Seasonality in the coastal lowlands of Kenya: Part 2: Introduction to seasonality

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Food and Nutrition Studies Programme

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Note on authors

This study has been a genuine team effort in which several researchers participated in different phases of the research. Also, during the course of the study some of our colleagues left and were replaced by others. Since it is not possible to list all of them as authors of individual reports, we have chosen to list as authors, the researchers who have played a leading role in that particular report, be it in data collection, analysis, reporting or otherwise. The full team, however, has contributed to the end results and therefore needs to be mentioned. The respective names, disciplines and periods of participation in the study are as follows:

Dr. Jan Hoorweg	programme director	1984-
Drs. Dick Foeken	human geography	1987-
Ir. Marian Geuns	human nutrition	1985-1986
Ir. Wijnand Klaver	human nutrition	1987-
Drs. Ted Kliest	human geography	1984-1987
Ir. Piet Leegwater	agriculture	1986-
Drs. Ria Lenior	data management	1986-1987
Drs. Maria Maas	anthropology	1986
Drs. Rudo Niemeyer	anthropology/data management	1985-
Walter Okello BSc	economy	1985-
Drs. Willem Veerman	data management	1987-

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1. Introduction

The pressure on land resources in Kenya threatens the future balance between national food demand and national food production (World Bank,1983; Senga et al.,1981; Kliest,1985). The existing agro-ecological potential for rain-fed farming is quite limited and the country is, in fact, already short of good agricultural land (Ruigu,1987). High and medium potential lands with good to fair prospects for crop production and intensive livestock activities account for only 20% of the land area. The rapid population growth, however, necessitates substantial increases in food production in the near future, together with increases in the production of export crops. Production increases will depend on the possibilities of increasing yields per hectare, and of bringing remaining, often marginal, areas under cultivation. (GOK, 1986)

The agricultural land is unevenly distributed over the country. The high and medium potential zones are found in the core region of the Central Highlands, the plateau adjoining Lake Victoria and the Ugandan border, and in the very narrow strip near the Indian Ocean. These lands are bordered by semi-arid, low-potential belts. Here, the annual rainfall with its high variability and seasonal nature offers only limited opportunities for rain-fed agriculture (Jaetzold & Schmidt,1982;1983; Braun,1982). At present, almost the entire high and medium-potential zones are under cultivation (Epp & Kilmayer,1982). As a consequence, cultivation has extended into semi-arid areas, notably the Eastern Foreland Plateau (Machakos, Kitui, Embu and Meru Districts) and the coastal hinterlands (Kwale and Kilifi Districts).

In the semi-arid zones, the rainfall pattern is characterized by a low reliability and low amounts of precipitation. Rain-fed agriculture shows a seasonal cycle of cultivation and harvesting. Such conditions of seasonality, particularly in areas with only one rainy season, easily lead to fluctuations in food availability and nutrition, and even to food shortages. The nutritional condition of the population is further influenced by health factors that are equally seasonally dependent. Although many African societies traditionally had to cope with seasonal food shortages, the effects of seasonality appear to have worsened as a consequence of the introduction of commercial cropping and because of increasing population pressure. Certain groups, such as small farmers, appear to be more vulnerable to the vagaries of the seasons than others (Chambers et al.,1981).

An earlier FNSP-study on seasonality, a precursor to the present research, has already been mentioned (Kliest : Regional and Seasonal Food Problems in Kenya, 1985). This report assessed the national food situation in Kenya together with its seasonal dynamics at the provincial and district level. It called particular attention to the recent population movements into the drier zones against the background of the factual instability of food production in these marginal areas. The dangers of the invasion of more and more people into these environments are many, as evinced by the regular food shortages in these areas. As a result, food relief through governmental and non-governmental agencies has become a matter of routine.

Coast Province is the third area of major population concentration in Kenya, after the Central and Western regions of the country. The climatic and economic conditions of the region are quite different from those of the highland areas. Although Coast Province knows two rainy seasons, in most parts the short rains are very unreliable and many farmers do not plant at this time of the year (Kliest,1985). Going inland, rainfall diminishes quickly while the potential evapotranspiration increases. Most soils are chemically poor and the fertility of the land tends to be low. The region comprises a variety of agro-ecological zones that can alternate over relatively short distances. The relatively humid coconut-cassava zone has a wide potential for food and cash crops, mainly depending on local variations in soil fertility. In the somewhat drier cashewnut-cassava zone possibilities for crop production are more restricted. The livestock-millet zone and the ranching zones, covering more than 68% of the agricultural land, offer only limited potential for rain-fed agriculture. Farmers in the first two zones largely depend on the cultivation of food crops and perennial cash crops. Smallholders in the third zone usually combine livestock rearing with the production of annual subsistence crops. The seasonal character and the low reliability of rainfall in the whole of the region, however, severely restrict the scope and intensity of agricultural activities. Although occasional surplusses are realized in good years, the population is regularly confronted with drought conditions (MOENR,1984a;1984b). People in the drier zones, in particular, have to cope with the disruptive effects of shorter and longer drought periods.

The economic development of the region has not kept pace with that of other parts of Kenya. Although the coastal lowlands were relatively prosperous in pre-colonial and early colonial times, the opening up of the highlands by European settlers meant an inevitable shift of development towards the interior (Cooper,1981). Afterwards and also in the post-independence period, economic development has stagnated due to a combination of political, economic and social factors. The industrial and services sectors are little

developed (with the exception of the tourist sector) and employment opportunities outside the agricultural sector are limited. Coast Province, in fact, scores quite low on accepted development indicators like child mortality and childhood malnutrition, degree of literacy, etc. (CBS,1983;1986). The relative incidence of rural poverty is high and living conditions of the population in large parts of the province are harsh. In addition, (new) wage employment opportunities are limited (CBS,1986). However, detailed information on how these conditions affect different population groups is not available, because of a relative lack of research.

This document is one of a series of reports on agro-economic and nutritional conditions in Coast Province, specifically in Kwale and Kilifi Districts. The reports cover several connected studies that were carried out between July 1985 and July 1987 by a team of the Food and Nutrition Planning Unit and the African Studies Centre. The studies were part of the Food and Nutrition Studies Programme (FNSP) and were concerned with two topics, namely :
(-) regional and seasonal fluctuations in food supply and nutrition; and
(-) nutrition in agricultural and rural development.

The major emphasis of the research concerns seasonality, since it offers an appropriate angle from which to analyse the (often precarious) living conditions in the coastal region. The study objective is to record, describe and analyse the effects of climatic seasonality on food supply and nutrition among the rural populations in the coastal lowlands, together with the coping mechanisms that are utilized by different population groups in order to deal with these seasonal variations.

This report is part 2 of the main study on seasonality in Kwale and Kilifi District. It presents a general introduction to the topic of seasonality in Africa and also reviews existing socio-economic knowledge about Kwale and Kilifi Districts. The findings regarding the socio-economic characteristics of the sampled populations will be presented in the next report of the same title, together with an analysis of social-economic differentiation (Part 3). Part 4 will cover the subjects of food consumption and nutritional status. Finally, the seasonal fluctuations of all these variables and their interrelationships will be dealt with in Part 5.[1]

[1] Other FNSP-studies in Coast Province carried out during the same period will appear under separate titles. These studies concern topics like nutritional conditions at settlement schemes (FNSP,1985a), the contribution of women's groups to settlement development (FNSP,1985b), and nutrition and dairy development (FNSP,1987). Subsidiary studies are concerned with the aetiology of childhood malnutrition in the region (Peters & Niemeyer,1987) and with farm management and ecological adaptations (Oosten,1988).

2. Seasonality in Africa

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 ideal 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.
>
> 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. Four topical conferences were held in recent years. The first

in 1978, organized by the Institute of Development Studies, 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 organised by AMREF (1982). In 1985, a workshop was held by IFPRI, Washington : *Seasonal causes of household food insecurity: policy implications and research needs.* 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.

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.[2] 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.[3] 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) :
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.

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2 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.

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

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-Sahara Africa.

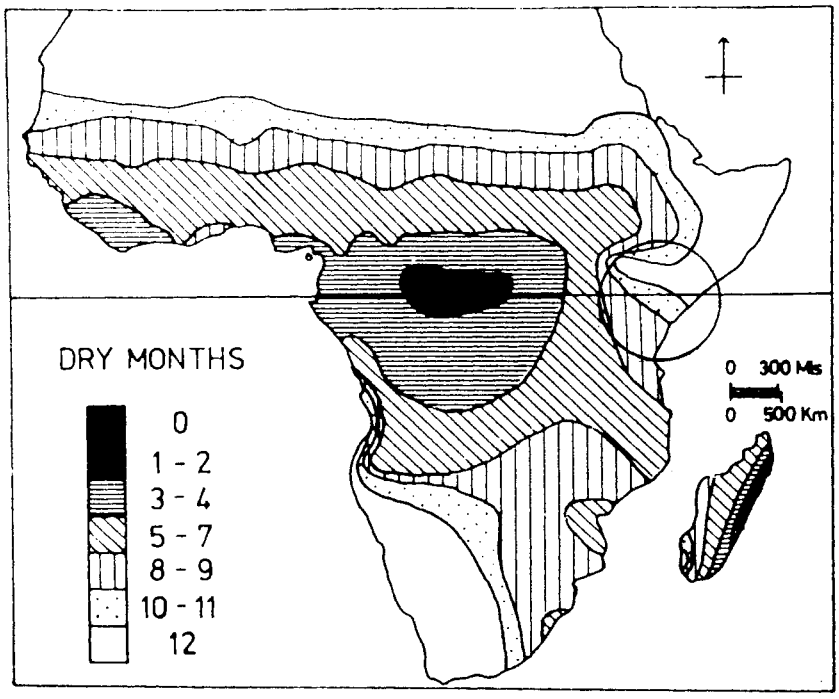

Figure 2.1: Sub-Saharan Africa: dry months per annum
(Kenya within the circle)
Source: Walsh, 1981.

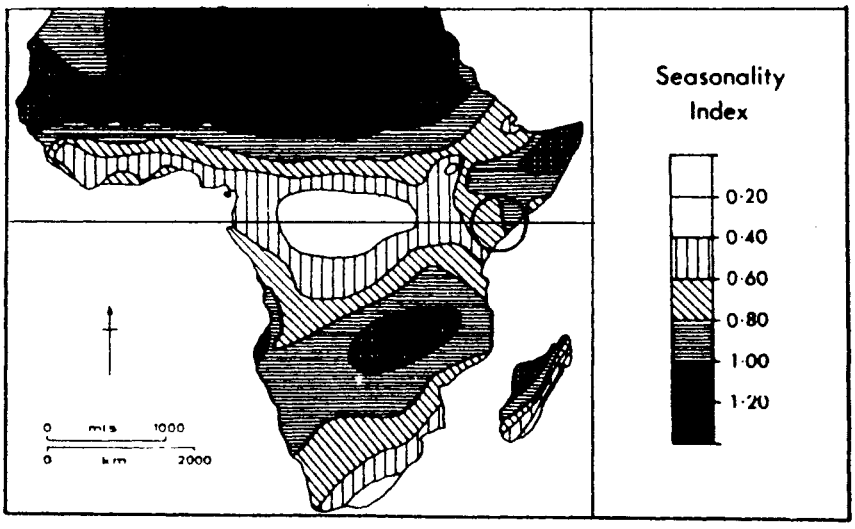

Figure 2.2.: Seasonality index for sub-Saharan Africa (Kenya within the circle).

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 & 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 cleaning 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 & Niemeyer,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.[4]

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 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

4 "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)

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, seasonal food availability may be felt even more strongly, because of the difficulty of storing milk. 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. Niemeyer 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 & Niemeyer (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, Louton (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 (1986: 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 (Louton,1985: 213-215).

Many authors stress the prevalence of certain diseases during particular seasons (Bradley,1981; 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 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. [5]

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 & Clark,1981: 139-141), especially during the wet season. Regarding diarrhoeal diseases, Onchere & Slooff (1981: 45) found that 80 percent 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 Van den 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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5 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 therefore spread during the dry season, from one person to another in dark, interior conditions.

