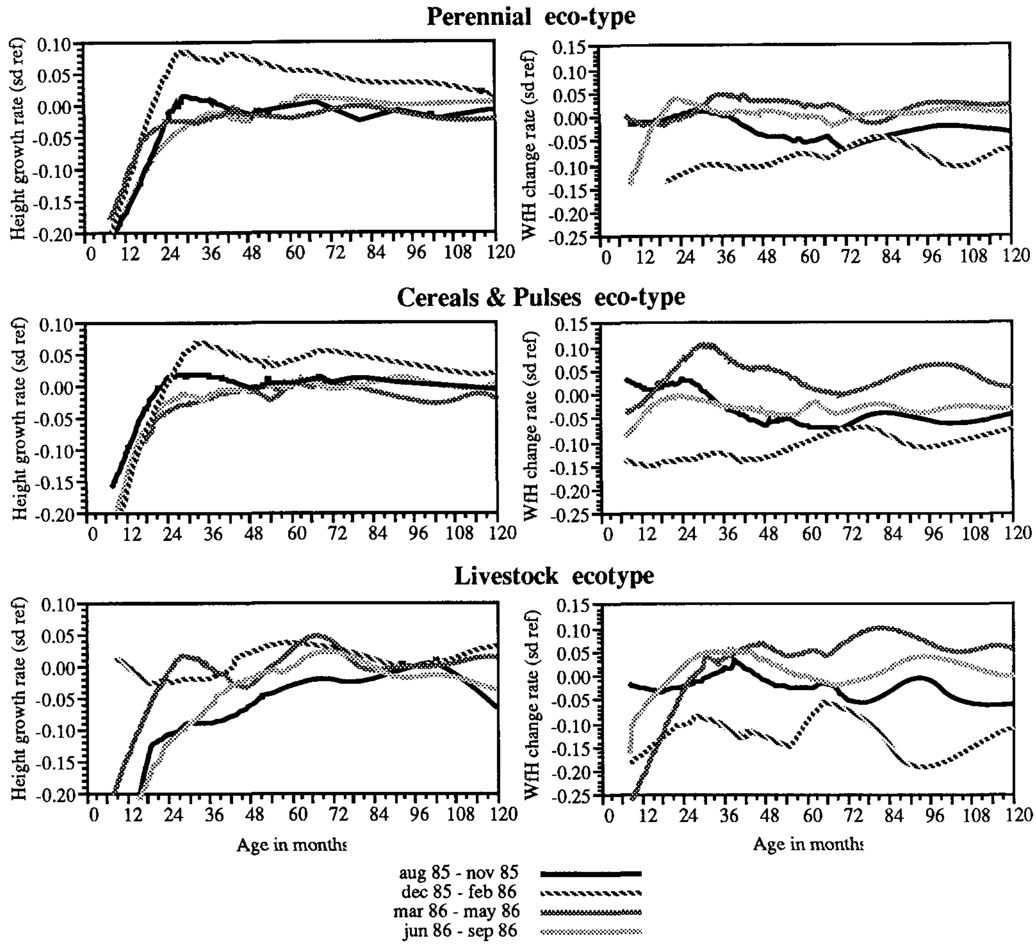

Figure 3.21: **Height-for-Age and Weight-for-Height seasonal growth rates by eco-type**

The results for the Livestock eco-type are less straightforward. As noted in the previous section, among the younger children height growth is slower in this eco-type than in the two other eco-types. Average growth rates tend to be between 0.05 to 0.10 standard deviations lower, a finding which was contributed to relatively poor harvests in the Livestock eco-type community. On closer inspection, these low rates are mainly confined to two periods, namely August to November 1985 and June to September 1986. In terms of a yearly cycle, the two periods overlap and more or less cover the second half of the year, which is a period when food stocks from the short rains harvest - the main harvest in this eco-type - are becoming scarce, especially when the long rains harvest fails. This finding appears in support of the interpretation forwarded in the previous section that the height growth of small children in this eco-type suffers from food related stress.

The evidence for a separate, health related, growth spurt in the dry season from December to February is much weaker in the Livestock eco-type, though. While growth in this period proceeds at normal rates (which is high in relative terms), so does growth in the adjacent period from March to May, albeit at a slightly lower level in most age groups. However, one must bear in mind that in the Livestock eco-type the December-February height growth spurt coincides with a period when food stocks from own production are at their very lowest, just before the cereal harvest, 9 to 12 months after the main harvest and 3 to 6 months after the much smaller secondary harvest. The effects of seasonal food supply variation are relatively large in the Livestock eco-type, contrary to the expectation (see Table 3.4) that the relative large income from off-farm activities would mitigate its effects. Actually, at most ages seasonal variations of Weight-for-Height are larger in the Livestock eco-type than in either of the other two, and they closely follow the expected pattern of increases after the short rains harvest (positive change rates between 0.05 and 0.10 standard deviations of the reference), followed by decreasing change rates to reach actual losses of Weight-for-Height (change rates ranging between -0.05 and -0.15 standard deviations) during the dry season, before the next short rain harvest.

The younger children form a special case in all eco-types. Weight-for-Height changes of the children under two years consistently follow a different seasonal pattern than those of the older children. The actual cross-over age differs from graph to graph, as does the size of the effect, but in general the younger children show deteriorating Weight-for-Height scores during the period from March to May and/or from June to September, the periods that their older siblings show improving Weight-for-Height scores. This certainly shows that the younger children do not profit as much from the increased food supply during these periods as the older children. An obvious explanation is that these younger children suffer more from the negative impact of deteriorating health conditions during this wet period, when repeated episodes of fever and diarrhoea would negatively affect Weight-for-Height.

In general, it appears as if there exists a clear gradient of rainfall with health effects on height growth: the largest effect is present in the Perennial eco-type, the wettest of the three, while only a very small effect is found in the Livestock eco-type, with the lowest precipitation. Although this gradient could be interpreted as indicating stronger health effects in the wetter zones. This interpretation has the beauty of simplicity, but alternative explanations based on food supply related seasonality cannot be ruled out completely. Specially, because height growth among the younger children in the Livestock eco-type appears to be influenced by food related stress, as well

Speculating in this manner about differences and similarities, also in connection to the pattern found among the mothers, it is important to take into account how the different seasonal factors interact within each eco-type. In all eco-types, the dry season, December, January, and February, is a relatively healthy season and apparently inducive to child growth, even though the amount of available food is low in all areas (the harvest in the Livestock eco-type, which consists mainly of maize and not of perennial foodcrops and vegetables, is not yet ready). In the following period, mothers in the Perennial and Cereals & Pulses eco-types experience relative hardship while, especially in the early stages of the rains, health conditions falter. These effects seem less operative in the Livestock eco-type which now entered the post-harvest season, with a smaller workload and where the rains are less heavy anyway. Weight growth however seems to be more influenced by food supply which tends to be good in this period (in the Livestock eco-type because of the short rains harvest, elsewhere because household food consumption is increased to cater for a higher energy expenditure of the adult labour force).

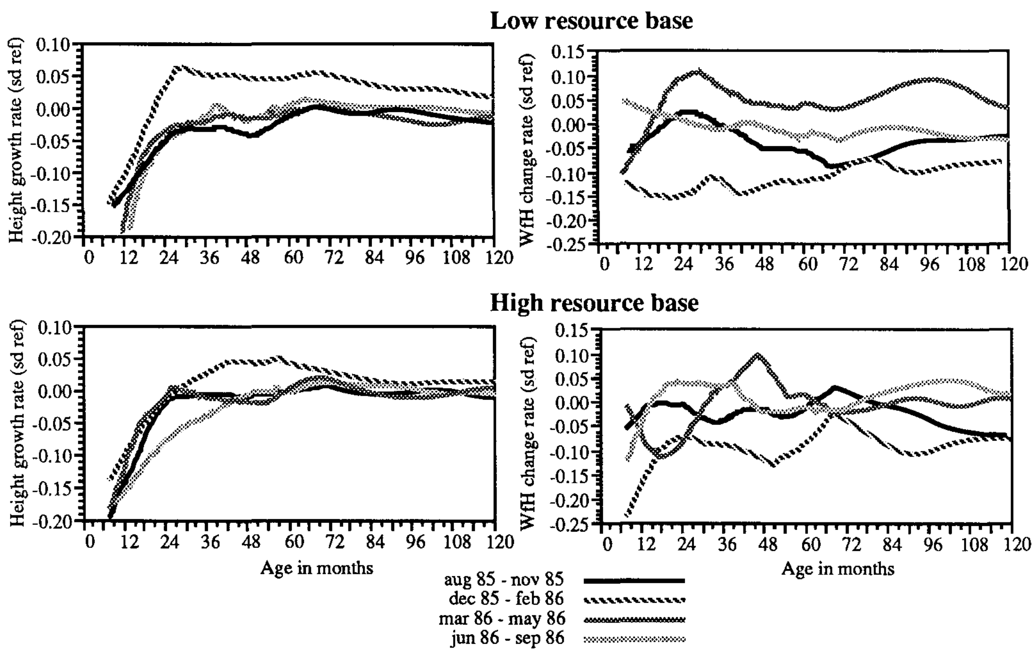

Figure 3.22: **Height-for-Age and Weight-for-Height seasonal growth rates by level of resource base**

Resource base and seasonality

The effects of resource base level on seasonal fluctuations of height growth and on Weight-for-Height appear in line with expectations. Figure 3.22 presents growth rates for children from households with a low resource base and children from households with a high resource base. According to the working hypothesis the amount of seasonal variation should be less among children from households with more resources. This is confirmed by the data: in terms of Height-for-Age growth as well as in terms of Weight-for-Height changes, seasonal variations are slightly smaller in the high resource base group. The difference is not very big, however, and is inconsistent.[20]

3.5 Discussion and conclusion

The general design of the present study was to compare anthropometrical data obtained in different communities with different ecological circumstances. In this aspect the study has been relatively successful, the six communities studied show a clear precipitation gradient which is further reflected in the agricultural activity pattern of their inhabitants. Also, in terms of household resources, it is clear that households with a high resource base depend much less on agriculture because of higher off-farm incomes. Together, these two aspects, ecology and resource base level, make up the six comparison groups, which form the basis of the design.

A number of working hypotheses were formulated regarding three types of intervening variables which were thought to link nutritional status to climatic seasonality: seasonal fluctuations of labour requirements, seasonal fluctuations of health conditions, and seasonal fluctuations in food supply from the agricultural system. Roughly, the expectation was formulated that the strongest seasonality effects of food supply would be found among the poorer households (who depend more on agriculture) and among the cereal cultivators of the Cereals & Pulses eco-type (who depend on a crop with relatively strong seasonality in terms of both labour requirements and food supply). It was further suggested that seasonal variations of the

[20] It would be interesting to know whether the relationship between seasonality and resource base level also holds in the Cereals & Pulses and Livestock eco-types. This is possible with the graphic methods used because the sample size does not allow a further breakdown to study the interaction between eco-type, resource base and seasonality.

activity pattern of the mother and of her nutritional situation might indirectly also affect the nutritional status of her, younger, children.

The findings concerning the nutritional status of the mothers suggest that there is indeed evidence of workload seasonality, especially in the Cereals & Pulses eco-type. The lowest point of their average Weight-for-Height was reached during the period of land preparation of the main cereal crop, which was during the short rains in the Livestock eco-type and during the long rains in the other two eco-types. In this regard, the data seem to fit the formulated working hypotheses well. However, there is no evidence of higher seasonality among the low resource base households. In fact, only in the Perennial eco-type a correlation exists between resource base level and nutritional status, but also there without any evidence of larger seasonality among the "poor". This negative finding agrees with an interpretation of nutritional status seasonality mediated through workload only. If food supply had played a role in this respect, the greater food supply seasonality in households with a low resource base should have been reflected in the Weight-for-Height results.