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 <u>prevent</u> seasonal stress and measures to <u>meet</u> 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.[6] 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 four 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 (...).

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

A fifth crop can be added to this list. Treecrops, 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).

6 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.

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 'receiver', 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 are, 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). These, however, are not the situations we are concerned with in this series of reports. Our research concentrates on the more or less regular seasonal fluctuations and the ways local farmers cope with these.

3. Kwale and Kilifi Districts

The following discussion of the two research districts will be guided by the seasonality aspects that were described in the previous section, with special attention for the six selected research areas. Firstly, however, the main infrastructural and demographic characteristics of the districts will be discussed.

3.1. A first impression: infrastructure and population

Figure 3.1 shows the network of main and secondary roads, and the location of service centres. There are five all-weather roads, three of which are trunk roads radiating from Mombasa, one north to Malindi, one south to Lunga-Lunga (with a branch to Kwale town), and one westwards to Nairobi (with a branch to Kaloleni). There is a hierarchy of service centres which, administratively, is meant to be as follows: a market centre should serve 15,000 people, a rural centre 40,000 and an urban centre 120,000.[7]

There is only one truly urban centre in the whole region: Mombasa. It is the second city of the country and it is important to view the location of the six research areas in relation with the town. Mwatate, very close to the Nairobi trunk road, has a quite favourable situation in this respect. Equally, from Bongwe (on the road to Lunga-Lunga) and from Chilulu (near the road to Kaloleni) it is possible to reach Mombasa within a relatively short time, say within the hour. Things are different if one lives in Kibandaongo or in Kitsoeni from where it may take a few hours to reach the 'city'. Bamba, in particular, has a poor connection with the main roads and during periods of heavy rainfall traffic often cannot pass to and from this rural centre and the only alternative, in East African colloquial, is to 'go footing' to Mariakani or Kilifi.

The rural inhabitants compose about 90% of the population, but they are unevenly distributed over the districts. The presence of roads and service centres reflects the density of the population (Figure 3.2). The majority of the population lives within a relatively short distance from the coast, i.e. in the narrow coastal strip (about 10-15 km wide) and in the better watered parts just behind it. Further inland, population densities are low. This is caused by differences in agricultural potential (see section 3.2), the concentration of modern

[7] However, as a policy objective, these figures are far from being achieved (MOENR,1984b: 57). There is a fourth, smaller type: so-called local centres that are to serve 5,000 people, but they have not been included in the map.

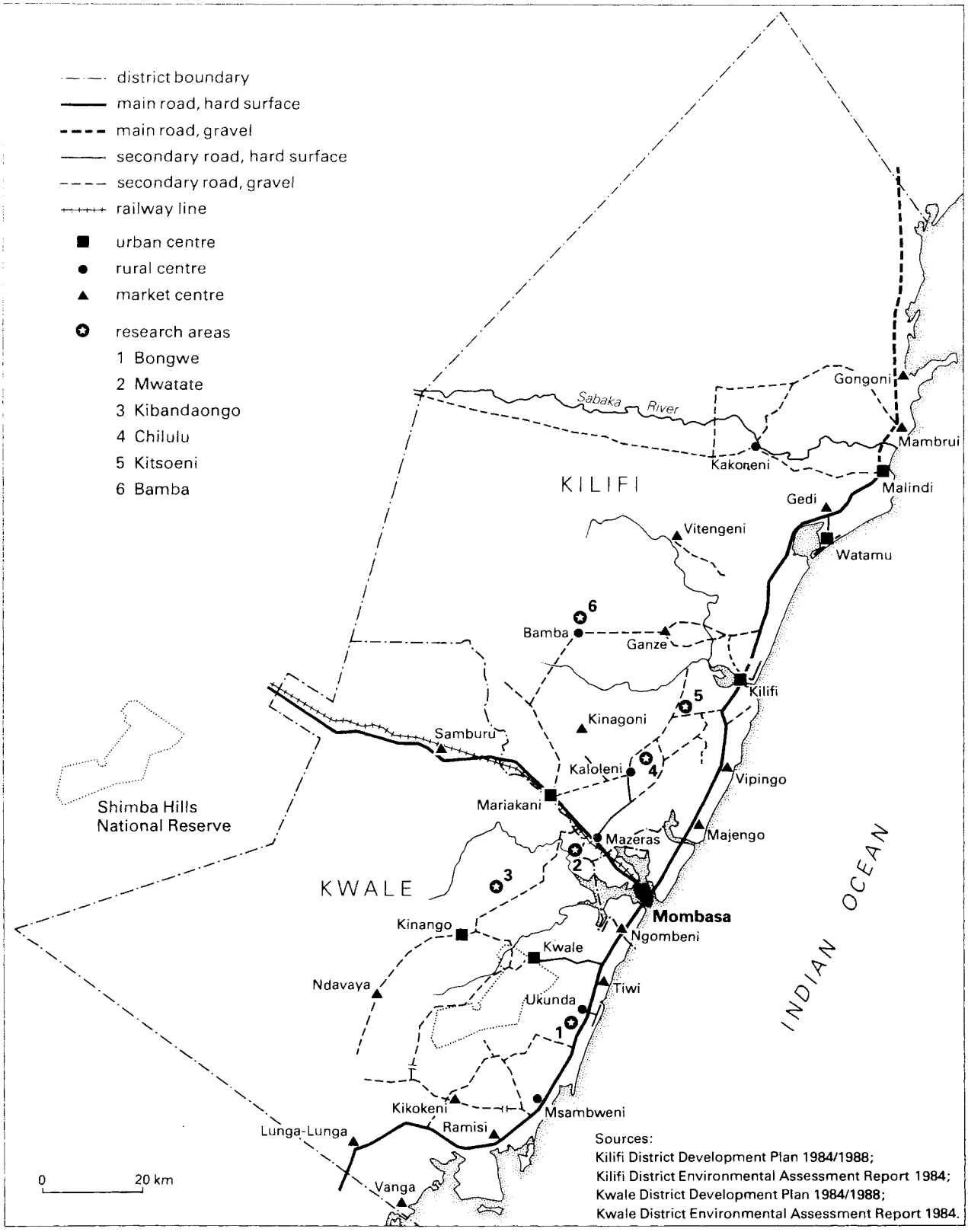

Figure 3.1 Roads and service centres

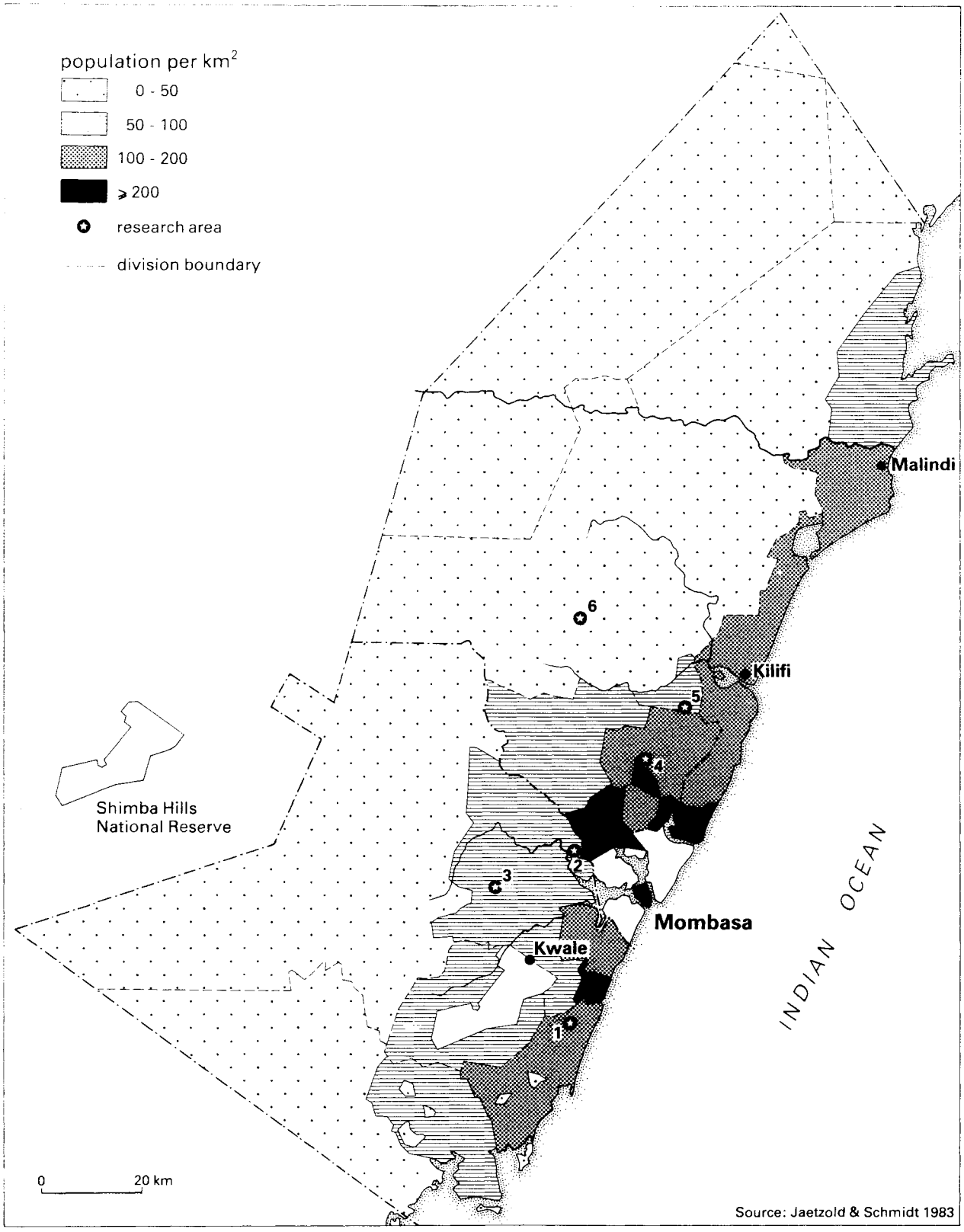

Figure 3.2 Population density

sector employment in the coastal strip (section 3.6), as well as recent government settlement policies and the history of the various Mijikenda sub-groups.

The majority of the population is of Mijikenda origin (Kwale over 80%, Kilifi over 90%), and in that sense the two districts can be regarded as one cultural entity (CBS,1981: 139-140). Nine ethnic sub-groups are distinguished, two in Kwale District (Digo, Duruma), the other seven inhabit Kilifi (Kauma, Giriama, Chonyi, Jibana, Kambe, Ribe, Rabai). There are remarkable differences in population size between these respective sub-groups (Table 3.1).

Table 3.1.
MIJIKENDA POPULATION

DISTRICT	SUB-GROUP	1948[1]	1969[2]	1979[3]	GROWTH 69-79
Kwale	Digo		66,300		
	Duruma		104,300		
	Sub-total	113,780	170,600	236,476	39%
Kilifi	Giriama		190,000		
	Kauma		5,900		
	Chonyi		42,600		
	Jibana		7,900		
	Kambe		5,150		
	Ribe		2,300		
	Rabai		29,300		
	Sub-total	126,036	283,150	390,006	38%
TOTAL		239,816	453,750	626,482	38%

Sources:
1) Prins, 1952:42
2) Adapted estimations by Spear (1978: 8-9) based on figures per location from the Census of Population 1969.
3) CBS, 1981.

The Mijikenda tribes originated from an area called Singwaya in the southern Somali hinterland, and migrated towards the coastal area at the turn of the 17th century. Initially, they settled in nine, individual, fortified hill-top villages called *kayas*, along the ridge inland from the southern Kenyan coast, roughly from Kwale in the south (the Digo kaya) to Kauma in the north (near Jaribuni) (Figure 3.3). Each kaya probably counted 1,500 to 2,000 inhabitants. As populations grew, people left to settle in the nearby lowlands. The Digo were the first to do this, followed by the Giriama and the Duruma. They obtained large tracts of land in the less fertile areas north, south and west of the kaya ridge, the easterly lands already being occupied by the original Swahili population. The rapid growth

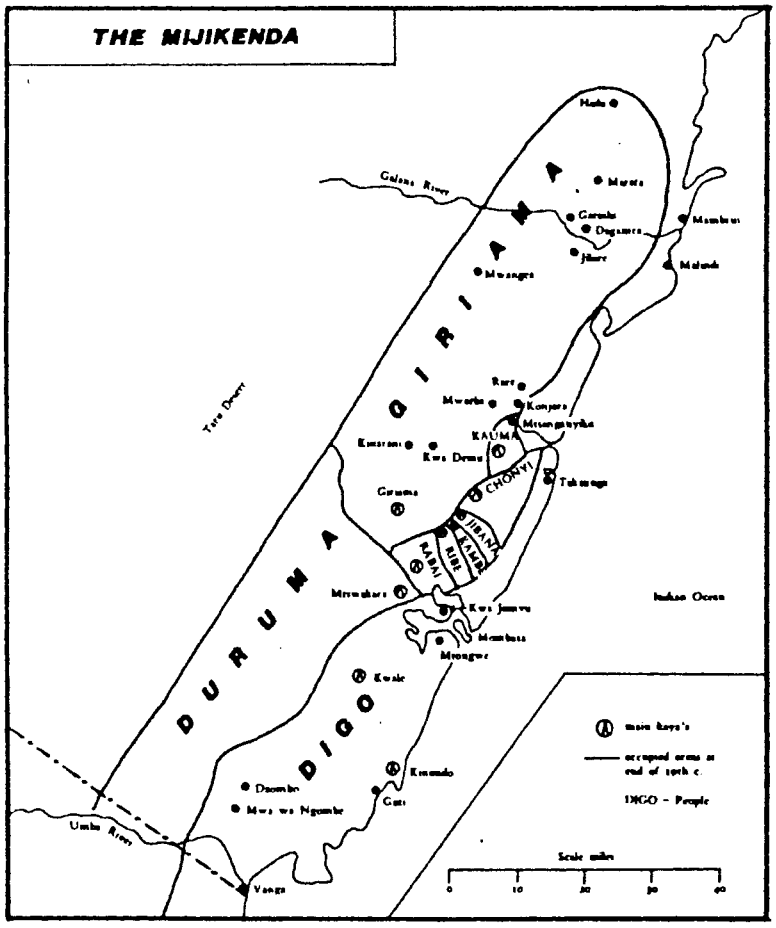

Figure 3.3: The Mijikenda (from Ogot, 1976)

of the Digo, Duruma, Rabai and Giriama populations can perhaps be explained by the following cultural and economic factors:

> the Digo, Duruma and Rabai traced descent matrilineally. By the late 19th century they were all taking large numbers of foreign wives or slave wives as men sought to ensure patrilineal inheritance and descent, thus giving them a higher rate of population increase than the other Mijikenda who were patrilineal. The patrilineal Giriama, on the other hand, were the most successful traders in the 19th century. Their success and their wealth attracted many foreigners, ex-slaves and other dependents, many of whom were adopted into Giriama lineages and served to augment their population. Since many of those adopted by Digo, Duruma, Rabai and Giriama were fellow Mijikenda, abnormal increases of these peoples would have been at the expense of the others and therefore restricted their growth (Spear,1978: 1,4,9-10).

Although there are no data on the population growth for the different ethnic sub-groups for the 1969-1979 period, there do exist figures for the locations and sub-locations in which the six research areas are situated (Table 3.2). Growth figures for the respective sub-locations are generally far below the locational figures. This points to relatively high out-migration from the rural sub-locations in which the research areas are located.

The growth figures for the three locations in Kwale District are higher than the district average. In Kilifi District, the reverse is the case although it has the same overall growth as Kwale District. The high growth figures for the three Kwale locations are probably due to the presence of the nearby service centres of Kinango, Ukunda and Mazeras (Figure 3.1). On the other hand, the fact that Bamba has been designated as rural centre can not prohibit a considerable outflow of people.

Areas with high out-migration generally have low sex ratios, because it is usually the men who try and find work elsewhere. Indeed, as the two right-hand columns in Table 3.2 show, males are under-represented in all (sub-)locations with the exception of Bongwe/Diani. The explanation for the latter finding must be that many of the (male) employees at the Diani Beach hotels rent accommodation somewhere in the location (this may also explain why Diani has the highest growth figure of all six locations). From comparison of the sex ratios for 1969 and 1979, however, it appears that m/f ratios have become less skewed, and that there has been a reverse trend, possibly because of improved transport facilities and more local employment opportunities.

Even at the district level, the sex ratios for Kwale and Kilifi are still below parity. Examination of the Mombasa figures confirms that many men from the two districts work in Mombasa. Despite this in-migration, population growth in Mombasa during the 1969-1979 period was lower than in the two districts. This is probably due to low birth rates as a

Table 3.2.
TOTAL POPULATION, POPULATION GROWTH AND SEX RATIO, BY ADMINISTRATIVE UNIT[1]

ADMINISTRATIVE UNIT	POPULATION 1969			POPULATION 1979			POP. GROWTH	SEX RATIO[2]	
	total	males	females	total	males	females	69/79	1969	1979
KWALE DISTRICT	205,602	101,785	103,817	288,363	141,746	146,617	40	98.0	96.7
BONGWE:									
Diani Location	17,713	9,258	8,455	28,393	14,838	13,555	60	109.5	109.5
Bongwe Sublocation	?	?	?	5,528	2,807	2,721	?	?	103.2
MWATATE									
Mwavumbo Location	10,705	4,928	5,777	15,475	7,151	8,324	45	85.3	85.9
Mwatate Sublocation	3,489	1,589	1,900	4,164	1,961	2,203	19	83.6	89.0
KIBANDAONGO									
Kinango Location	9,751	4,546	5,205	15,132	7,119	8,013	55	87.3	88.8
Kibandongo Sublocation	3,404	1,530	1,874	4,055	1,891	2,164	19	81.6	87.4
KILIFI DISTRICT	307,568	146,677	160,891	430,986	205,360	225,626	40	91.2	91.0
CHILULU									
Jibana Location	7,903	3,674	4,229	9,423	4,510	4,913	19	86.9	91.8
Chilulu/Tsangwa Sublocation	?	?	?	5,041	2,425	2,616	?	?	92.7
KITSOENI									
Chonyi (N+S) Location[3]	23.358	10,305	13,053	30,783	13,945	16,838	32	79.0	82.8
Kitsoeni Sublocation	3,808	1,621	2,187	3,991	1,788	2,203	5	74,1	81,2
BAMBA									
Bamba Location	20,880	9,558	11,322	26,107	11,800	14,307	25	84.4	82.5
Mikamini Sublocation[4]	2,488	1,174	1,314	2,818	1,278	1,540	13	89.4	83.0
MOMBASA DISTRICT	247,073	143,731	103,342	341,148	189,942	151,206	38	139.1	125.6
KENYA	10,942,705	5,482,381	5,460,324	15,327,061	7,607,113	7,719,948	40	100.4	98.5

Sources: - Kenya Population Census, 1969, vol. I, Table I.
- Kenya Population Census, 1979, vol. I, Table I.

Notes:

[1]Figures may be less trustworthy due to boundary changes.

[2]Number of males per 100 females.

[3]In 1969, there was one location Chonyi, afterwards divided into Chonyi North and Chonyi South. At the same time, the number of Sublocations increased, while also the boundaries changed. This explains why figures of Chonyi North and Chonyi South had to be taken together for Kitsoeni.

[4]In 1969, this was called Bamba Sublocation.

result of the unbalanced sex ratio. There is certainly no standstill of Mijikenda migration to the city. The Mijikenda population in Mombasa increased by 49% in that decade, against 38% in Kwale and Kilifi Districts (CBS,1970;1981; Table 2).

Beside these migration flows across the district borders, there also exist internal patterns of population movement. In Kilifi District, people have been moving from the populated southern parts and the arid hinterland to the coastal strip and to the less populated marginal lands north-west of Malindi. Factors behind this migration are the search for arable land and the employment opportunities at the coast (MFP,1984a). In Kwale District, there seems to be a similar shift of population with people moving out of the areas with the highest risk of crop failure to the relatively better watered parts and to those areas which tend to offer greater employment opportunities. The establishment of settlement schemes in the 2 districts has also been a contributing factor.[8]

3.2. Climatic seasonality

In section 2.1, the availability of soil moisture was identified as the main limiting factor in tropical agriculture as determined by a) the quantity of rainfall and its distribution through time, and b) the loss of moisture through evaporation and transpiration of plants.

In general, the annual precipitation in the districts varies with the distance to the coast. Along the coastline, rainfall ranges from 900-1100 mm per year in the north-east of Kilifi District to more than 1300 mm per year in the south-east of Kwale District. About 40 to 50 km inland, the 700 mm isohyet can be found. However, this general picture is slightly disturbed by the relief of the two districts. Only slightly, because the four major topographical zones which can be discerned also run north-south. These zones are:
I) The *Coastal Plain*, a narrow belt along the coast, with a maximum altitude of about 60 metres. This zone extends to 10 km inland in the area stretching from Lunga-Lunga on the Tanzanian border to the town of Kilifi. North of Kilifi town, the plain widens until it reaches some 30 km inland near Malindi town.
II) The *Foot Plateau*, the western extension of the Coastal Plain. This plateau has an altitude of 60 to 120 metres, although it is characterised by a relatively flat surface, alternated with a number of hills.

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[8] Unfortunately, boundary changes between the administrative units prohibit a quantitative analysis of the recent migrations in the two districts.

III) The *Coastal Range*, rather steeply rising inland from the Foot Plateau. This zone includes hill complexes, such as the Shimba Hills in Kwale District and the hilly country of the Mazeras-Kaloleni-Kitsoeni area in Kilifi District, as well as a number of isolated hills.
IV) The *Nyika Plateau*, extending to the west of the Coastal Range. It has a gently rolling relief and an altitude of 200 to 300 metres.

Figure 3.4a shows the four zones for the Kilifi area. A cross-section (3.4b) drawn along the WE-line of Figure 3.4a, is added. The arrows point to the steep slopes which form the transition between the Foot Plateau and the hilly Mazeras-Kaloleni-Kitsoeni area of the Coastal Range. Such steep, eastern facing slopes promote rainfall, causing the "wet islands" in the interior . Thus, as Figure 3.5 shows, average annual precipitation does not show a perfect east-west continuum because of differences in relief. Average annual evapotranspiration, on the other hand, shows a much more regular pattern, with only the Shimba Hills forming a disturbance in the east-west gradient (Figure 3.6).

Comparing mean annual rainfall with mean annual evapotranspiration, it is clear that - on a yearly basis - there is a considerable water deficit. But, while evaporation is equally distributed throughout the year, rainfall is not. There is "a pronounced concentration of rainfall at the beginning of the April-June rains, particularly in the hinterland" (Smaling & Boxem,1987: 14).[9] This means that only during relatively short seasons there is a water surplus in the soil. These periods determine the length of the growing periods, which are generally short in Coast Province.