An important finding is further that the average Weight-for-Height level of the women in the communities studied was found to be quite low. In this light, the hypothesis that some of the seasonal variation experienced by the mothers might be passed on their children, assumes increased importance: younger children might indeed be deprived of care and breast-milk during peak periods of workload in the agricultural cycle, because their mothers already are in a precarious condition throughout the remainder of the year.

The findings regarding the children are much more difficult to interprete. First of all, there is the increased complexity of age: younger children may experience a different seasonality than their older siblings. Secondly, growth data of children always involve two separate but correlated aspects, height and weight. Changes in Weight-for-Height may indicate either a relative growth spurt in height, or a deteriorating nutritional condition reflected in loss of weight due to low intakes or health problems.

In general, growth of the children included in the survey proceeded very slowly. Between the age of 18 to 24 months there is evidence of some catch-up growth, possibly connected to a period of relative well-being after the adaptation to the weaning diet is complete. After this short period of catch-up, growth stabilizes, height at a level slightly above that of the reference group, weight slightly below the reference, which means that the children remain lean. The seasonal breakdown shows that there is a height growth spurt during the dry season, which is probably health related, and an improvement of Weight-for-Height during the long rains, which is probably related to food supply conditions.

The younger children form an exception, here. The Weight-for-Height of the young children does not improve during the long rains, which may be an indirect effect of the seasonality of the condition of the mothers, who at that time are involved in heavy manual labour, which also influences their nutritional status. Theoretically, this effect should be strongest in the Cereals & Pulses eco-type. However, the data do not really permit a test of the relative importance of this effect in the three eco-types. Graphical comparison confirms the presence of a special position of children under two in all three eco-types.

Further findings regarding seasonal fluctuations of growth and eco-type only partly confirm the working hypotheses concerning the effects of climatic seasonality on growth. In general, ecological differences in seasonality not very big among children. As expected, Weight-for-Height fluctuations in the Perennial eco-type were smaller than elsewhere, but fluctuations of growth in the Livestock eco-type appear larger than expected and there is a suggestion that health factors cause larger fluctuations of height growth in the Perennial eco-type.

With regard to the latter, it was already mentioned that this point needs further investigation. The large seasonal fluctuations in the Livestock eco-type, however, deserve more attention here. The original working hypotheses of medium seasonality was based on the argument that food crops were less important in the Livestock eco-type than in the Cereal & Pulses eco-type. The assumption is that higher incomes from off-farm employment and livestock production actually reach the children concerned because of remittances and sales of stock during periods of low food supply. That is, the negative effect low food supply would be offset by greater expenditures on food in the household. This is also the assumption behind the similar hypothesis, that children from households with a low resource base would show more seasonal fluctuations than children from "rich" households. The findings suggest that this assumption may need correction, in particular in the Cereals & Pulses and the Livestock eco-types. Not only was there almost no effect of resource base on nutritional status of women and children in these two eco-types, but among the adult women seasonal fluctuations were equal in both resource base groups while the effect among the children was relatively small. A further study of food consumption data in relation to food supply and anthropometry seems indicated. According to the original assumption, food supply and food consumption correlate less when there is off-farm income, the findings however suggest that this only true in the Perennial eco-type.

This last remark is a good starting point to draw up a balance for the present undertaking, as it clearly shows its limitations. The paper set out to study the effects of climatic seasonality on nutritional status. A number of conclusions were reached. The analysis demonstrated several effects of climatic seasonality on the anthropometric measures of children and mothers. Most effects appear to be cyclic, i.e. related to the yearly succession of wet and dry seasons, although for one eco-type (Livestock) there some indication of stress of a non-annual nature, both among mothers and children. It was demonstrated that effects are age specific, younger children are showing different trends than older children. Also a relationship was found with eco-type and resource base level. However, for a better understanding of the actual links between nutritional status and climatic seasonality these two variables are clearly lacking in precision. For that purpose more knowledge is required of the intervening variables themselves, food consumption and health.

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4. Seasonality in food intake and energy balance of rural Beninese women: some difficulties in interpreting results

Joop M.A. van Raaij & Werner J. Schultink*

4.1. Introduction

Seasonality in food intake and in energy balance has recently attracted a lively interest, as shown by the rapidly expanding amount of literature on this topic. Studies on food intake and energy balance may demonstrate the seriousness of the seasonal stress caused by limited food availability and may indicate the seasons during which energy balance is disturbed. Such studies may also quantify to what level disturbances of energy balance are compensated by adaptation in energy expenditure. The various types of adaptation are not always 'costless' in terms of maintenance of good health or in terms of maintenance of economically necessary and socially desirable physical activity. However, the 'price tickets' attached to the various levels of adaptation are not known. This hampers a more profound interpretation of findings from food intake and energy balance studies. This will be demonstrated by discussing the main results from a study performed on rural Beninese women.[1] Before this contemplation some background information on energy balance and on adaptation in energy expenditure will be given.

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[1] The authors are grateful to Dr. M.C. Nago, Vice-Dean of the Faculty of Agricultural Sciences, and Dr. H.F. Nouwakpo, Head of the Nutrition and Food Technology Section, both of the University of Benin, for their generous assistance and valuable suggestions.

4.2. Energy balance

Energy balance is usually defined as the difference between food energy intake (metabolisable energy) and energy expenditure (metabolised energy). If an individual is in a state of positive energy balance, i.e. if energy intake exceeds energy expenditure, body tissues will be deposited and body weight will increase. Likewise, in a state of negative energy balance body tissues will be mobilised and body weight will decrease.

Daily energy expenditure is usually divided into three components: (1) basal metabolism, (2) dietary-induced thermogenesis, and (3) work-induced thermogenesis. The basal metabolic rate is defined as the rate of energy expenditure at complete rest, without any physical activity, and as measured under strictly standardised conditions (lying down, shortly after being awake, in thermoneutral state, 12 to 14 hours after last meal, emotionally undisturbed, without disease or fever). Daily basal metabolism, obtained by extrapolating basal metabolic rate to 24 hours, covers 50 to 65% of daily energy expenditure. The increase in energy expenditure above basal metabolic rate after ingestion of a meal is called postprandial thermogenesis. This postprandial response depends upon the amount and type of food ingested. The overall response of food intake over 24 hours is called dietary-induced thermogenesis, and amounts to about 10% of daily energy expenditure. The increase in energy expenditure above basal metabolic rate after starting an exercise is called energy expenditure for physical activity or work-induced thermogenesis. The size of this component is highly variable, but usually ranges from 25 to 40% of daily energy expenditure.

Adaptation in energy expenditure

If an individual with a stable body weight (and body composition) and an established daily activity pattern will change his habitual energy intake, he will get out of energy balance. The disturbance in energy balance will partly be compensated by the altered contribution of dietary-induced thermogenesis. However, since thermogenesis amounts to about 10% of energy intake, only 10% of the disturbance will be met by the altered themogenesis. In order to re-establish energy balance, 90% of the disturbance need to be covered by other means. In principle, three types of adaptation in energy expenditure are conceivable: (1) biological adaptation, (2) social/behavioural adaptation, and (3) metabolic adaptation.

Biological adaptation means a change in body weight (or body composition). Suppose that the habitual intake of an individual has been reduced whereas his activity pattern remains unaltered. Then body weight will diminish, and so will the individual's basal metabolism and his energy cost for physical activity (a smaller body needs to be moved!). In this situation, body weight will decline until the reduced energy expenditure will balance the new level of habitual intake.

Social/behavioural adaptation means a modification in activity pattern (including changes in pace of activities). An individual whose habitual intake has been reduced might achieve energy balance without losing weight if he reduces his energy expenditure for physical activity by a less active physical activity pattern.

Metabolic adaptation includes mechanisms which might increase efficiency of energy metabolism. Little is known about metabolic adaptation, and many scientists doubt its existence. If metabolic adaptation really exists, it would mean that an individual whose habitual energy intake has been changed might re-establish energy balance without changes in body weight or in activity pattern.

It will be clear that with the various types of adaptation an individual may achieve energy balance at different levels of energy intake. In this respect adaptation can be considered as a process of moving from one energy balance level to another in response to fluctuations in energy intake.

Prices attached to adaptation

The various types of adaptation have a 'price'. In situations of reduced food intakes a new state of energy balance can be achieved by lowering body weight (biological adaptation). However, there will be a borderline for body weight under which a price is to be paid in terms of deterioration of health status or in terms of incapability of maintenance of economically necessary and socially desirable physical activity. There will also be a borderline above which such prices are to be paid. The above-mentioned holds for all groups within the community. There will be borderlines for growth rates of infants and children, for weight gains over the period of pregnancy, for birth weights, for breast milk production rates, and so on, beyond which prices are to be paid in terms of health status or in terms of economic and social function. The same is true for social/behavioural adaptations. Reducing level of physical activity cannot continue unlimited. A certain level (borderline) of physical activity will be needed for keeping good health and for allowing maintenance of economically necessary and social desirable physical activity. Metabolic adaptation, if it exists, is the only type of adaptation which would be more or less without 'price'.

As noted before, an individual or a group of individuals may achieve energy balance at different levels of energy intake. Whether a price or what price has to be paid will depend upon how energy balance will be re-established and upon the borderlines that will be passed. Unfortunately, such borderlines have not been adequately mapped out. Not until more is known about these borderlines, a definition of energy requirement as given by FAO/WHO/UNU[2] is of limited use.

4.3. Benin studies on seasonality in food intake and in energy balance

In the context of this paper, seasonality refers to a regularly recurring set of conditions leading to approximately annual alternations of restricted and unrestricted access to food energy, often coinciding with periods of variable demand for physical labour (Ferro-Luzzi et al., 1988). In countries with a seasonality in food availability one might expect a seasonal variation in food intake and on levels in which biological adaptation (changes in body weight) and social/behavioural adaptation (changes in activity pattern) occur.

From 1985 onwards several studies on seasonality in energy balance are being performed in Benin, West-Africa. The studies are supervised by the Department of Human Nutrition of the Wageningen Agricultural University (The Netherlands) and by the *Section de Nutrition et des Sciences agro-alimentaires du Faculté des Sciences agronomiques de l'Université nationale du Bénin*. The first study (1985-1986) was carried out in Houéyogbé District of Mono Province (south-western Benin; see Figure 4.1). A second series of studies (1987-1989) was performed in Dogbo District, also in Mono Province. A third series of studies (1989-1992) will be carried out at Manta, situated in the district of Boukombé of Atacora Province (north-western Benin). Thusfar, the results from the first study have been elaborated and published (Schultink et al., 1990). In this paper, the main findings of the first-mentioned study will be reproduced.