In section 2.1 two methods of measuring climatic seasonality were discussed. *Absolute seasonality* was determined as the average number of 'dry' months per year: months with less than 102 mm of precipitation. A relative *seasonality index (SI)* was also used: the sum of the absolute deviations of mean monthly rainfall from the overall monthly mean, divided by mean annual rainfall. Walsh (1981: 18-19) divided both absolute seasonality and relative seasonality into seven classes: the first ranging from A (no dry month) to G (12 dry months), the latter from 0 (SI below 0.20) to 6 (SI over 1.20). Theoretically, 49 climatic combinations are possible from A0 to G6, but in practice this is not so because the two measures are to a certain extent correlated. Accordingly, the southern part of Kenya (including Coast Province) was classified as type E3*, i.e. with 8-9 dry months (E) and SI

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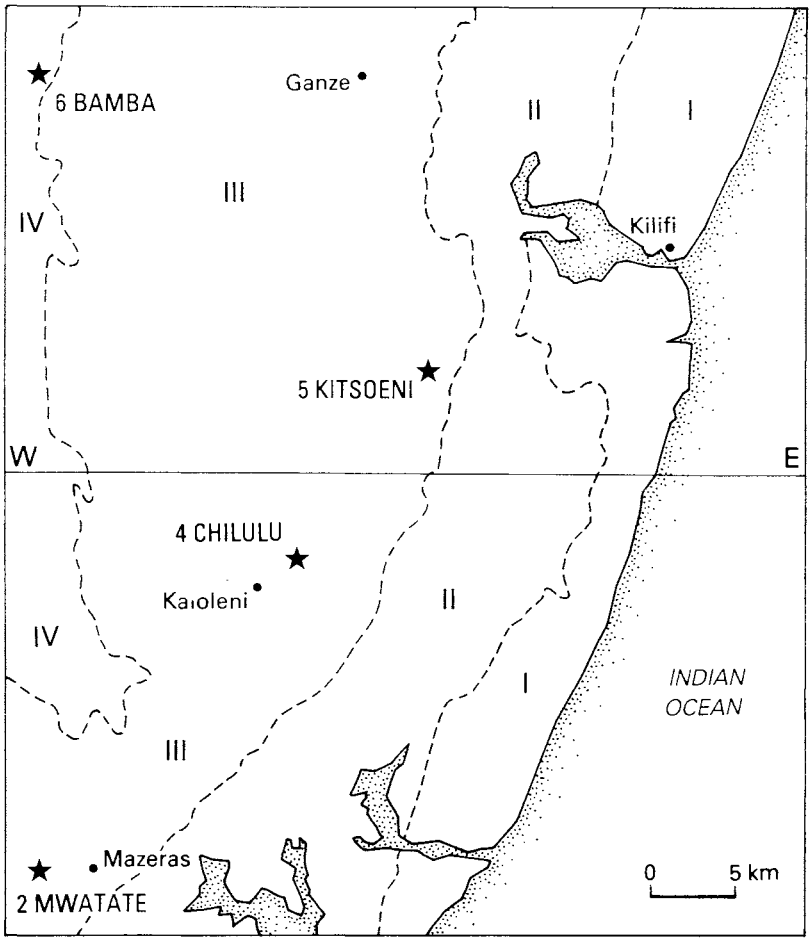
[9] If measured in 90-days periods, the relative portions of annual evaporation fluctuate around 25%, ranging along the coast from 22% during April-June to 29% during January-March, and in the hinterland from 24% to 27% during the same periods (Smaling & Boxem,1987:14). On the other hand, 50% of the precipitation during the 3 month period of April-June falls during the first 33 days; in the hinterland during the first 18 days. Of the first rains at the coast 75% falls during the first 53 days, and further inland during the first 38 days.



----- approximate boundary between topographical zones

★ research area

Figure 3.4 a Topographical zones in the Kilifi area (after Waaijenberg 1987)

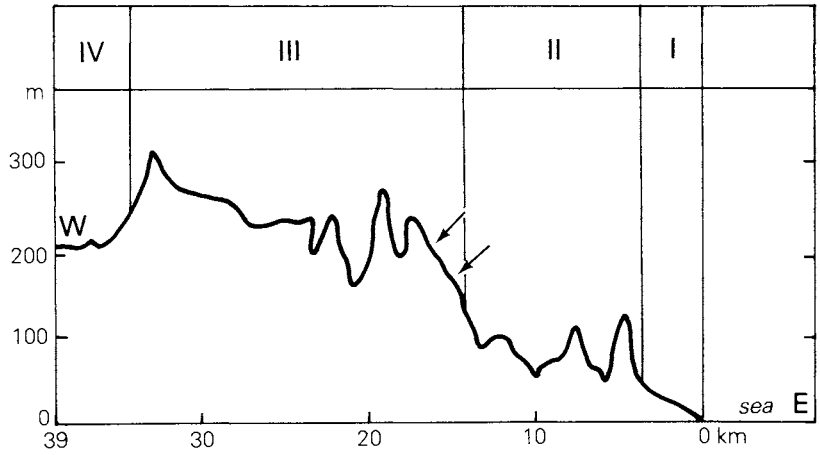


Figure 3.4 b Cross-section of the WE-line in figure 3.4 a (after Waaijenberg 1987)

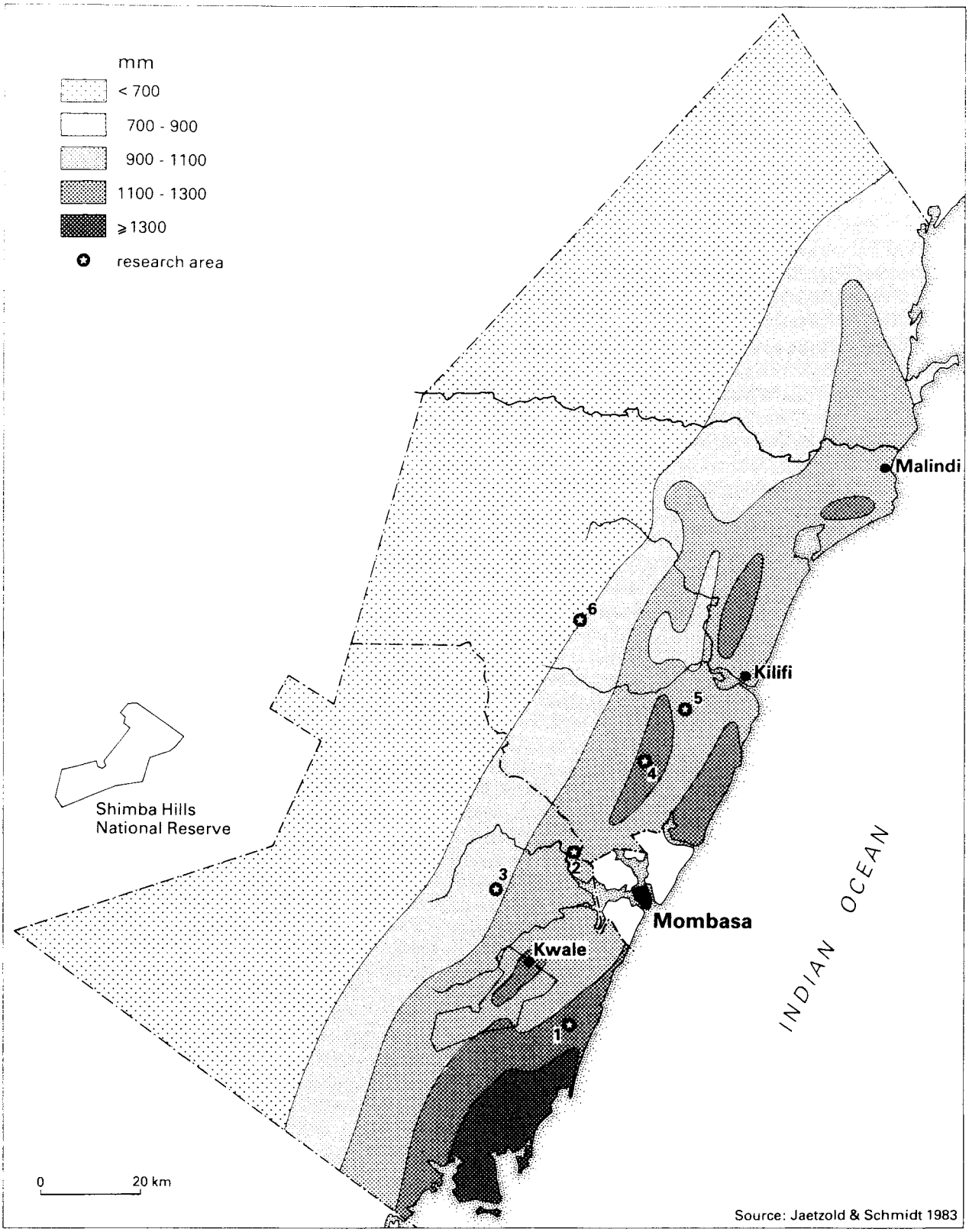


Figure 3.5 Mean annual rainfall

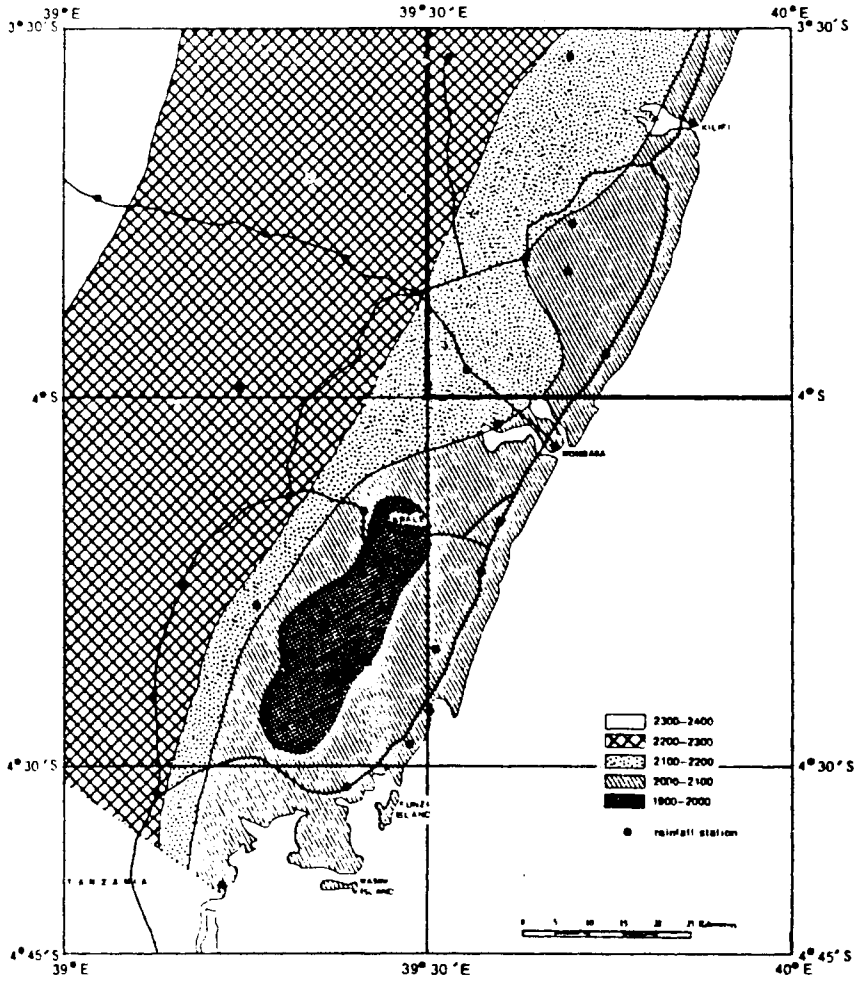


Figure 3.6: Average annual evapotranspiration (mm) in the Kilifi area, after Braun (Michieka et al., 1978).

ranging from 0.60 to 0.79 (3 or 'seasonal'). The asterisk denotes the bimodal character of the E3 type in East Africa, i.e. with two rainy seasons (Chambers et al,1981: 26).

However, if one studies the rainfall data of Coast Province in more detail, the climatic situation appears to be much more diverse. Table 3.3 presents data for selected stations in Kwale and Kilifi districts which are evenly spread over the districts and/or located near the six research areas (for comparison purposes, stations in Mombasa, Taita and Kitui are also included). For each station, the absolute seasonality and the relative seasonality index were calculated. The results are remarkable.