2 "The energy requirement of an individual is the level of energy intake from food that will balance energy expenditure when the individual has a body size and composition, and level of physical

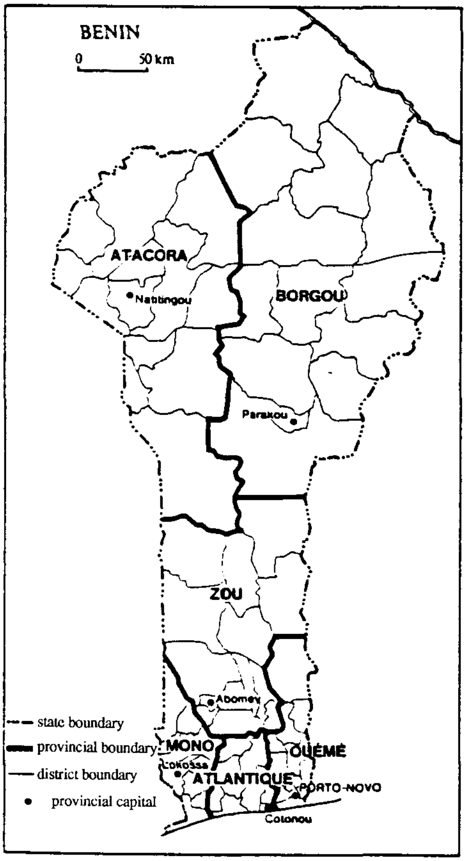

Figure 4.1: **Republic of Benin: provinces and districts**

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activity, consistent with long-term good health; and that will allow for the maintenance of economically necessary and socially desirable physical activity." (WHO, 1985)

The Houéyogbé study

The study was carried out in eight villages of the rural district of Houéyogbé. The district is situated at about 50 km from the coast, at an altitude of about 50 m above sea-level. The region is located in a relatively dry belt stretching from Togo into the south-western part of Mono Province. It has a mean annual rainfall of about 850 mm, and two rainy seasons. The population consists mainly of subsistence farmers. The main crops are maize, cassava, oil palms and beans. Cultivation (using hoes) is done by men as well as by women; women usually cultivate their own fields. Maize, which is the staple food, is harvested twice a year, in July and in December. Preparation of the fields for sowing maize is done in February and August; sowing is done in March and September. Processing of cassava, a typical task of women, is mainly done in January and February. Women also take care of the children, fetch water, gather fire wood, prepare food and do the housekeeping.

Between December 1985 and November 1986, 130 women were weighed every two weeks. A subgroup of 17 women was selected for measurements on basal metabolism, and a subgroup of 18 women was selected for determining food consumption and physical activity pattern. Some main characteristics of these three study populations are presented in Table 4.1.

Table 4.1
Some physical characteristics of the women

	weight group (N=130)	BMR subgroup (N=17)	energy intake and activity subgroup (N=18)
- age (average number of years)	33.2	32.8	34.2
- weight (average in kg)	50.4	51.7	52.6
- height (average in cm)	157.0	156.4	159.3
- BMI* (average in kg/m^2)	20.4	21.1	20.8

* Body Mass Index as measured at the start of the survey (December 1985)
Source: Schultink et al., 1990

Basal metabolism, food consumption and activity pattern were measured in three different seasons: March-April, June-July, and September-October. In each season basal metabolism was measured on two days within the same week; food intake and activity pattern were studied over four consecutive days. Daily food intakes were measured using the precise weighed food intake method. Daily activity pattern was studied by recording the time spent on six categories of activities. Details of the methodology used are given elsewhere (Schultink et al., 1990).

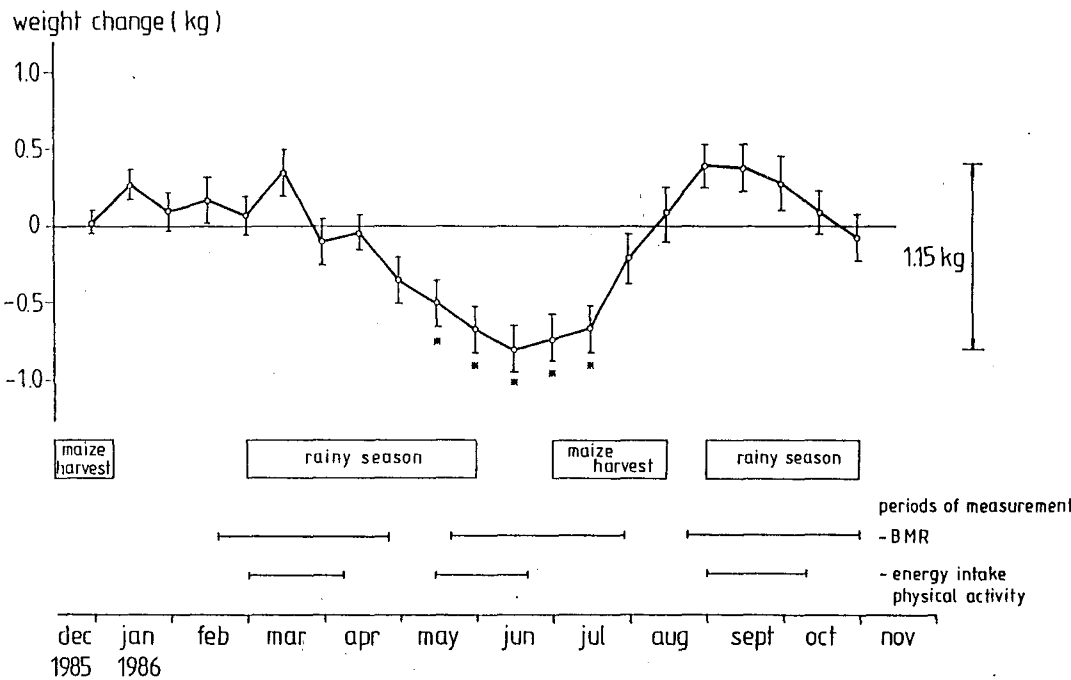

Figure 4.2: **Body weight changes throughout the year**
(the small circles reflect the means; standard errors are shown by the vertical lines; an asterisk indicates that the difference reached statistical significance, i.e. $p<0.005$; source: Schultink et al., 1990)

The seasonal changes regarding the average body weight of the 130 women are shown in Figure 4.2. The body weight changes are expressed as difference from the baseline body weight in December 1985 (average of two fortnightly measurements). From December to March the women had a more or less stable body weight and were able to maintain energy balance. In April to June they went into a state of negative energy balance and lost weight. In July-August they were in a state of positive energy balance and gained weight, and from September onwards they got again into a state of slightly negative energy balance and lost some weight. The lowest average weight was reached in June, and the obtained value was, on average, 1.15 kg[3] lower than the average weight in the post-harvest period in August.

The disturbances in energy balance were clearly caused by the seasonal variation in food availability. Table 4.2 shows that in May-June, just before the main harvest, the energy intake (1558 kcal per day) was substantially lower than in March-April (1882 kcal per day). When expressed in term of basal metabolism, the energy intake in May-June reached to only 1.17 times basal metabolism, which is even below the survival requirement as defined by FAO/WHO/UNU (WHO, 1985). Unfortunately, we did not collect food consumption data in July-August, which is the post-harvest period, when the women were in a state of positive energy balance. In September-October when women started to loose weight again the energy intake (1661 kcal per day) was again substantially lower than in March-April. In the periods of limited food consumption the women started to "consume" their own body tissues (weight loss) and, as a consequence, energy expenditure became progressively reduced (biological adaptation).

Table 4.2
Basal metabolic rate and energy intake (kcal/day), by season

	February-April	May-July	August-October
- basal metabolic rate (b.m.r.;N=17)	1,328 (±168)	1,337 (±175)	1,335 (±152)
- energy intake (N=18)	1,882 (±384)	1,558 (±219)	1,661 (±342)
- energy intake/b.m.r. ratio	1.42	1.17	1.24

Note: Figures between brackets are the standard deviations.
Source: Schultink et al., 1990

We also observed a significant seasonal variation in activity patterns. As can be seen in Table 4.3, fluctuations in the daily activity pattern are mainly caused by the fluctuations in agricultural tasks to be performed. In May-June the amount of time spent on agricultural activities was clearly lower (7%) than in March-April (17%) or in August-September (19%), the amount of time spent on other tasks remaining fairly

[3] The standard deviation was 1.27 kg.

constant. As a consequence, the amount of time spent on resting (sleeping, sitting, resting), if included in the daily pattern, is higher in May-June: 67%, against 61-62% in the other two periods. These changes in activity pattern obviously resulted in a lower energy expenditure for physical activity in May-June (behavioural adaptation).

Table 4.3
Daily activity pattern of 18 women (in percentages), by season
(excluding resting, sitting and sleeping)

	March-April	May-June	September-October
- agricultural work	17	7	19
- domestic work	63	72	64
- other activities	20	21	17
	(100)	(100)	(100)

Source: Schultink et al., 1990

4.4. Conclusion

Studies (like our Benin studies) on seasonality in energy balances of people who experience seasonal stress of restricted food availability may indicate the seasons in which energy balance is disturbed and may quantify to what levels disturbances in energy balance are compensated by biological adaptations (weight changes) and by social/behavioural adaptations (changes in physical activity). However, a more profound interpretation of the findings is hardly possible since little is known about the borderlines of adaptation beyond which health status and level of economically necessary and socially desirable physical activity are being deteriorated. This topic warrants high priority in future research and should be considered as an enormous challenge for medical doctors, nutritionists, antropologists, economists, and social scientists.

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5. Adjustment of food habits in situations of seasonality

Adel P. den Hartog & Inge D. Brouwer*

5.1. Introduction

The aim of this paper is to give an analysis of coping mechanisms of rural households in situations of seasonal food shortage. The emphasis lies on the way food habits are adjusted to overcome these situations.[1]

First, some theoretical aspects of coping behaviour will be discussed. Then, based on emperical findings, a hierarchy of measures which rural households take in order to cope with increasing seasonal food shortages, will be presented. At the same time, attention is given to the position of women as they play a central role in Africa concerning food and nutrition. As said before, this paper is limited to rural households because seasonality is most obviously felt there. However, this does not mean that urban populations might not be confronted with seasonal shortages as well.

5.2. Some theoretical considerations

What are food habits? From which practical and useful theoretical framework, a deeper understanding of the mechanism of adjustment of food habits can be obtained? These questions will be discussed below.

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[1] With special thanks to Roland Friele for his valuable suggestions concerning coping behaviour in stress situations in which nutrition plays a role. Likewise, our gratitude concerns Marti van Liere and Sioe Kie Kroes.

Food habits

According to Margaret Mead, food habits can be defined as the way in which individuals or groups choose, consume and use the available foods in relation to social, economic, cultural and ecological circumstances.

Food habits include the following elements: food procurement, preparation of food and usage of food determined by norms and values about food prevailing in a society (see Figure 1). Rural households procure their food in different ways; primarily by agricultural production, but also by collecting wild foods, by means of gifts and loans within social relationships, and by purchasng food on the market. Purchase of food becomes more and more important, especially in countries where households are increasingly involved in a market economy. Households generate an income by activities such as commercial farming (a.o. sales of cash crops), sales of home-processed foods, wage labour and employment.