Table 3.3
CLIMATIC SEASONALITY, SELECTED STATIONS

DISTRICT	ALT. (m)	STATION	NR.OF REC. YEARS	ANNUAL RAINFALL (mm)	NR.OF DRY MONTHS	SEAS. INDEX (si)[2]	TYPE[1]
Kilifi	120	Adu	11	931	9	0.45	E2
	91	Chakama	16	539	11	0.58	F2
	3	Malindi, D.O.	78	1050	10	0.76	F3
	8	Kilifi, D.O.	53	954	9	0.56	E2
	244	Bamba	18	677	10	0.54	F2
	256	Chonyi	33	1150	9	0.43	E2
	226	Kaloleni	15	1090	7	0.40	D2
	204	Mariakani	34	856	9	0.41	E2
Mombasa	56	Port Reitz	30	1050	10	0.45	F2
Kwale	279	Samburu	42	616	12	0.46	G2
	305	Kinango	47	858	10	0.42	F2
	393	Kwale Town	64	1151	7	0.43	D2
	60	Muhaka	34	1151	9	0.51	E2
	122	Mwangulu	21	739	10	0.41	F2
	12	Vanga	40	1109	10	0.55	F2
Taita	517	Maungu	12	384	12	0.66	G3
Kitui	1158	Kitui	29	1015	8	0.95	E4

Sources: Meteorological Department, Nairobi (Kinango, Muhaka)
Jaetzold & Schmidt, 1983 (other stations)

Notes:
[1] D = 5 - 7 dry months
E = 8 - 9 " "
F = 10 - 11 " "
G = 12 " "
(see Walsh, 1981)

2: si = 0.40 - 0.59
3: si = 0.60 - 0.79
4: si = 0.80 - 0.99

[2] The formula of si is added to figure 2.2. (page 13)

No fewer than seven different seasonality types are represented in Table 3.3, ranging from D2 to G3. The "2" types, with a seasonality index of 0.40 - 0.59 or "rather seasonal" in Walsh's terms, predominate. The existence of so many different climatic types in the two districts is mainly caused by the number of dry months, ranging from seven in Kaloleni and Kwale town to the maximum of twelve in Samburu.[10] Thus, on the one hand, Coast Province appears more seasonal than calculated by Walsh, because of the presence of F and G types (absolute seasonality). On the other hand, the region also appears less seasonal because of the presence of mainly '2' types (relative seasonality).

Figure 3.7 gives further insight into the distribution of rainfall throughout the year for the stations in Table 3.3. Along the narrow coastal strip, a unimodal climate prevails, i.e. with one rainfall peak around May, Malindi being the clearest example. More inland, a weak bimodal regime is found - with two wet seasons, one in April-May and one in October-December. This is the intermediate region between the unimodal type at the coast and the real bimodal type further inland (Braun,1985: 8). Kitui is a good example of the latter, with two rainy peaks and very dry periods in between. In Kwale and Kilifi, the period between the first rains and the second rains, is not totally dry, which is the reason for the moderate seasonality indices. The only real 'dry' months are January and February. This means that the classification as a bimodal climatic type should also be taken with care.

Another important rainfall feature, especially in the drier climates, is the interannual variability, measured as the yearly deviation from the average annual rainfall. Table 3.4 shows - for the six rainfall stations close to the research areas - the number of years in which the total annual rainfall deviates at least 20% from the average annual rainfall.

In Kinango, Muhaka and Kaloleni this occurs in six out of every ten years, in Mariakani and Bamba once in every two years. In five of the six stations, a deviation of no less than 40% occurs once in every four or five years.[11] One cannot conclude from the data in the table that the lesser the annual rainfall the greater the interannual variability. When rainfall shows such large yearly fluctuations, monthly rainfall also varies substantially. Some extreme deviations in the wettest month (May) and in the driest month (January) will serve as examples. The absolute peak in May is +269% in Kinango in 1947 when 627 mm was

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10 Ironically, the E3 type was not found at all in Coast Province, with the exception of Gazi in Kwale District. If similar calculations are made for all rainfall stations, one more climatic type (F1) is found to exist, also in Kwale District.

11 There seems to be no correlation between the degree of this deviation on the one hand and the average annual rainfall on the other. Thus, Walsh's hypothesis that the drier the climate the greater the annual variability is not confirmed in this case.

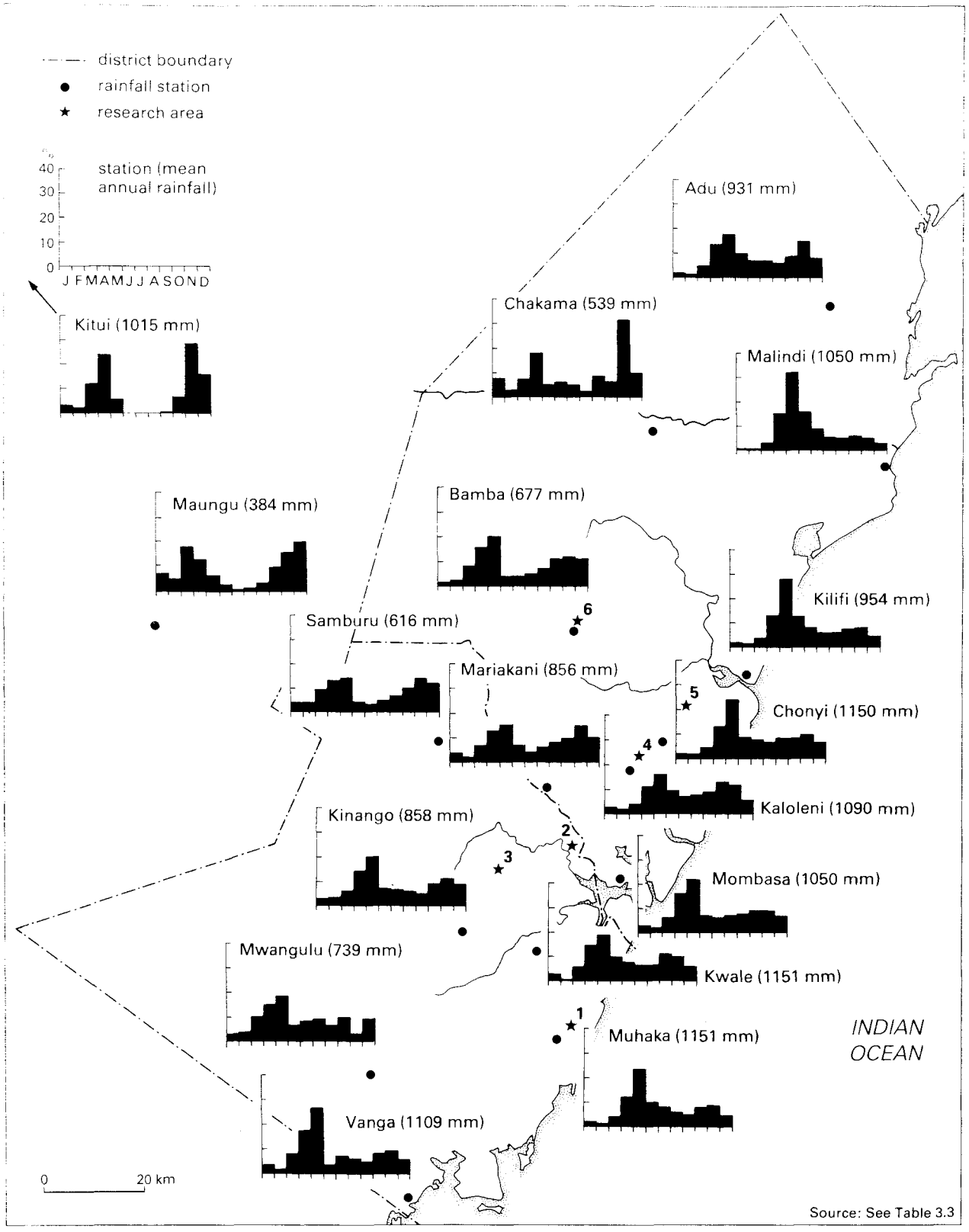

Figure 3.7 Mean monthly rainfall as a percentage of mean annual rainfall (selected stations)

Table 3.4
NUMBER OF DEVIATING YEARS (IN %) FROM MEAN ANNUAL RAINFALL, BY DEGREE OF ABSOLUTE DEVIATION, FOR SELECTED STATIONS.

STATION	NR.OF REC. YEARS	MEAN ANNUAL RAINFALL	DEVIATION >20%	>30%	>40%
Kinango	42	835	62	38	21
Muhaka	33	1151	61	36	12
Kaloleni	19	1069	58	37	26
Mariakani	10	822	50	40	40
Chonyi	13	1163	38	31	23
Bamba	11	657	55	45	27

Source: Calculated from data from the Meteorological Department, Nairobi.

measured instead of the 'normal' 170 mm. On the other hand, very dry May months occurred in 1969 (-90% in Kinango and -80% in Muhaka), while in 1962 there was no rain at all in Mariakani in this 'wettest' month. The mean rainfall in January ranges from 20 to 30 mm in the different stations and deviations of -100% (no rain at all) occur regularly. Sometimes, however, there is considerable rainfall during this month, as in 1979 when Muhaka, Chonyi and Bamba recorded 123, 150 and 121 mm (i.e. four to five-fold the average) respectively. Again, Kinango ranks first, measuring 182 mm in 1978 or a deviation of +550% (calculated from data from the Meteorological Department, Nairobi).

Monthly rainfall can also vary between years with the same overall rainfall, as the four examples in Figure 3.8 illustrate. For each of the four stations, two years have been selected with a total rainfall slightly above or below the average annual rainfall. Nevertheless, the monthly distributions are highly different. In the one year there is a clear rainfall peak during the first rains, in the other year during the second rains. This variation reflects that even in years with 'normal' or 'above-normal' rainfall, the monthly distribution does not necessarily coincide with the needs of the agrarian cycle.

Finally, the last type of rainfall fluctuation: spatial variability. Kinango and Muhaka, are two stations which are only 30 kilometres apart as the crow flies. Although the yearly rainfall shows a high degree of correlation between the two stations, there are also some marked differences. In 8 out of the 32 years for which figures are at hand, the difference between their respective deviations from mean annual rainfall was 25% or more. In Kinango and Bamba, the two 'dry' stations in our sample, this happened in four out of eleven recorded years in the 1972-1985 period.

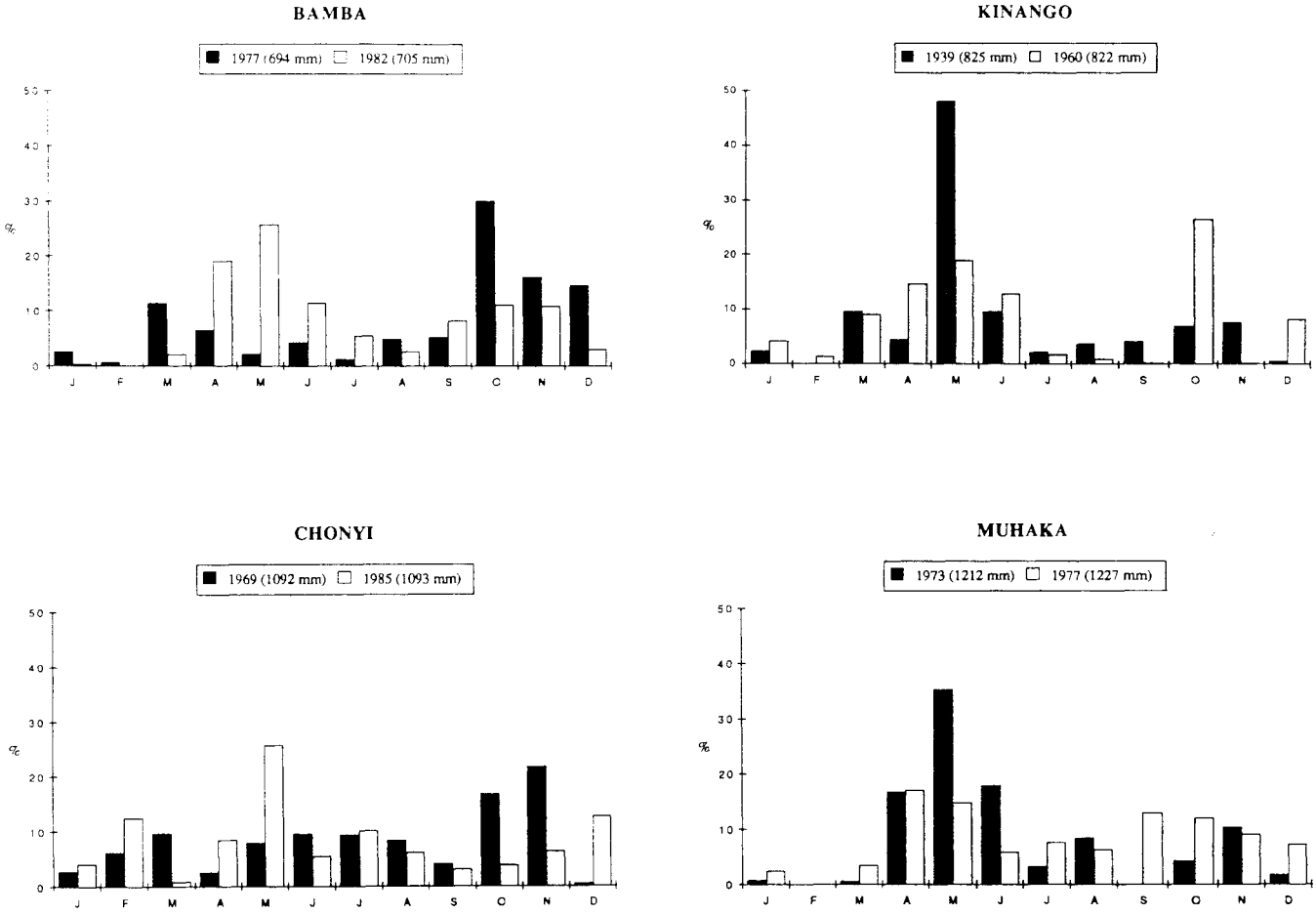

Figure 3.8: Monthly distribution of rainfall (in %) for selected years.
Source: Calculated from data from the Meteorological Department, Nairobi

In review, it is striking how rainfall fluctuates, not only intra-annually and inter-annually but also between the same months in different years, as well as between places. In other words, it is highly unpredictable when the rains will start, how much rain will fall, and how the rain will be distributed over the seasons. Since rainfall determines the agricultural calendar, this makes the crop cycle equally uncertain.

3.3. Agro-ecological zones

Agricultural potential and growing periods of crops[12] are largely decided by the following determinants: a) temperature, b) annual rainfall, and c) seasonal distribution of rainfall. Based on these three elements, Jaetzold & Schmidt (1983: 9) have constructed an agro-ecological zonation for the different districts of Kenya.

Firstly, *zone groups* are based on temperature belts, "defined according to the maximum temperature limits within which the main crops in Kenya can flourish". Kwale and Kilifi belong to one temperature belt, with mean annual temperature higher than 24°C and mean maximum temperature lower than 31°C. This zone group is denoted as CL, i.e. Coastal Lowlands, with cashewnuts and coconuts being the characteristic main crops. Secondly, within these zone groups, *main zones* are distinguished, determined by the mean annual rainfall. These main zones are based on "their probability of meeting the temperature and water requirements of the main leading crops". In Kwale and Kilifi Districts, there are five main agro-ecological zones, ranging from CL2 (where '2' stands for 'sub-humid') to CL6 ('arid'), characterised by the leading crops and/or agricultural activities in each of them (Figure 3.9):

(CL2): The Lowland sugar-cane zone is found in Kwale District and has an annual rainfall of over 1400 mm. The zone totals only 235 km^2, of which a large part is used for sugar-cane production.

(CL3): The Coconut-cassava zone, about 1,450 km^2 in size, has a medium potential for agricultural activities. The annual precipitation averages about 1200 mm, but the short rains do not allow for cultivation of a wide range of annual crops.

(CL4): The Cashewnut-cassava zone totals about 2,940 km^2 and has a low to medium potential for cropping. Rainfall averages 1000 mm annually, but in only six out of ten years the amount and distribution of the long rains are likely to be adequate for the production of

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12 According to Jaetzold & Schmidt (1983: 9), growing periods are defined as:
"seasons with enough moisture in the soil to grow most crops, starting with a supply for plants to transpirate more than $0.4E_0$ (i.e., >40% of the open water evaporation), coming up to $>E_0$ (in the ideal case) during the time of peak demand, and then falling down in the maturity phase again".

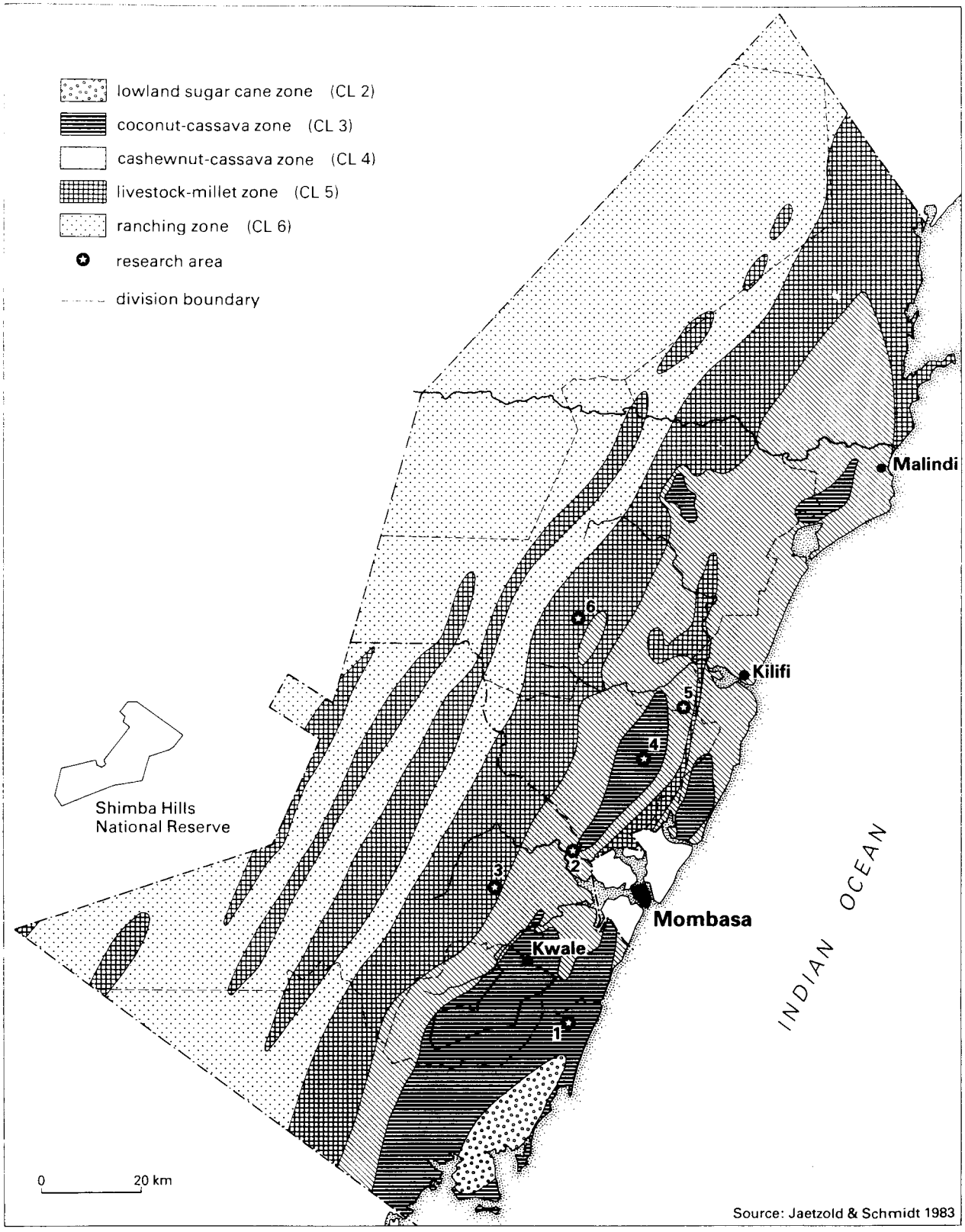

Figure 3.9 Main agro-ecological zones

annual crops. Cultivation of annual crops during the period of the short rains is normally not possible.

(CL5): The Livestock-millet zone, with 5,000 km^2 the largest main zone in the area, is characterised by an average annual rainfall of about 800 mm and very unreliable rains. Due to the short duration of the long rains, crop production in this zone is restricted to drought-resistent crops.

(CL6): The Ranching zone, finally, has virtually no potential for arable agriculture. Annual precipitation is less than 700 mm on average and is extremely unreliable. Agricultural activities are restricted to non-intensive types of livestock rearing. It covers 4,800 km^2.

Table 3.5 shows the distribution of the main zones in the two districts. Two-thirds of the agricultural lands belong to the low potential category, CL5 and CL6, while only 12% is considered to be medium or high potential land. It is not surprising that three-quarters of the farm households are found in one-third of the area (Table 3.5, right-hand columns). Almost 90% of the rural population, in fact, live in the three zones CL3, CL4 and CL5 and this is one reason why the present study is limited to six research sites selected from these three zones. Zone CL2 and CL6 were not included in the survey.

Table 3.5
AGRICULTURAL LAND AND NUMBER OF FARM FAMILIES, BY MAIN AGRO-ECOLOGICAL ZONES.

MAIN	KWALE		KILIFI		TOTAL		FARM FAMILIES	
ZONES	km^2	%	km^2	%	km^2	%	(N)	%
CL2	235	3	–	-	235	2	3,000	3
CL3	953	13	496	7	1,449	10	34,000	28
CL4	897	12	2,045	29	2,942	20	54,000	45
CL5	2,342	32	2,658	37	5,000	35	17,000	14
CL6	2,886	40	1,914	27	4,800	33	12,000	10
TOTAL	7,313	100	7,113	100	14,426	100	120,000	100

Source: Jaetzold & Schmidt, 1983: 309, 350.

Since, as described earlier, considerable variations in rainfall distribution over the seasons exist, the main zones can be divided in *sub-zones*, "according to the yearly distribution and the lengths of the growing periods". Using as criteria the length of the first and second rainy seasons and the existence of intermediate rains, a range of combinations is possible (Jaetzold & Schmidt,1983:9).[13] Table 3.6 lists the various sub-zones in which the six

[13] The actual sub-zonation was done on the basis of a 60% probability factor, i.e. the given length of the growing period should be reached or surpassed in at least 6 out of 10 years. There is, of course, a correlation

research areas are located with their main characteristics and the explanations of the various denotations.

Table 3.6
AGRO-ECOLOGICAL SUB-ZONES BY RESEARCH AREA.

AREA	AGRO-ECOLOG. SUB-ZONE*	MEAN ANN. RAINFALL (mm)	LENGTH 1ST GROW.PER. (days)	INTERM. RAINS	LENGTH 2ND. GROW.PER. (days)
Bongwe	CL3 m/l,i	1100-1200	155-174	yes	-
Chilulu	CL3 m/l,i,s	1100-1200	155-174	yes	85-104
Kitsoeni	CL4 m,i,vs	1000-1100	135-154	yes	40-54
Mwatate	CL4 m/s,i,vs	1000-1100	115-134	yes	40-54
Kibandaongo	CL5 s,i,vs	800-900	85-104	yes	40-54
Bamba	CL5 vs/s,vs	700-800	55-74	no	40-54

Source: Jaetzold & Schmidt, 1983

* CL3, CL4, etc: see text

growth period:		
	m/l	medium to long
	m	medium
	m/s	medium to short
	s	short growing period
	vs/s	very short to short
	vs	very short
	i	intermediate rains

Mean annual rainfall, length of the first growing period, possible intermediate rains, and length of the second growing period determine the types of crops which can be grown and - to a lesser extent - the average yield potential. The latter is also influenced by soil characteristics such as depth, texture and chemical and physical structure. The soil types broadly correspond with the topographical division (page 38). In the Coastal Plain, soils have developed on coastal sands and coral limestones and are generally well-drained but vary in depth and structure. Their fertility is moderate to low. The soils of the Foot Plateau are deep and well-drained, but also with moderate to low fertility. Soil units in the Coastal Range vary greatly. Depending on the ways in which they were formed and the type of parent material, they range from well-drained, deep, sandy and clayey soils with varying degrees of fertility to shallow, coarse, sandy soils which, especially on the steeper slopes of the hills and hill complexes, are prone to erosion. Finally, the soils of the Nyika Plateau are sandy and clayey in nature. In general, their fertility is low although in certain places fertile soils occur. Many soil units in this zone are degraded through erosion.

between the mean annual rainfall (In which the main zonation is based) and the length of the growing periods (sub-zonation); although not completely, which is reason for the sub-zonation.