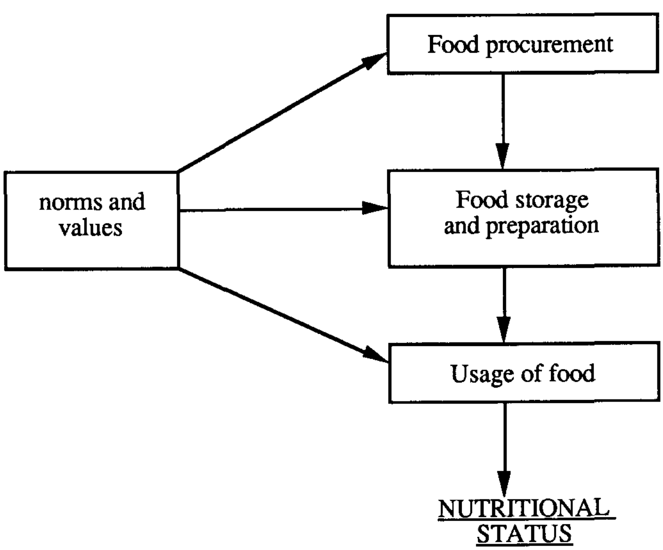

Figure 5.1: **Basic components of food habits**

Food has two essential functions in a society: a physiological and a social function. Man needs food to stay alive and healthy and food has to fulfilL social needs of man (Den Hartog & van Staveren, 1983). The social functions of food in a society are, among others: a gastronomical function, a means of communication (e.g. hospitality), an expression of economic wealth or status, and a function as a means of power. Food as means of power plays an important role at household level, especially in areas where foods have to be stored to overcome the dry season. The head of the household who controls the grain silos, exerts a large influence over other members of the household by distributing the grain in times of shortages.

Adjustment of food habits compelled by necessity

Every change of a socio-economic or climatological nature implies an adjustment of food habits. Usually a more gradual change of food habits occurs as a result of socio-economic processes like the introduction of cash crops, changes of prosperity, urbanization and all kinds of external influences, be it cultural or economical. Food habits, however, will also change because of a strong reduction of the food supply caused by climatological factors or political upheaval. In areas with a distinct seasonality in food supply, households will be forced to adjust their food habits in order to survive. This change, however, is temporary. When the period of shortages is over, people will go back to their desired food habits as soon as possible.

In most African countries, the rural economy is based on a network of family ties and other affinities. Likewise, productive processes at household level are still very much embedded in a kinship system (see e.g. Hyden, 1986). This brings us to the question of how to define a household: as a family unit, a production unit or as a consumption unit (see e.g. Guyer, 1986). For the purpose of nutrition studies, households may be defined as "a group of persons sharing the same cooking pot", a consumption unit.[2]

How do people handle their food in an emergency or stress situation? A useful theoretical framework is derived from a socio-psychological study by Folkman and Lazarus (1980,1988). Although their studies refer to the industrialized world - the United States - and are carried out at the individual level, it nevertheless offers a useful framework.

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[2] It should be realized that in many African societies, and particular in the savannah zones of West Africa, a family compound consisting of different cooking units, may be considered as a household.

Coping behaviour can be regarded as any attempt to resist a problematic situation, in this case food shortages. The starting point is the controlability of the situation. Confronted with food shortages, households will make a cognitive appraisal of the encounter. This appraisal is based on the answer to two questions: "What is at stake in this encounter" and "What can be done, what are the options for coping with it"?

The answer to these questions affects the way in which households will try to adjust themselves. Folkman and Lazarus distinguish two important ways of coping behaviour: emotion-focused coping and problem-focused coping. The emotion-focused ways of coping include, among others, resignation, distancing, escape-avoidance, accepting responsibility or blame (Folkman & Lazarus, 1980). For example, in a period of food shortages, will households resign to the situation as something inevitable or do they intend to take some measures?

Problem-focused ways of coping try to change the cause of food shortages and to control the shortage problem as well as possible. In this paper, problem-focused behaviour is considered as measures people take to overcome problematic situations, referring to what people actually do.

If a stressful situation is appraised as unchangeable, especially emotion-focused coping strategies will be used. Is the encounter appraised as manageable, then problem-focused coping strategies are more likely to be used. Folkman and Lazarus indicate that in a stressful situation usually both ways of coping play a role.

Emotion-focused coping of households exerts a strong influence on the way actual coping will take place. To be able to change a situation, the emotional stress caused by this situation has to be manageable.

In areas with clear seasonality, households have already for generations experience with food shortage problems. To a certain extent, people know what can be expected and how this period of food shortage usually will develop. Therefore, it is plausible that they are emotionally prepared. This is in contrast with, for instance, the humid forest zones of Africa where extreme fluctuations in food supply are not common.

The existence of specific names in a local language for periods of food shortages shows that people are familiair with these situations. In the savannah zones of West Africa, the dry season is known as 'hungry season' in English and as 'période de soudure' in French.

Without denying the importance of the emotion-focused ways of coping, this paper will be limited to problem-focused ways of coping. As regards to this, it is useful to refer to Longhurst's approach. Longhurst (1986) distinguishes measures to prevent seasonal stress and measures to meet actual stress.

Measures to prevent seasonal stress[3] are mainly found in the domain of household food production and the management of the food stocks, necessary to overcome the period when food cultivation is not possible. There are some indications that the old farmer's wisdom saying that grain silos should be kept as filled as possible, is under heavy pressure. A need for cash may cause that after the harvest too much of the food destined for household stocks is sold. The cultivation of cash crops like cotton may also have a negative effect on the production of food. Direct measures to meet seasonal shortages will be discussed in the following paragraphs.

Socio-cultural and physiological determinants of adjustment of food habits

In a situation of clear food shortages, adjustment of food habits will be guided, in the long run, by a primary urge to survive. People will have to adjust in order to stay alive. The physiological need of food, which is not perceptible under normal circumstances, brings us to Malinowski's ideas about basic needs.

According to Malinowski (1944), nutrition is one of the physiological determined basic needs of man and gives in a society a culturally determined response in the domain of food supply and consumption. In other words, during food shortages, on the one hand, people will try to confine the hungry feeling as much as possible, and on the other hand, they will try to maintain the core of their food habits. Decreasing or omitting appreciated foods compelled by necessity is experienced as a hardship.

Besides an adjustment of food habits, another adjustment takes place which has also a physiological basis: decreasing activities. Contrary to the dry season, when people do not have to work in the fields, the situations become problematic during the rainy seasons when the fields have to be prepared and food availability diminishes. In the fifties, Pierre Gourou in his classical study on the tropics already indicated that at the end of the dry season and at the beginning of the rainy season, an undernourished population will have to work on the fields in order to make possible a new agricultural season (Hamilton, Popkin & Spicer, 1984; Hussain, 1985; Longhurst & Payne, 1981).

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[3] This paper deals solely with coping mechanisms in the sphere of food habits.

5.3. Adjustment of food habits as a coping strategy

The gravity or degree of food shortages at household level is determined by the quantity of food which is lacking and the duration of these shortages. From time to time it happens that, what seems to be a seasonal shortage, is slowly developing into a situation of a more chronic nature (famine). However, as indicated by Longhurst (1986), it is very difficult to decide where the threshold between seasonal food shortage and famine lies.

From available literature, a hierarchy of coping strategies can be constructed. This hierarchy is mostly determined by the nature and duration of the shortages. In reality, however, the hierarchy of measures as presented in Table 5.1 are not strictly separated and likewise regional differences may occur. The hierarchy of coping strategies given in Table 5.1 aims in the first place to give an understanding of the various processes of adjustment.

Preventive coping strategies (see e.g. Corbett, 1988; Longhurst, 1986) will not be discussed here as the focus will be on direct measures of households to meet actual stress.

Seasonal shortages

When seasonal shortages occur with a distinct regularity, in first instance coping strategies will mainly be focused on food habits. This implies a decrease of food consumption by reducing the number of meals per day, reducing the portions and diluting the meals with extra water to suppress the hunger feeling. When shortages last longer, non-conventional foods will be consumed. These foods, mostly vegetables, are collected in the field and are known in the literature as "famine foods".
Adjustment of food habits can be illustrated by means of several different situations: in forest zones, in savannah zones, and among the nomadic tribes in the arid and semi-arid regions. Although the forest zones of tropical Africa are normally not subject to extreme seasonality, seasonal food shortages may still occur. Pagézy's work (1982) in Zaïre, e.g., points to a strong seasonality in the production of yam and plantain. In these equatorial forests, cassava plays a supplementary role in periods of shortages, even though this crop is not yet part of the dietary habits. When the common foods are abundant again, cassava is omitted. It is known that in colonial times in Zambia,

Table 5.1
Hierarchy of coping strategies

I	**Seasonal shortages**	**Specific action**
	Measures	- Reduction of quantity • reduction of number of meals • reduction of portions • diluting with extra water
	Dietary habits	- Consumption of unconventional foods • so-called famine foods, i.e. plants and animals which will not be eaten otherwise • consumption of sowing seed
II	**Shortages of a more chronic nature**	
	Selling of properties, obtaining or borrowing money	- Selling cattle, land and jewelry (of women) for food - (Temporarily) migration of men for money, income
	Roaming for food	- Borrowing of food from other households - Wandering in search for food in other areas - Raids
	Migration	- Temporarily settling down in other areas and towns - Boarding out of children to family elsewhere
	Religious measures	- Prayer and magic (e.g., rain making)

Source: Den Hartog, 1982: 155-161

the cultivation os cassava as a reserve crop was stimulated by the authorities. Therefore, the origin of cassava cultivation can also be regarded in several regions as a preventive coping measure.

In the savannah zones it is not unusual for women groups to search for seeds of wild grasses, tubers and wild fruits, which would not be eaten otherwise. It is known that in several parts of Africa insects such as locusts, flying ants and caterpillars are eaten often as a delicacy (Bodenheimer, 1951; Silow, 1976). Some varieties of e.g. flying ants and caterpillars are also eaten as famine foods in periods of need (Gelfand, 1971).

When the shortages further continue, people will turn to an extremely hazardous measure, namely the consumption of seeds for sowing and planting by which they could be heading towards a disaster. However, households try to limit the consumption of seeds for sowing to the last.

Regarding the savannah zones in Cameroon, De Garine (1988) and his colleagues point out that extreme seasonal food shortages do not only affect nutrition, loss of weight and health in general. When shortages last longer, the first signs of social desintegration can be noticed: rules of reciprocity between villagers and between families become looser and a dangerous aggressiveness develops.

Bernus (1980) gives a description of the Tuareg concerning adjustment of dietary habits by nomadic tribes. In the dry season, the amount of cattle fodder decreases visibly and likewise the production of milk, butter and cheese. Shortages of milk are felt as a serious hardship and, according to the Tuareg, as a consequence all kinds of diseases will develop. Milk is not just a food but also a drink of a salutary nature.

Of all cereal varieties, millet is the most appreciated by the Tuareg. It is prepared together with milk to obtain a thick porridge. During the dry season, the milk eventually disappears from the porridge. Millet becomes scarce and in order to compensate the loss of volume of the porridge, bran is added which normally is thrown away. In order to get food or money to buy food, people will start to sell their cattle.

The collection of wild fruits and seeds always plays an important part in the nutrition of the Tuareg. In the dry season, however, people change to those products which are usually not consumed in better times; for example, because of an unpleasant taste. Such products are: seeds to be picked out of ant-hills, stones of wild fruits, seeds of certain grasses, and leaves of trees. Collecting wild foods is a task of women. Riding a donkey, they roam the area, equipped with a stick with an iron hoe to turn up ant-hills, a winnow to seperate the pebbles from the seeds, and a leather bag for storage.

At the social level, society comes under heavy pressure (Dirks, 1980; Ogbu 1973). Because of food shortages, rules of hospitality such as offering meals to visitors, can not or hardly be maintained. Comparable coping strategies are found among other pastoralic peoples such as the Fulani and Peul (White 1986).

Another example of adjusting dietary habits from necessity among the Fulani is a change to the consumption of fish. As known, fish is not eaten by nomadic tribes and they even have a strong aversion against this food. During the dry season, Fulani migrate towards the river Niger. When drought lasts very long, they will eventually turn to the consumption of fish.