Figure 3.10 shows an overall picture of soil fertility. Areas with really fertile soils are scarce. The major parts of the two districts have a moderate to low soil fertility. Particularly, the northern half of Kilifi District is infertile. Four of the six research areas are located in areas with moderate soil fertility, one (Chilulu) in a low fertility region, while Bongwe is situated in the narrow belt along the coast where fertility is variable.

We may now turn to the various crops that can be grown in the respective research areas and their possible yields (Table 3.7). There are sharp contrasts between relatively wet areas like Bongwe and Chilulu on the one hand, and relatively dry regions like Kibandaongo and Bamba on the other. Firstly, while in the CL3 sub-zones many permanent crops (fruits, cassava, etc.) offer good yields, in the CL5 sub-zones only a few of such crops will grow. Secondly, the growing period during the first rains in the CL3 sub-zones is so much longer than in the CL5 sub-zones that practically all annual crops give satisfactory yields. In the CL5 sub-zones, this is only the case with some drought-resistant grains (sorghum, millet) and vegetables (green grams, gourds). Other crops give at best 'fair' yields. The CL4 sub-zones have only a slightly shorter growing period than the CL3 sub-zones, but the difference regarding crops and crop yield potentials is nevertheless remarkable. Thirdly, as we have seen, in most areas the growing period during the second rains is too short. This implies that in Bongwe there is no second cropping period. However, the long intermediate rains explain why many year-round crops mature well in that area. In the other areas, a second growing period exists (at least, in 'normal' years), but rainfall is only slightly above what has been labelled as intermediate rains. Only a few drought-resistent crops can be grown then, but at best with 'fair' results.

3.4. Farming systems

A number of surveys have been carried out in recent years on the structure of the smallholder agricultural sector in the two districts.[14] Farm surveys in 1977 in the coconut-cassava (CL3) and the cashewnut-cassava (CL4) zones indicated an average holding size of 8.2 ha for the smallholders in Kwale District and 6.5 ha for those in Kilifi District (Jaetzold & Schmidt,1983: 310, 351), which is quite high. Carlsen (1980: 143) estimated an average holding size of 8.8 ha from his survey of 98 farm households in the Coconut-cassava zone (CL3) near Kikoneni in Kwale District. There are considerable variations in holding size, not only between the different agro-ecological zones, but also

[14] Beinum et al 1985, Carlsen 1980, Floor 1981, Jaetzold & Schmidt 1983, Schreurs 1982, Waaijenberg 1981, Waaijenberg & Salim 1983.

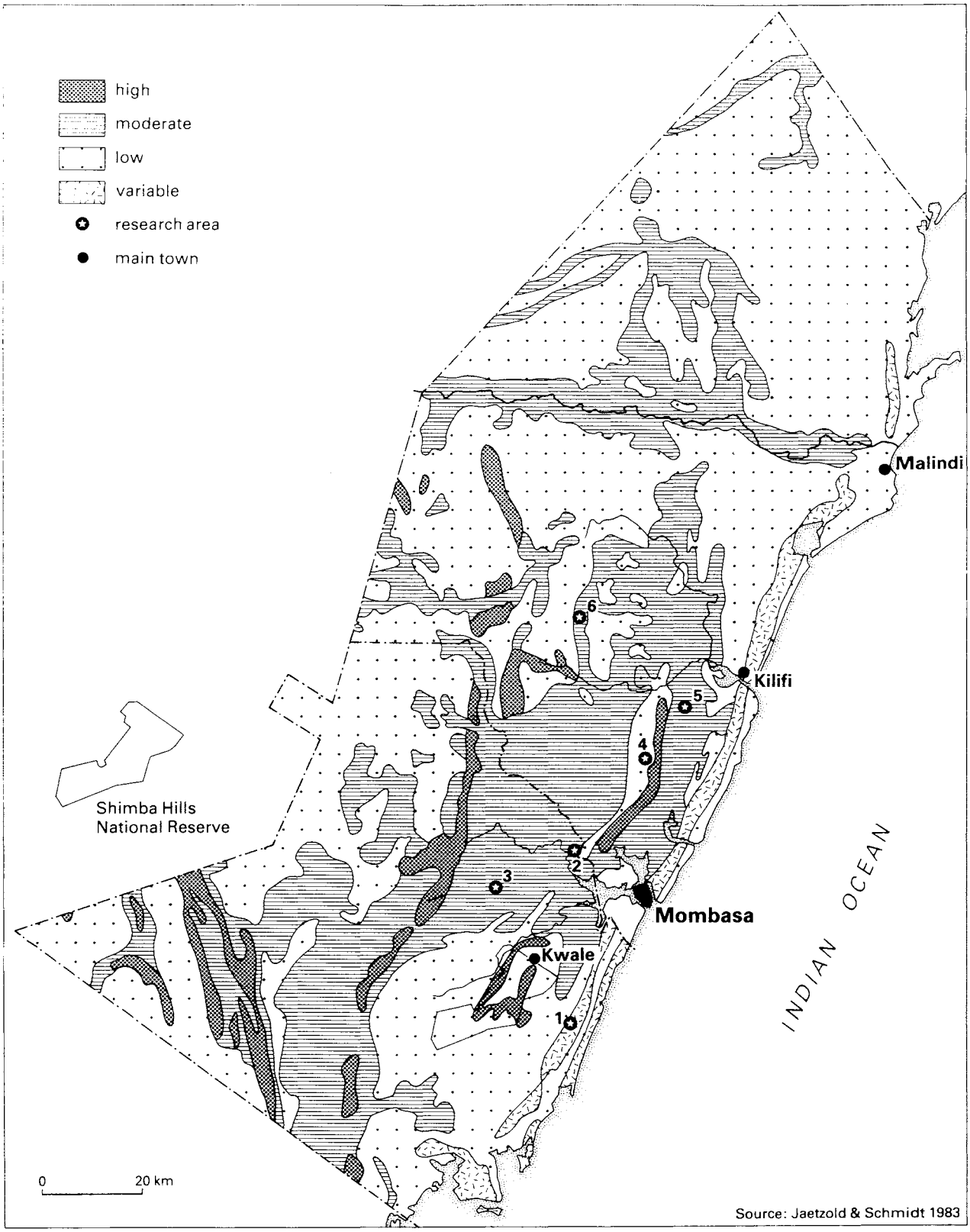

Figure 3.10 Soil fertility

TABLE 3.7
POTENTIAL CROP YIELDS, BY AGRO-ECOLOGICAL SUB-ZONE AND BY SEASON.

CLUSTER		BONGWE	CHILULU	KITSOENI	MWATATE	KIBANDAONGO	BAMBA
A.E.Z.		CL 3 m/l, i	CL 3 m/l, i, s	CL 4 m, i, vs	CL 4 m/s, i, vs	CL 5 s, i, vs	CL 5 vs/s, vs
MEAN ANN. RAINFALL		1100 - 1200 mm.	1100 - 1200 mm	1000 - 1100 mm	1100 - 1100 mm	800 - 900 mm	700 - 800 mm
WHOLE YEAR		*FR*: Coconuts, Mangoes Bananas, Pawpaws Avocadoes, Guavas, Pineapples, Citrus	*FR*: Coconuts, Mangoes Bananas, Pawpaws, Avocadoes, Guavas	*FR*: Cashew Nuts Mangoes, Avocadoes, Pineapples	*FR*: Cashew Nuts Mangoes	*FR*: -	*FR*: -
YIELD POTENTIAL	GOOD	*VEG*: - *MISC*: Cassava, Bixa, Sisal, Castor	*VEG*: - *MISC*: Bixa, Sisal Castor	*VEG*: - *MISC*: Sisal, Castor	*VEG*: - *MISC*: Cassava, Sisal Castor	*VEG*: M.Beans, Gourds *MISC*: -	*VEG*: M.Beans,Gourds *MISC*: -
	FAIR	*FR*: Cashew Nuts *VEG*: - *MISC*: Sugar cane, Curcuma	*FR*: Cashew Nuts Pineapples, Citrus *VEG*: - *MISC*: Cassava,Curcuma	*FR*: Pawpaws Guavas *VEG*: - *MISC*: Cassava, Bixa	*FR*: Pawpaws *VEG*: - *MISC*: Bixa	*Fr*: - *VEG*: - *MISC*: Cassava, Sisal Castor	*FR*: - *VEG*: - *MISC*: Cassava, Sisal Castor
1st RAINS: Growing Per.		155-174 days	155-174 days	135-154 days	115-134 days	85-104 days	55-74 days
YIELD POTENTIAL	GOOD	*GR*: C.C.Maize, P.H. Maize, Sorghum *VEG*: Sw. Potatoes, Cow Peas, Chick Peas, Egg Plant, Simsim, Kales, Gr. Grams, Bl. Grams Chillies, M. Beans, Tomatoes, Gourds *MISC*: -	*GR*: C.C. Maize, P.H Maize, Sorghum *VEG*: Sw. Potatoes, Cow Peas, Chick Peas, Egg Plant, Kales, Green Grams, Bl. Grams, Chillies, M. Beans, Tomatoes, Gourds *MISC*: -	*GR*: C.C. Maize, Sorghum *VEG*: Sw. Potatoes, Egg Plant, Kales, Chillies *MISC*: -	*GR*: Sorghum *VEG*: Sw. Potatoes Egg Plant, Kales Chillies *MISC*: Groundnuts Bamb. Groundnuts	*GR*: Sorghum Millet *VEG*: Green Grams *MISC*: -	*GR*: Sorghum Millet *VEG*: Gourds *MISC*: -
	FAIR	*GR*: Rice *VEG*: - *MISC*: Cotton	*GR*: Rice *VEG*: Simsim *MISC*: Cotton	*GR*: P.H. Maize *VEG*: Cow peas, Simsim, Tomatoes *MISC*: Groundnuts, cotton	*Gr*: C.C. Maize, P.H.Maize *VEG*: Cow Peas, Tomatoes *MISC*: Cotton	*GR*: - *VEG*: Sw. Potatoes Cow Peas, Chick Peas, Bl.Grams *MISC*: Bamb.Groundnuts	*GR*: - *VEG*: Cow Peas Chick Peas, Green Grams, Bl. Grams *MISC*: Bamb.Groundnuts
2 nd RAINS: Growing per.		-	85-104 days	40-54 days	40-54 days	40-54 days	40-54 days
YIELD POTENTIAL	FAIR	*GR*: - *VEG*: -	*GR*: Sorghum *VEG*: Sw. Potatoes Green Grams	*GR*: Sorghum, Millet *VEG*: Cow Peas Green Grams	*GR*: Millet *VEG*: Cow Peas, Chick Peas, Gr. Grams	*GR*: - *VEG*: Cow Peas, Chick Peas, Gr. Grams	*GR*: - *VEG*: -
	POOR	*GR*: - *VEG*: -	*GR*: C.C. Maize *VEG*: -	*GR*: C.C. Maize *VEG*: Sw. Potatoes	*GR*: Sorghum *VEG*: -	*GR*: Sorhum, Millet *VEG*: Sw. Potatoes	*GR*: Sorghum, Millet *VEG*: Gr. Grams

EXPLANATIONS:

AGRO-ECOLOCIAL ZONES
CL3, CL4, CL5: see text
m/l
m
m/s
s
vs/s
vs
i
see Table 3.6

YIELD POTENTIAL
GOOD: average 60% of optimum
FAIR: average 40-60% of optimum
POOR: average 20-40% of optimum

CROPS
GR: grains
FR: fruits
VEG: vegetables
MISC: miscellaneous crops
C.C. Maize: Coast Composite maize
P.H. Maize: Pioneer Hybrid maize
Sorghum: early maturing varieties
Millet: early maturing bulrush millet
Sw. Potatoes: sweet potatoes
Gr. Grams: green grams
Bl. Grams: black grams
M. Beans: Marama beans
Bamb: Bambara groundnuts

SOURCE: Jaetzold & Schmidt, 1983.

among the different households living within similar zones. As a rule of thumb, however, smaller holdings dominate in the more humid, populated areas whereas larger farms are found in the marginal farm lands in the western part of the districts (Schreurs,1982; Jaetzold & Schmidt,1983), mainly due to differences in the carrying capacity of the land.