Food shortages of a chronic nature

As said before, from time to time a seasonal shortage may change into a chronic situation. Adjustment of food habits will not be able to give relief anymore. Households have to turn to other measures. By selling properties and borrowing money, foods can be purchased. Selling cattle and jewelry of women is one way to find money for food purchases. It is also not unusual to borrow a bag of maize from a merchant which later on has to be paid back, e.g. in the form of two or three bags of maize. This means that households pay usurious interests in kind.

Roaming for food is another measure to be taken. Poorer households will start doing this earlier than richer ones who can sustain longer by selling their properties. Members of households or even complete households will start wandering in search for food. This search can wind up in predatory expeditions, which can create great social unrest in less affected areas.

Migration, in its form of temporarily settling somewhere else or in towns, is one of the final options in a worsening situation. In the dry savannah of West Africa , this means settling down temporarily in the humid forest zones of the south.

To meet a continuously worsening situation, people may turn to religious measures: prayers for the mercy of God or begging the gods for help or trying to take over the course of events by turning to magic. The so-called rainmakers fall under this category of measures. Although religious measures are mentioned last in Table 5.1, people will often turn to prayer in an early stage of the dry season.

5.4. Women and food shortages

Women fulfil a central role in food supply, food preparation and distribution of prepared food among the different members of the household. At the same time, 'being a woman' coincides with 'being a mother' in African society. Women carry direct responsibility for the care of young children. Seasonal shortages imply an additional care and burden for women (Hamilton, 1984; Jiggins, 1986; Palmer, 1981; Rangasmai, 1985). Under difficult circumstances, women are expected to be able to prepare a meal. How will intra-household food distribution be arranged?

Concerning the distribution of food within the household, there is a tendency in many societies to favour male members at the expense of women and young children (Den Hartog, 1972). In periods of relative abundance there is usually enough food for all members, regardless how the food is being distributed. When the quantity of food at household level diminishes, it is likely to be at the expense of women. Will women make sacrifices at their own expense in order to give at least some food to her young children and her husband?

Seasonal food shortages mostly coincide with a lack of sufficient drinking water. Water is an indispensable basic need of the human being and fetching water is a task of women and children. When food availability decreases due to drought, water should be fetched at longer distances.

The work load of women in the domain of food supply and food preparation is determined, amongst others, by:

(1) The extent and duration of the seasonal shortages.

(2) The assistance women can get from their children or other women in the household, the willingness of her husband and other men to drop cultural determined role patterns in times of emergency and to participate in "women's work". In poorer households men will have to assist much sooner in female tasks than in richer households.

(3) The resource base of a household and the division of property rights of men and women determine further the work load of female tasks. Who owns cattle, land, jewelry and clothes and who is authorized to sell or to trade these for food? Jewelry and clothes are often a capital reserve of women. Forced sales of these goods may deteriorate the position of women (Jiggins, 1986).

(4) Another important point to be mentioned is the physical condition of women which will be weakened towards the end of the dry season and will deteriorate during the rainy season when much agricultural work has to be done.

5.5. Final remarks

Summarizing, one may state that households develop coping strategies during seasonal food shortages in order to meet this stressful situation. Adjustment includes emotion-focused as well as problem-focused ways of coping behaviour. When seasonal shortages are over, the food habits of households return as soon as possible to what is desired in times of relative abundance. As far as changing of food habits in tropical Africa is concerned, the following aspects have to be taken into account.
Food habits are determined in the first place by socio-economic and cultural factors; factors that are continuously changing. Examples of relatively recent changes are: the development of a market-centered agriculture, urbanization and modern education. Within these changes, seasonal fluctuations occur, either of a 'normal' or an 'extreme' nature. In short then, coping strategies can be considered as socio-economic and cultural responses to a physiologically determined life threat.

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6. Seasonality and the rhythm of external interference

Ton J. Dietz*

6.1. Introduction

Since the publication of Chambers', Longhurst's and Pacey's "Seasonal Dimensions to Rural Poverty" in 1981, the international community of socio-economic scientists dealing with development problems has been alerted to 'seasonality' as an important fact of life for millions of poor people. Foeken's and Hoorweg's recent summary of the literature mentions a large number of titles which deal with various aspects of seasonality: seasonal production and labour cycles, food availability cycles, price cycles, income cycles, birth and death cycles even. In the 1980s many scientific fieldworkers included 'seasonality' as one of their research topics and the empirical evidence is showing that it is indeed a fact of life to be reckoned with. In studies about 'livelihood strategies' of poor groups in society, the preventive and curative actions (or 'coping mechanisms') to pull through potentially threatening periods of seasonal 'stress' received considerable scientific attention. Seasonality was found to be a major problem in dry environments especially. However, in these dry environments the often extreme inter-annual variability of rainfall means that the relative importance of 'seasonality' also varies considerably between years. 'Normal' stress can become critical stress during adverse years. 'Normal' coping mechanisms are no longer sufficient and have to be replaced by more drastic 'survival strategies' during those years. Scientists should be more careful than they normally are in using these catchwords. But they should also be more inclusive in dealing with 'seasonality', 'coping mechanisms', 'crises' and 'survival strategies'.

The host of seasonality studies take households and local environments as points of departure, often highlighting the fact that the effects of seasonality deepen the existing stratification in local societies and aggravate existing poverty situations for relatively poor groups. However, local societies are not isolated 'genres de vie'. They

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are intertwined with the world at large and especially with regional and national political, economic and cultural environments. The extralocal influence on local societies has its own rhythm, sometimes neatly fitting into local patterns of seasonality, but often with its own calendars, which can and often do collide with these local patterns of seasonality. This is most obvious in the institutional calendar of government. In this study I will tentatively deal with the rhythms of external institutions as an additional and connected problem of seasonality. My own experience in northwestern Kenya will be my major point of reference, but I will also use the experience of my colleagues and students at the Department of Geography of the University of Amsterdam, who all dealt with relatively dry environments. Some of them worked in Africa too; in the savannah region of northern Togo and northern Benin (Haan, 1988; Kruithof, 1989); in the mountainous area of northern Morocco (Jungerius, De Mas & Van der Wusten, 1986; Pascon & Van der Wusten, 1983); and in the 'middle veld' of eastern Zimbabwe (Andel & Kruik).

6.2. Northwestern Kenya

The semi-arid areas North and East of the Cherangani Hills in northwestern Kenya are very clear examples of 'seasonal environments'. The Pokot and Marakwet (part of the Kalenjin group of the Nilotic people) show a remarkable adaptation to this environment. They combine agriculture and animal husbandry. The lowland Pokot are semi-nomadic pastoralists with cattle, goats and 'hair' sheep, combining this with what is sometimes called 'hit and run' cultivation of millet and sorghum. The Pokot and Marakwet living at the Cherangani escarpment are predominantly agriculturalists, partly irrigating their millet and sorghum fields (as well as maize and bananas) using an ingenious system of indigenous furrows, tapping water from the mountain rivers. But these people do have goats and hair sheep too; some of them even possess cattle. The Pokot living in the Sekerr and Chemorongit Hills more North are dryland cultivators of maize and millet, combining it with what remained of their herds and flocks after dramatic droughts, diseases and insecurity during the late 1970s and 1980s.[1]

[1] Elsewhere I have especially dealt with the 'survival strategies' and the influence of external interventions in the western Pokot area (Dietz 1987); for the Arid and Semi-Arid Lands Programmes of West Pokot and Elgeyo Marakwet Districts 'Locational Development Profiles' have been prepared

In Figure 6.1 the seasonality of life in this area has been summarized as well as the calendar of external interference. This is a generalized picture. Inter-annual variation may be large. People reckon with a rainy season from April (sometimes March) to August, with a dangerous dry spell in June. As an example, Figure 6.2 shows how tricky the rainfall situation is in lowland Marakwet, i.e. in Chesongoch Catholic Mission Station. Inter-annual variation in the 1972-185 period ranges from 466 mm to 1518 mm. The figure compares three recent years: 1982-1984, showing a chaotic picture of unpredictability. This should warn us for too static 'seasonality' images.

The rainfall season in the Pokot and Marakwet areas from April to August is generally long enough to allow the growth of a millet or sorghum crop on non-irrigated fields; recently the cultivation of drought-adapted maize varieties is increasing. However, the dry spell in June can damage the crop. Short rains in October and November are not relevant for rain-fed cultivation. In areas where mountain streams allow gravity irrigation, furrows have been constructed; in Marakwet some furrows are at least a few hundred years old; in Pokot they are more recent, although partly from before colonial times too. Furrow irrigation is mainly important to overcome dry spells and droughts during the normal growing season. Cultivators are especially eager to use irrigation when the April rains are disappointing. However, in case of highland droughts, most mountain streams are drying up which means that irrigation is impossible. In a few areas the streams are perennial, enabling some irrigation of ratoon crops of sorghum. In that case two crops per annum are possible. Alongside these major rivers and furrows, people cultivate bananas and cassava, and one can also find mango trees and, recently, citrus gardens there. Within the area the possibilities for irrigation differ a lot. Especially in Marakwet we find villages where most households have access to irrigation water every week. But there are also villages where a very complex system of annually alternating uses of furrows exists, in which households only have water rights once every three or even seven years (cf. Dietz. et al., 1986; various articles in Kipkorir et al., 1983).

The result of this system of agriculture is a labour peak in March-April and in June. Villages (or clans) with irrigation may have additional labour peaks in May and July-August, to check and repair the furrows which are easily destroyed during downpours and escarpment floods. Crop-labour peaks clearly coincide with scarcity periods with regard to own-produced grains, and with peaks in diseases in cultivation

for most Pokot and Marakwet Locations (Dietz, Van Haastrecht, Schomaker a.o., 1982-1986), giving some more details of other areas too.

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A) LOCAL RHYTHMS												
climate: rainfall												
crops: irrigation	—I—	—Hr)		F—	—P	—I	—	(I)—	—H		(I	—I—
crops: dryland			P—	—S—	—	W—	—H					
crop labour peaks	–							- -	- -		–	–
cattle		M	M C	R	m	m	m	m	m	T		Sf
goats	m	E			m	m					m	m Sf
barter milk for grains	xxx						xxxx	XXXX	XXXX	xxxx	xxxx	xxxx
animal labour peaks												
beekeeping	A						A	A	A			
non-agricultural activities	B	wf	wf	G	G		B	B	D		wf	wf D
local ceremonies												xxxx
food availability: crops												
meat												
milk												
wild food	- - -	- - -	- -									
disease peak												
B) NON-LOCAL RHYTHMS												
labour migration (agric.)	Mh				Me	Me	Me				Mh	Mh
labour migration (pastoral)	Me	Me	Me									
government financial year							start					
communications difficult												
(food aid)			(	xxxx	xxxx	xxxx	xxxx	)				
food-for-work	xxxx	xxxx	xxxx								xxxx	xxxx
school year	xxx	xxxx	xx	xxx	xxxx	xxxx	x	xx	xxxx	xxxx	xxxx	x
sale of crops (peak)								xxxx	xxxx			
sale of hides/skins (peak)		xx	xxxx									
sale of animals (peak)			xx	xxxx						(	xxxx	xxx)
national availability of maize	xxxx	xxxx	xxx									
insecurity	xxxx	xxxx	xxxx	xxx								
lab. recruitment (migrants)	xxxx	xxx										
taxation	xxxx	x										
cas. work for govt. projects	xxxx									xxxx	xxxx	xxxx
provision of farm inputs			xxxx	xxx								
vaccination of animals							xxxx	xxxx	xxx			
loan recruitment/recovery	xxxx	xxxx	xx									
civil servant mobility	xxxx	xxxx								xxxx	XXXX	xxxx
change of govt. personnel							xxxx	xxxx	XXXX			
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

Figure 6.1: **Seasonality in West-Pokot, Kenya**
(explanation of symbols on page 93)

Symbols used with Figure 6.1

Crop husbandry
F Renew irrigation furrows
H Harvesting
Hr Harvesting ratoon crop of sorghum
I Irrigation
P Land preparation
Pm Mulching
S Planting, sowing
W Weeding
( ) sometimes

Animal husbandry
C Period of peak calving
E Emergency slaughter
M Period of highest animal mobility
m Period of highest milk availability for human consumption
R Return of cattle from dry season camps
Sf Slaughter for festivities
T Cattle trek to highland areas or better watered areas

Non-agricultural activities
A Apiculture (beekeeping)
B Building and repair of houses, stores, platforms
D Preparing alcoholic beverages for feasts or for sale (peaks)
G Peak in gold digging
wf Labour peak in the provision of firewood and (drinking) water

Migration
Me Emergency migration ('looking for food')
Mh Migration to highlands to assist in highland harvest

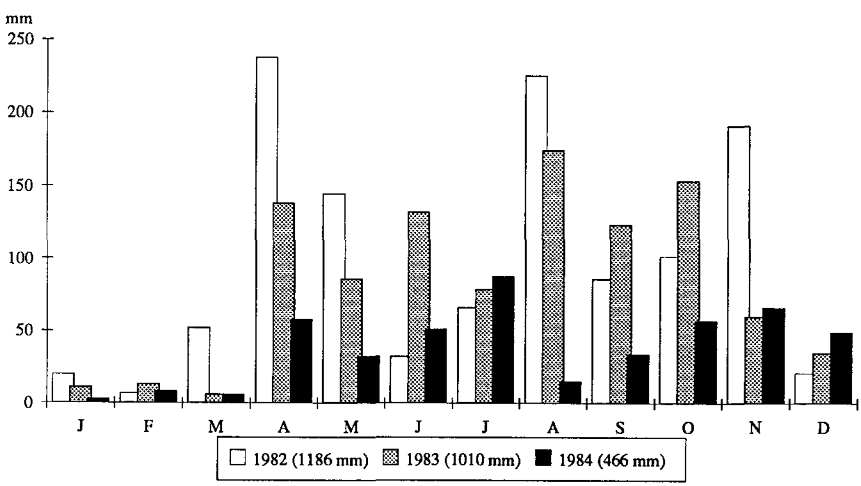

Figure 6.2: **Rainfall distribution in Chesongoch, Kenya (1982-1984)**

areas during the rainy season (malaria, respiratory diseases, malnutrition-related diseases).

Lowland pastoralists are directly or indirectly confronted with the seasonality of rain-fed crops too. The women and children do cultivate small gardens of millets, with a minor labour peak when the rains start. They consume own-produced grains during the months immediately following the harvest, from July-August onwards. Indirectly the women acquire grains by barter with agriculturalists, selling fresh or preserved milk. There is a peak barter trade of milk against grains from July onwards. This may continue until February even. Especially the Cherangani area (but recently the Chemorongit area too) shows a peculiar altitudinal variation in harvest dates. Figure 4 gives an example for Mwino. In the semi-arid lowlands millet and sorghum harvests are in July-August; in the sub-humid escarpment zone millet and maize harvests are in September-November; in the humid highland zone maize harvests are in December-February (all crops start in March-April with the start of the rainy season; also cf. Porter, 1965 and 1988). Lowland pastoralists (but also lowland agriculturalists short of food) can acquire grains from ever higher cultivators, from July to February. An important strategy for (polygamous) lowland men is to marry wives from various ecological zones/altitudes, which gives them (and their relatives) direct access to a 'stretched harvest season' (Figure 6.3). Another related strategy is to have fields at various altitudes within one micro-household. With the recent increase in large-scale trading in maize from the highlands to the lowlands (after the harvest in the highlands, from November to February) it also becomes relevant to have 'acquaintances' amongst traders and shop owners in the market places.

In the semi-arid lowlands of the Pokot area semi-nomadic herders keep their cattle. In the dry season the herd mobility increases, but this mainly involves steers, heifers and older calves. Especially in February and March the herd mobility is at its peak. During this period men and animals are continuously on the move to secure water and feed. In April the herders return to the living quarters of women, children and elderly people, where normally also the cows-in-calf, many cows with young calves and goats and sheep have stayed. Many cows get their calves in April or May with the result that normally there is a lot of milk for human consumption from May until about September. The variability between years can be large, though, and seasonal patterns as well as trek routes differ from year to year. In 'normal' years there is a lot of milk during the rainy season, which compensates for a meagre provision of grains during those months. But in dry years, the milk production is low and herders' families first have to sell small stock or even cattle to secure grains by barter or purchase; when the drought becomes more severe, families are forced to slaughter nearly-dead animals or to eat animals that have actually died. Normally, the consumption of meat is rather low - as with most pastoral peoples - with the exception of periods of ceremonies, which are often concentrated in December, before the really dry months when the herders are far away and before the annual labour peak in animal

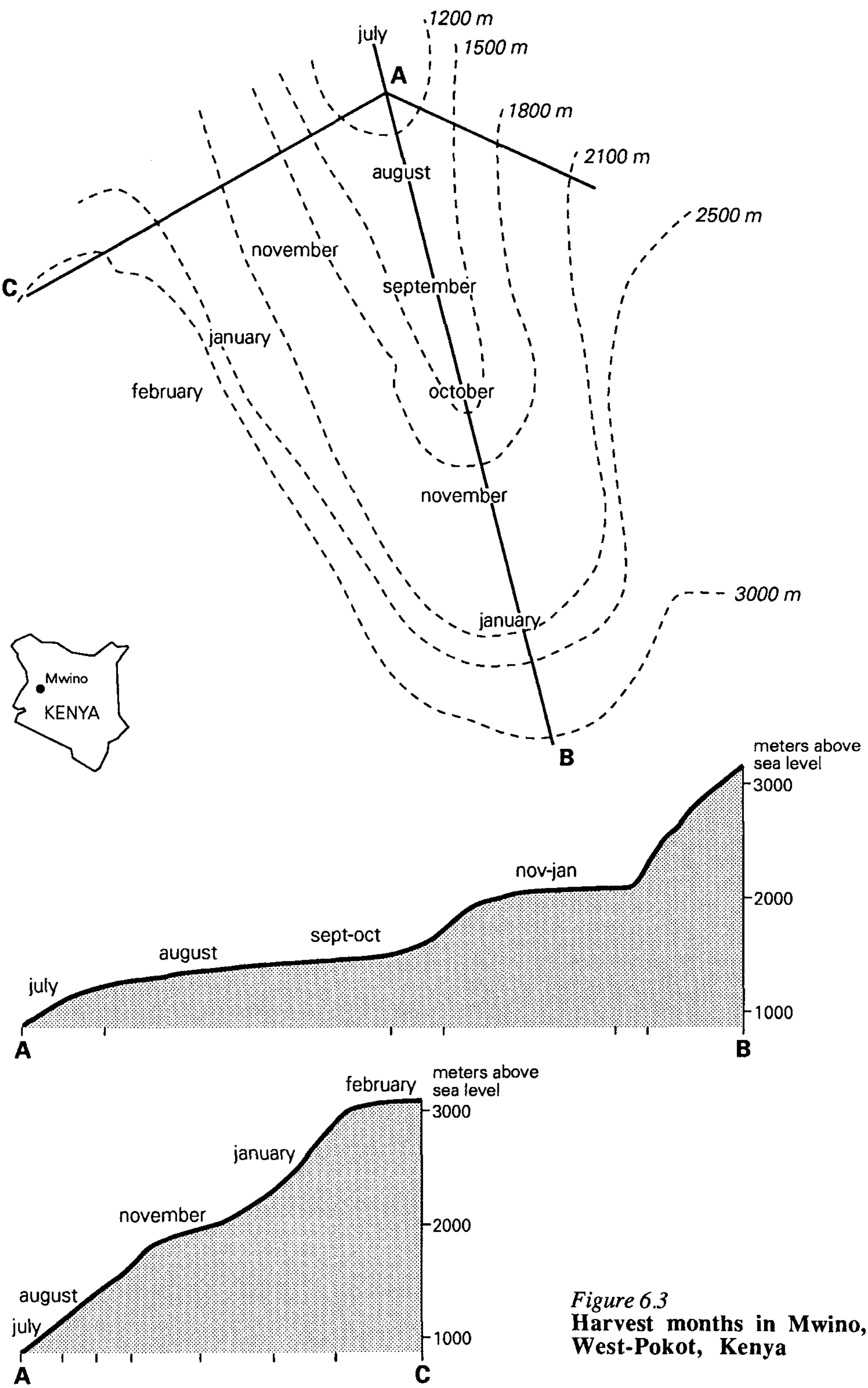

Figure 6.3
Harvest months in Mwino, West-Pokot, Kenya

husbandry, which starts in January and goes on until April of May.

A labour peak in cultivation and/or livestock activities easily suggests a peak in human energy requirements, but this is too simple. Labour peaks in non-agricultural activities, like the hauling of water or the collection of firewood or even the concentration of celebrations and ceremonies can be much more taxing in terms of human energy consumption. The impact of seasonality should not be narrowed to agriculture. Rural areas are more than agricultural areas. The various types of seasonality have an impact which goes far beyond agriculture.

The non-agricultural activities also show a clear seasonal pattern. Huts and fences are normally built at the end of the dry season, platforms in the sorghum fields (to scare away birds) in July and storage huts in August. Beekeeping, which is rather important in this area, has a labour peak in January for making hives and in July for collecting honey. Women brew beer after the harvest and during the December ceremonies, an activitiy recently forbidden by the Kenyan government. During the dry season a lot of labour time is spent on the collection of water for domestic purposes and on the collection of firewood (also this activity has to be done a bit secretive, because of the risk of prosecution). As soon as the rainy season starts and the water is going to flow in the seasonal streams, many people nowadays start to plan alluvial gold, an activity which was the most important cash-oriented survival strategy during the disaster years 1979-81 and 1984-85, but which is undermining the agricultural activities in years with good rainfall.

Labour migration to the highlands for harvest work there does not interfere with the cropping calendar of most of the agricultural Pokot and Marakwet. The highland harvest takes place in the slack period at home, from November until February. In colonial times tax requirements (with a campaign in January to 'crackdown on arrears' for the past year) forced even the most reluctant man to participate in one-month labour gangs to work for white farmers in the highlands' harvest, unless he was prepared to sell an animal or to flee to Uganda. Labour migration 'in gangs' as a response to taxation was very important for the Marakwet, not so much for the Pokot. Since large-farm harvest work has been strongly mechanized (after the late 1950s for wheat and after the mid-1960s for maize, but more in Uasin Gishu than in Trans Nzoia) and since taxation for the poor has been abolished (around 1970), harvest migration to the highlands from the Marakwet area has considerably diminished. For the poor, both in Marakwet and in Pokot, nowadays labour migration takes the form of emergency migration during the hunger season: January-March for pastoralists, May-July for agriculturalists. Men, and in very poor households women and children as well, go out 'to look for food' and return home as soon as some food is acquired. This clearly does interfere with the agricultural calendar at home and it is a dramatic poverty trap.

The seasonality of labour migration is a clear externally-related addition to the local rainfall-related seasonality. Another external addition is the seasonality of government activities.

In Kenya the government financial year starts in July. New civil servants are being appointed; officials get orders to move to other posts in other areas. Project money ('Authority to Incur Expenditure') and delayed salaries and other payments trickle down from September onwards. From March until August, not much money is left. From March onwards also the possibilities to communicate between the government centres in the highlands and activities in the lowlands deteriorate. Roads become impassable. Bridges disappear. Rivers become 'impossible to negotiate' as it so aptly called in the English language of the Kenyan bureaucracy. Many government vehicles break down and exactly in this period the money lacks for repairs. There is little money for petrol anyhow during those months, nor for 'night's out allowances' which might force the civil servants to go to the field once in a while.

All this is rather unfortunate, because the low tide of government possibilities (no money, bad roads) coincides with the peak of needs for agricultural assistance: inputs like (hybrid) seeds and credit, fertilizers and insecticides for the more prosperous farmers, vaccins and animal treatment for livestock owners. If it reaches the farms, it is often late. For many district-wide officers, including the agricultural staff, the knowledge of the lowland and escarpment agriculture is very meagre, because of their isolation during this crucial period of the agricultural calendar. But, to be realistic, many government officers use the opportunity of a forced idleness in their job to go to their own farms - which they almost all have - somewhere in their home district. 'If you can't do anything useful for your farmers, you better do something good for your farm' is a rather general attitude.

Food aid, if it is necessary, often has to fight the same problem. It is often most needed during the wet season, after a drought, but the wet season means a huge distribution problem, with meagre and dwindling funds for transport and vehicle repairs. Mostly, missions are the ones who can overcome those problems better than the government. They have more flexible funds, which, if necessary, are used to buy food in the highlands, after the grain harvest there, and use it for food-for-food and food-for-the-destitude projects in the lowlands.

A positive aspect of the government calendar for lowland/escarpment Pokot and Marakwet farmers is the time of school holidays. Children can assist during land preparation and planting in April, with 'bird scaring' and the harvest in July/August and with preparations for the festivities during the December holidays. It depends on the location, but often school holidays coincide with labour peaks in agriculture.

Government activities surrounding livestock marketing have to deal with a problematic seasonality aspect in these areas. In general there is a potential supply peak of (often emaciated) animals in February and March at the end of the dry season. If there would have been buyers, many herd owners are willing to sell during those months. But in these periods the herds are mostly far away from centres where livestock auctions are (or better: were) normally organized. On top of that, the end of the dry season is a period of insecurity. Buyers are unwilling to buy animals far away in the bush with a chance that during the return journey the animals are raided by cattle thieves ('ngoroko'). Officials from the County Council, responsible for cattle auctions, are frustrated by the lack of response and in the post-colonial period the system of cattle auctions has generally decayed. However, goat's marketing thrived. Goats are near the homes, not far from markets and not a victim of raiding.

Finally, there is another aspect of external interference with a clear calendar. Both the government and non-governmental organizations have recently provided a lot of casual employment opportunities in the dry season: road construction, soil conservation, the construction of water dams and the like. Partly this is being organized as a food-for-work provision. Generally these opportunities are not provided during months in which the lack of food is most pressing, i.e. the pre-harvest period in the rainy season. Technically, construction activities have to be done predominantly in the dry period. And, due to the financial calendar, as we have seen, government money for those activities is available then. During colonial times this was a subject of heated debate. If there were paid labour opportunities in the lowlands from October onwards, this would compete with the labour demands of the white farmers. Partly to avoid this competition, public works in the lowlands were minimized. And the government even went as far, e.g. in the Marakwet area, to prohibit the commercial sales of highland maize in the lowlands, partly to stimulate the lowlands to be self-supporting in the production of grains, but partly also to avoid the undermining of the provision of migrant labour from lowlands to highlands.

Recently, within West Pokot, the activities of the Arid and Semi-Arid Lands Programme did result in a considerable increase of casual employment opportunities during the rainy season, instead of the dry season. Support for the irrigation works and soil conservation, support for grass and bush upgrading and support for minor water supplies all had this effect, with a peak in the real lowlands from March to May (starting during the end of the pastoral hunger period) and in the agricultural escarpment area from May to October (starting during the hunger period there). Table

6.1, from a recent survey (Dietz & Ongong'a, 1989), gives the details for 1988. Using foreign funds and a 'direct payment' method, the normal problems of lack of funds during this period do not apply, making this creation of additional casual employment during the most problematic months possible. Employment for public purposes during these months can compete with employment needs at home, though, especially because the income per day, a minimum wage, probably far exceeds the production value of farm income per working day. However, an increasing landlessness in agricultural areas and cattlelessness in pastoral areas make the potential competition of casual labour projects with agricultural work at home irrelevant for a growing number of households.

Table 6.1
Casual Labour Days in ASAL-sponsored Direct-Labour Projects, 1988 (x 100)

Sectoral	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Agriculture	14	11	12	17	21	24	27	22	26	21	16	17
Livestock	3	7	12	10	11	6	5	9	2	3	2	2
Water	6	4	5	9	8	3	7	4	3	3	3	1
Total	24	28	29	36	41	33	39	35	32	28	22	21

In the Kenyan case we found that the government adds its own calendar to the existing seasonality. Aspects are the seasonal ups and downs in the provision of funds and assistance: in the sphere of food aid, in the sphere of extension, credit and marketing of crops and livestock and in the sphere of public works; the calendar of school activities is of some importance too. Now we will compare these findings with the situation in three other African areas: Eastern Zimbabwe, Northern Togo and Benin, and Northern Morocco.

6.3. Eastern Zimbabwe

In Zimbabwe evidence is used from the eastern semi-arid area, near Gutu, studied by Andel & Kruik (1989). Figure 6.4 presents the seasonality illustration. Immediately we see a completely different periodization, compared with the Pokot/Marakwet area in Kenya, due to a different rainfall pattern.
But there are other differences as wel. The type of rain-fed agriculture is much more diverse and intensive in Gutu, with groundnuts and beans playing an important role, besides millets and sorghum. In irrigated gardens a large variety of crops is being produced during the dry season; much more varied than in the irrigated fields of the Marakwet and agricultural Pokot. Altogether the vegetarian diet is more varied compared to the Kenyan example, but the animal component in the diet is less. Another remarkable difference is the widespread usage of animal traction, with the additional seasonality problem that their needs of feed and water have to be given more attention at the end of the dry season: the animals have to be most productive at the end of the dry season and the beginning of the rainy season; their strength during this period is crucial. Finally, a major difference between northwestern Kenya and eastern Zimbabwe is the fluctuation in food prices: high during the growing season and half of this level immediately after the harvest. In the Kenyan study area (but not everywhere in Kenya) there are hardly any seasonal price differences of bags of maize grains and prices of packets maize meal are controlled effectively.

In this Zimbabwean area the collection of wild food is as important as in the Kenyan area: wild vegetables during the rainy season, flying ants in November, crickets from December until February, grasshoppers in April, termites in August and during the dry season all types of fruits. In a local artificial water dam fish is being caught, especially from December until June, although it is declared illegal.

If we look at the calendar of government finances, in the Zimbabwean study area this is favourable for an adequate assistance to agriculture and for the organization of food aid, which has recently become very well organized. Some communication problems exist, though, due to bad weather and in December most civil servants are away from duty. The August school holidays are not at all useful for agricultural activities. However, the December holidays are very much used for children's assistance to agriculture during the most labour-intensive period.
Labour migration to the large-farming areas during harvest times there - as in other parts of southern and eastern Africa pushed by colonial taxation and labour recruitment drives, and later becoming a self-evident part of rural life - does very much

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A) LOCAL RHYTHMS												
climate: rainfall												
crops: dry	—W—	———	——H	———	H——	(Pm)			P	——P	———	S—
crops: irrigated gardens						———	———	—H	—			
crop labour peaks												
cattle/chicken	m				———	———	Ch—	—E	E	C	m	Sf
non-agricultural activities	D		D	B	B		w / f		w / f			
local casual jobs	x x x x	x x x x	x x x									
food availibility: crops												
milk/meat	x			(x)				x x	x		x	x x x x
wild food	x x x x	x x x x	x		x x x			x x	x x			x x x x
fish	x x x x	x x x x	x x x x	x x x x	x x x x	x x						x x x x
food prices	high	high										
disease peak												
B) NON-LOCAL RHYTHMS												
labour migration	Mh	Me		Mh								
government financial year				money problems			[start					
communications difficult												
public works												
food aid/food-for-work/cas. govt. work (anti-erosion)												
school year	x x	x x x x	x x x x	x x	x x	x x x x	x x x x	x	x x x	x x x x	x x x x	x
(govt.) celebrations/holidays				x				x				x x x
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

Crop husbandry
- H Harvesting
- P Land preparation
- Pm Mulching
- S Planting, sowing
- W Weeding
- ( ) sometimes

Animal husbandry
- C Period of peak calving
- Ch Breed chicken
- E Emergency slaughter
- m Period of highest milk availability for human consumption
- Sf Slaughter for festivities

Non-agricultural activities
- B Building and repair of houses, stores, platforms
- D Preparing alcoholic beverages for feasts or for sale (peaks)
- w/f Labour peak in the provision of firewood and (drinking) water

Migration
- Me Emergency migration ('looking for food')
- Mh Migration to highlands to assist in highland harvest

Figure 6.4: **Seasonality in eastern Zimbabwe**

coincide with the harvest period of small farmers. In general this means that harvest work had predominantly become the responsibility of women, assisted by their children.

6.4. Northern Togo and Benin

To describe the patterns of seasonality, the studies of Haan (1988) and Kruithof (1989) will be used, as in all other cases combined with their personal observations. The situation is illustrated in Figure 6.5.

This savannah area is a bit more humid compared to the Kenyan and Zimbabwean areas described before, but with a large inter-annual variability and seasonality too. The rainy season and hence the rain-fed agricultural period is longer and on top of that the harvest period is very much stretched because of the use of a large variety of millets and groundnuts, each with different lengths of growing seasons. Other food products are hardly relevant, though, which results in a one-sided diet. For agriculturalists in this area, milk as additional food only plays a minor role. They used to give their animals in custody to the nomadic Peulh group, who migrate to far northern grazing areas during the rainy season, the season when milk production is highest.

Besides the production of food, the production of cotton has recently become very important. Income from cotton is the major source of money to overcome periods of food shortage. However, the production of cotton is very much dependent on the correct use of inputs and here the farmers are confronted with a problem. The government is the most important supplier of cotton inputs, and in January, when the farmers should be paid for their cotton harvest to be able to start a new cotton season, the government is normally in its annual payment crisis. Gradually the cotton payments have been delayed. Second payment tranches are often paid in May-June only, soon after the new financial year for the government has started. For many cotton farmers this is too late for a good start of the new cotton season and on top of that many farmers' households have to deal with food problems which get the first priority.

Financial government assistance during the cropping (and especially the cotton) season is very well possible if we look at the financial calendar of the government. In the course of the growing season the government can supply civil servants in

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A) LOCAL RHYTHMS												
climate: rainfall												
crops: dry				P—	—S—	——W	—H	——	——	—H		
crop labour peaks												
cattle	Sf	M	M	C	m	m	m	m				M
(Peul cattle)		so	uth			north	(Niger)				so	uth
goats	Sf	Sf E	E									
animal labour peaks												
non-agricultural activities	D	B D	B									
	w / f	w / f	w / f									
food availibility: crops												
meat												
milk												
disease peak												
B) NON-LOCAL RHYTHMS												
labour migration	(	—Mt	——)				Mc—	——	——	—Mc		
government financial year				[star	t							
communications difficult												
taxation, forced labour	xxxx	xxxx	xxxx									
casual labour, infrastructure	x x								x	xxxx	xxxx	xxxx
school year	x x	xxxx	xxxx	x x	xxxx	xxxx	xxx		xxx	xxxx	xxxx	x
government holidays				x				x				x
trade (cotton)	xxxx	xxxx	x			xxx	x				x	xxxx
NGO school milk	x x	xxxx	xxxx	x x	xxxx	xxx						
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

Crop husbandry
- H Harvesting
- P Land preparation
- S Planting, sowing
- W Weeding

Animal husbandry
- C Period of peak calving
- E Emergency slaughter
- M Period of highest animal mobility
- m Period of highest milk availability for human consumption
- Sf Slaughter for festivities

Non-agricultural activities
- B Building and repair of houses, stores, platforms
- D Preparing alcoholic beverages for feasts or for sale (peaks)
- w/f Labour peak in the provision of firewood and (drinking) water

Migration
- Mc Seasonal migration to areas with export crops like coffee, cocoa
- Mt Migration to evade tax collection

Figure 6.5: **Seasonality in northern Togo/Benin**

agriculture with funds of the new financial year. The period of the long school holidays is very well placed within the year to allow children to assist with the harvest work.

Compared to Zimbabwe and Kenya, in northern Togo and Benin there are very few government activities in the sphere of food aid and public works, neither during the dry season nor during the hunger season. Missions do assist a bit, e.g. with school milk programmes during this season. In colonial times the dry season was the time of
forced labour in the sphere of local public works. Many adult men migrated to neighbouring countries (Ghana, Nigeria) to avoid this labour and taxation. After independence labour migration increased to the southern zones of export agriculture: first to the cocoa areas in Ghana, recently to Ivory Coast especially. Labour migration started and still starts in July, which interferes negatively with the last part of the crop season and goes on in the months afterwards. It probably explains part of the dominant role of women in harvest work and marketing in this part of Africa.

6.5. Northern Morocco

The last example concerns the northern Moroccan Rif area, an area which is a research area for geographers from Amsterdam since fifteen years (e.g. see Pascon & Van der Wusten, 1983; Jungerius, De Mas & Van der Wusten, 1986). Figure 6.6 presents the general picture of seasonality.

Compared with the other African cases, the Moroccan case differs in almost every respect. In the first place seasonality is not only a result of wet and dry seasons, but of hot and cold months as well. The humid cold of the Riffean winter formerly forced a considerable labour investment to collect enough firewood in autumn. Currently this has completely been replaced by the purchase of bottles of butagaz and bags of imported charcoal. The former activities to make the houses more resistant to the winter cold have recently been made redundant by the structural improvement of houses, paid by labour migrant remittances.

The traditional cropping season has various cycles next to each other. First there is the rain-fed production of barley and wheat, form the end of October until May, with labour peaks at the beginning and at the end. This is followed by the harvest of fruit trees until August. Fields which are irrigated by wells and springs have a double

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
A) LOCAL RHYTHMS												
climate: - rainfall												
- temperature	c o	l d					w a	r m			c	o l d
crops: dry (wheat, barley)	—W	—	—	—H—	—H					P/S	—	—
trees (figs, almonds)					H	—	—	—H				
irrigation: rivers	xxxx	xxxx										xx
well/spring	—H	P—	—	—	Irr—	—	—	H	P—	—Irr	—	—H—
crop labour peaks												
harvest remains/feed for sheep (=dung)				xxxx	xxxx	xx						
goats and sheep:												
- birth peak (= labour peak)		x	xxxx	xxx								
- slaughter							x	xxxx	xxxx			
non-agricultural activities					(fis	hing)	w	w / f	w/B/f			
local food availibility												
disease peak												
festivities/marriages								x	xxxx	x		
birth peak					x	xxxx	x					
B) NON-LOCAL RHYTHMS												
migration to lowland large farms					R	(olives)				R		
long distance migration								Rm		Ml		
government financial year	[start				planning					money problems		
school year	xxxx	xxxx	xxx	xxxx	xxxx	xxx			xx	xxxx	xxxx	xxx
government holidays							x	xxxx				
elections					x				x			
payments to landlords					x							
govt. work/food for work			xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxxx	xxx		
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

Crop husbandry
H Harvesting
P Land preparation
S Planting, sowing
W Weeding

Non-agricultural activities
B Building and repair of houses, stores, platforms
f Labour peak in the provision of firewood
w Labour peak in the provision of (drinking) water

Migration
Ml Long distance migration
R Return of seasonal labour migrants
Rm Return of (long-distance) migrants

Figure 6.6: **Seasonality in northern Morocco**

season: the production of vegetables and spices from September until January and the cultivation of maize and fodder in February-July, with a heavy labour peak in September and a less heavy one in February. At the end of the dry season many emaciated goats and rams are being slaughtered and during the same summer months fish from the Mediterranean Sea adds considerable quantities of calories and protein too.

In former times there were mainly local food shortages in October-November and in February-April. The gradual population increase made these periods of local insufficiency of food production ever longer. During the 1960s this resulted in large-scale labour migration to Western Europe. And during the 1970s and 1980s the Moroccan government organized a lot of *promotion nationale* projects to supply the remaining population with additional income. On top of that the Moroccan government takes very good care of a guaranteed provision of food.

The agricultural cycle does not fit favourably with the government cycle. Especially from September to December the government is generally short of money and it is in this period that the Riffean agriculture would need most government assistance and funds. Also the extremely long school holidays are badly timed: during the hottest time of the year when there is hardly any work to do in the fields. On top of that the school year starts in September, i.e. the month of religious ceremonies and marriage festivities.

In Morocco, besides the two rhythms of agriculture and government, a third rhythm is intertwined in a very complex way: the calendar of Islam, with the great slaughter feast (*Ait Kbir*) and the Ramadan period of fasting, which move backward with a month every year. Ait Kbir results in bleeding and depletion of the flock of sheep. The Ramadan month is a period of reflection, prayer and fasting during the day, but also of consumption peaks during the nights and after Ramadan. If the Ramadan period is situated during the labour peaks in agriculture its impact is large and negative. If the Ramadan takes place during one of the hunger months civil disturbances are likely.

The last few decades these rhythms have largely been superseded by a fourth rhythm: the rhythm of labour migration. Formerly migration was circularly and related to the agricultural cycle. Migrants generally returned during agricultural labour peaks and during the month of celebrations. At the moment the temporary return of labour migrants is completely dictated by the period of the major holidays in Europe, i.e. in July and August. Many migrants try to extend their stay until September to enjoy the feasts and the enormous peak in consumption which is manifest during this month. Figure 6.7 gives a nice illustration.

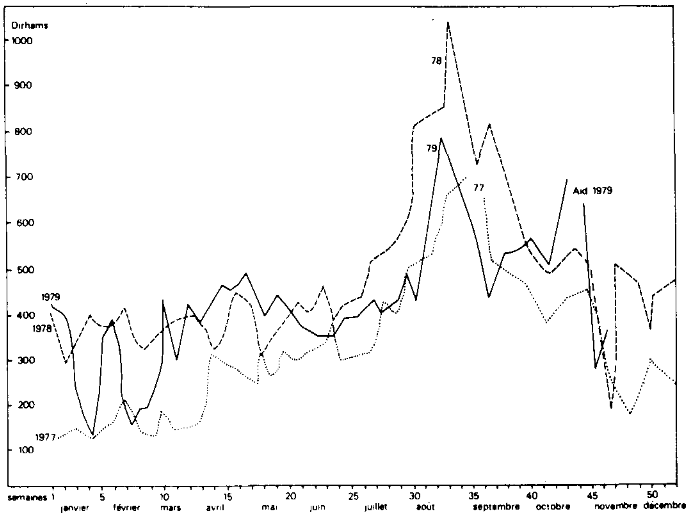

Figure 6.7: **Market fees received at the Beni Boufrah market, 1977-79 (in dirhams)** (from Pascon & Van der Wusten, 1983: 202)

The overwhelming importance of labour migration and remittances make agriculture a ritual activity only and agricultural seasonality is hardly important anymore for food consumption. The seasonal rhythm of life is very much externally induced. This is even so in a biological sense. The Moroccan Rif is one of those areas with a clear seasonal peak in pregnancy and births, as a result of peaks in annual visits by migrants and of marriage peaks. Happily enough, the birth peak here coincides with the post-harvest period of sufficient food, during the summer time.

6.6. Conclusion

The seasonality literature generally concentrates on rainfall-related forms of seasonality and its impact on health, food availability and labour rhythm. In this exploratory paper it is argued that the study of other rhythms, and especially the rhythm of labour migration and government calendars should be added to arrive at a better understanding of seasonal aspects of life in tropical and sub-tropical rural areas. At least the following aspects need to be studied.

- Government assistance during the cropping season and in times of food shortage can be hampered by season-related communication problems; the more isolated, the more marshy or the more mountainous an area is, the more relevant this problem is.
- The financial year of the government as well as the school calendar are important to take into account; non-governmental organizations generally are more flexible in this respect.
- Government demands do often fluctuate during the year, e.g. taxation, provision of labour for public works (either voluntary or forced), provision of labour migrants, etc.
- The agricultural calendar and the rhythm of labour migration can be alternating, but they can also be very competitive.

Seasonality studies can become even more relevant if they also include the impact of the non-local rhythms on local livelihood possibilities and constraints.

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The Institute goes out from the premise that the research which is carried out in Africa must be of such a nature that the results are directly or indirectly relevant to the population in the country concerned. Other objectives include the systematic promotion of research and education covering the afore-mentioned areas, and also the spread of the knowledge of African societies and cultures.

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The department of Political and Historical Studies concentrates on pure scientific research. The main emphasis is on the ideological and economic aspects of the State in Africa. Research takes place within the framework of the Cameroon programme, and in conjunction with the socio-economic department of the Centre. Important subjects are wage labour in the rural areas, land law problems, in particular in the neighbourhood of the larger cities, ethnic articulation and regional incorporation; comparative study of effects on rural development of French and British colonial administration. The department also has a programme focusing on Southern Africa. Here the main objective is to analyse developments in political economy and culture and the effects of these on neighbouring areas. A part of the research in this department falls outside the scope of these regional programmes, viz., the research into peasant movements in general and legal pluralism in Africa.

In addition to the research departments, the Institute has a library and a documentation section.
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The Centre is responsible for a monograph series which is published by Kegan Paul Int., London. Other research reports and working papers are published by the Institute itself. Periodic publications include an Abstracts Journal with summaries of articles from recently published journals and collections; a list of the latest library acquisitions; and a Newsletter on African Studies in the Netherlands containing an annual survey of research concerning Africa in the Netherlands, which is published in cooperation with the African Studies Association.

The African Studies Association cooperates closely with the African Studies Centre in promoting research and education relevant to African studies in the Netherlands. The Association advises the Netherlands Foundation for the Advancement of Tropical Research (WOTRO) on applications for research funding in the social sciences and the humanities concerning Africa. The secretariat is based in the Institute's offices.

The library is open to the public on weekdays between 9.00-13.00 and 14.00-17.00, tel. 071-273354.

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