The smallholder farming systems of Kwale and Kilifi are rather complex and differ from those found elsewhere in Kenya. The available information indicates the existence of four basic smallholder farming systems. In three of them, farmers combine annual food crop cultivation with perennial cash crop cultivation but with little or no livestock production. The fourth system is mainly geared to livestock production, with additional food crop cultivation for subsistence. The location of each of these farming systems is closely related to the differences in ecology described above.

The size of the farm area cultivated depends on the agro-ecological environment and the specific farming system, but particularly on the availability of family labour, because of the low levels of technology utilized. The area under annual and perennial crops is generally rather small. For instance, the average farmer in the coconut-cassava zone (CL3) in Kwale District used about 50% of the holding for the cultivation of annual and permanent crops. The remainder was either used as pasture land or left fallow. Smallholders living in the same agro-ecological zone in Kilifi District devoted almost two-thirds of their land to crop cultivation (Jaetzold & Schmidt,1983: 310, 351). Farmers near Kikoneni, Kwale (also CL3), cultivated some 85% of their holding, the rest of the land being left fallow (Carlsen,1980: 148).

Smallholder farms in the coconut-cassava (CL3) and the cashewnut-cassava (CL4) zones are able to grow commercial tree crops like coconuts, cashewnuts, mango and citrus, sugar-cane, and annual food crops such as maize, cassava, paddy, pulses and vegetables, are found in varying combinations. Surveys indicate that farmers in CL3 and CL4 have about equal proportions of their crop land under food crops and under commercial crops (Jaetzold & Schmidt,1983: 314,355). However, the relative importance of the different crops in the cropping pattern depends on the specific micro conditions of the individual farms. In parts of Kilifi District, sesame and cotton are sometimes included in the cropping system, whereas bixa is a cash crop in part of the Coastal Range of Kwale.

In the drier parts of the CL4 and in the Livestock-millet zone (CL5), cash crop cultivation is unimportant and farmers mainly depend on the production of annual food crops such as maize, cassava, millet, sorghum and pulses. In the drier parts of CL5 and in the Ranching

zone (CL6), livestock activities are supplemented by marginal food crop production of drought-resistent crops such as millet, sorghum and grams. Stock rearing is mainly for subsistence purposes and most of the farmers in the hinterland are organized in so-called Group Ranches. Land ownership is vested in the Group Ranch Committee and the individual families have the right of use.

The proportion of the area under food crops to that under cash crops (tree crops) on the smallholdings in the more humid parts of Kwale and Kilifi is generally restricted, resulting in a relatively low degree of self-sufficiency among the farming population. In the drier parts of the districts, on the other hand, the frequent occurrence of drought is a continuous threat to the self-sufficiency of the farming families living there.

The rural population in Kwale and Kilifi Districts makes a living chiefly in agriculture. The size of the holding, the type of farm enterprise and cropping pattern are the main determinants of agricultural production. Yield levels, and consequently incomes, are generally low. At district level, we have some figures regarding crop yields in the 1981-1985 period in Kilifi District for the three main food crops, maize, sorghum and cassava. Firstly, yields can differ very much in different years. For instance, productivity of local maize was 300 kg/ha in 1982, but 1200 kg/ha in 1984. Figures for sorghum in these years were 250 and 650 kg/ha respectively. Secondly, yields of improved maize varieties were much higher, 1.5-1.9 times (but also requiring high inputs), than those of the local maize which is grown by the large majority of the smallholder farmers. Thirdly, cassava harvests show an inverse correlation with yields of annual food crops such as maize and sorghum. In a 'poor' year like 1982, twice as much cassava was harvested than in a 'good' year like 1984. This indicates the importance of cassava as a 'survival crop' (MOA, 1985: 46-48; MOA, 1986: 28-32; MOENR, 1984a: 59).

There are further differences in crop yields in relation to agro-ecological zones, soil types, farming inputs, etc. Waaijenberg (1984: 7-11; 1985: 224) found large differences in maize yields, between villages as well as within four villages in the southern central part of Kilifi District in the 1981-1984 period. One remarkable finding was that there appeared to be little correlation between maize yield and main agro-ecological zone (i.e. mean annual rainfall). All villages did relatively well in 1981, when the long rains were well distributed. But the next year yields were low, not because of lack of rain but because rains were excessively heavy. In the latter year, there were important differences in crop yields (kg/ha) between the various farms in each village. How to explain these differences is not at all clear, but productivity is generally low for a number of reasons. There are the limiting physical

features such as unreliable rainfall, poor soils, destruction by wildlife; the economic and financial constraints such as low prices for cash crops, lack or unawareness of credit facilities and the unfavourable infrastructural characteristics such as inaccessability of markets due to poor roads, tolls like the Likoni ferry, and shortage of storage facilities. Furthermore, there are limitations of a socio-cultural nature, notably the presence of traditional farming practices, with their poor levels of crop husbandry, low degree of adaptation of improved crop varieties and the limited use of external farm inputs, but also more pernicious factors like an often noted lack of motivation among the local population. Last, but not least, there are serious labour constraints that have to do with poor health status of the population but also with actual shortage of labour (MOENR,1984a:175-176; MOENR,1984b: 98).

3.5. Effects of seasonality

Labour

Because of the seasonal distribution of rainfall, discussed in the previous section, there is only one growing period along the coastal strip, while inland two harvests may be possible, although the short rains are often too marginal and unreliable to make a second planting successful. By far the most important crop is (local) maize. Land preparation starts in February, i.e. before the start of the long rains. Seeding is concentrated in the following two months, but especially in March. The first weeding follows shortly afterwards (April-May). This is also the time that land preparation for beans and cowpeas is done, followed by seeding in June. Usually, these crops are interplanted with the maize. Cassava is planted as well. From June to August the harvesting of the maize takes place, with a distinct peak in July. The first beans are harvested at this time. Some farmers - but certainly not all - start land preparation and seeding for a second maize crop. The following months, i.e. from September to January, are relatively lean, with such activities as weeding and harvesting of beans and cowpeas and the possible care of a second maize crop. It is during this period that harvesting of tree crops like cashewnuts and citrus also takes place (coconuts are harvested the whole year round). In sum, farming activities are mainly concentrated in the March-July period, i.e. partly during the rainy season. (Jaetzold & Schmidt,1983: 318-320,359-361; Waayenberg,1987: 220-221)

Nearly all cultivation activities for annual crops - planting, weeding, harvesting - are done by women. There is a clear correlation between the maize hectarage per household and the

number of women (mothers, wives, daughters) who were working on the farm, and consequently "lack of (female) labour may be one of the factors limiting maize production". Men are responsible for the clearing of new fields, cutting and burning of trees and shrubs, but "as land use becomes more intensive, these activities decrease in importance". House building, tree crops (cash) and livestock are also men's responsibilities, "although part or all of the work may be done by women, e.g. making 'makuti' (roofing tiles of palm leaf), collecting cashewnuts, herding, watering, milking" (Waayenberg,1984: 7; 1987: 214).

Beside the cultivation of annual crops, women fulfil a whole range of activities which are centred around the homestead, generally assisted by the girls. These tasks consist of cleaning the house and the courtyard, cooking, washing, making fire, collecting firewood, fetching water, collecting vegetables, pounding grain, grinding, milking, winnowing, and taking care of the young children. Especially collecting firewood and fetching water can be very burdensome tasks. In one household sample in Coast Province, fifteen per cent reportedly had to cover more than four miles to obtain water in the dry season (Geist,1981: 208). For over half of the farm households in the two districts, the nearest water source in the dry season is at least two kilometres from the house, compared with a distance of one-quarter of a kilometre in Kenya as a whole. The situation is better in the wet season, although more than 10% of the households are still at least two kilometres from the nearest water source (CBS,1983: 72-73).

Fetching water is a major daily task but there are also other activities with which, during peak labour periods, the whole family - but the women in particular - have a busy time:

> Women wake up slightly later than men. They sweep the houses and courtyards, milk cows and prepare breakfast for the children before joining their husbands on the farm. During peak-labour seasons, boys and girls also wake up almost at the same time as their parents and all go to do various jobs on the farm. During such seasons, lunch is prepared and eaten on the farm. It is only after five in the evening that the family returns home after a day's work. On returning to the village, women and girls continue with household activities like splitting of firewood, pounding and winnowing of grain (rice, maize or sorghum), grinding, fetching water and cooking dinner. Men and boys do such activities as tapping palm wine, felling coconut fruits, and checking on cattle, sheep and goats to ensure that they have been properly grazed and none is missing from the fold. (Were et al, 1986: 30)

Food consumption, nutritional status and health

The degree of food self-sufficiency is low compared with the rest of Kenya. Geist (1981: 161-162), using data from the first Integrated Rural Survey (1974-75), calculated the average values of own production and consumption of rural households. She found that the rate of food self-sufficiency in Coast Province was only 25.6 per cent, compared with 42.5

to 52.6 per cent in provinces like Central, Nyanza and Western. She also found a clear difference in the rate of food self-sufficiency in the coastal strip (17.3%) and the hinterland (34.6%). Carlsen (1980: 182) reported that households in Kikoneni had to purchase 83.7 per cent of the total consumptive food. Compared with three other samples in Taita, Kisumu and Kisii Districts, this was a high proportion. Finally, Waaijenberg (1984: 13; 1987) measured the rates of self-sufficiency in four inland villages in Kilifi District, with average annual rainfall ranging from 850 to 1130 mm. He found a clear relationship with annual rainfall: the rate of maize self-sufficiency ranging from about 50% in the wettest village to about 32% in the driest village.

Maize deficits vary with the time of the year. Data for 1982 and 1983 show that immediately after harvesting, 75 to 95% of the households in the same four villages were eating maize from their own stock. In January, this had dropped to about one-third and one-fifth respectively. During the three months before the next harvest, nobody in the 'driest' village had any maize left in stock (Waaijenberg,1984: 12; 1987: 225). Evidently, a large proportion of the food consumed in the two districts must somehow be purchased, particularly in the coastal strip. This dependency on food purchases means that people must have sufficient amounts of money at their disposal to feed themselves and their families. Since, however, cash crop production as well as opportunities for off-farm employment are rather limited (see below) it is not surprising that hunger is a recurrent phenomenon in the districts, occasionally resulting in famines in the distant and more recent past.

The health and nutrition situation generally reflects these perilous circumstances. The most widespread disease in Kwale and Kilifi Districts is malaria. Together with protein calorie malnutrition (PCM, i.e. marasmus and kwashiorkor), anaemia, diarrhoea and vomiting, this is the main cause of death (MOENR,1984a: 164; Were et al,1986: 50,108). Figures presented by Masai (1983: 7) and Blankhart (1982: 411) indicate that child morbidity and mortality rates are high compared with other provinces. The number of hospital admissions of children with severe forms of PCM in Coast Province in 1966-1968 was twice as high as in Eastern and Rift Valley Province and 2.5 times as high as in Nyanza and Western Provinces. The rate of deaths in Coast Province due to PCM was 2-5 times higher than in the other provinces.

The two districts have the highest percentage of stunted children (height-for-age ratio of 90% or less) of Kenya. Kilifi District - including Tana River and Lamu - ranks first with 42.1%, Kwale second with 38.5%. Concerning the percentages of wasted children

(weight-for-height ratio of 80% or less), Kilifi ranks third (5.1%) and Kwale fifth (4.9%), the national figure being 3.0% (CBS,1983: 70-71).

The seasonal character of certain diseases and mortality among children is occasionally aggravated. During the dry season(s) there is a lack of pure drinking water and sanitation, which, combined with general malnutrition, causes periodic occurrences of gastroenteritis and "considerable mortality and morbidity among children" (MOENR,1984b: 123). Were et al (1986: 50) also state that most deaths occur from October to April and in June and July.

Some interesting figures are presented by Blankhart (1982: 415) who compared young children from four groups in Kwale District. Among relatively prosperous farmers near the coast, malnutrition appeared to be very limited. On the other hand, among households in the dry hinterland, the number of children that were stunted was found to be 66%, while all children had an upperarm circumference of less than 90% of the circumference-for-age standard. However, other researchers indicate that malnutrition and related diseases, as well as morbidity and mortality are less severe in the drier and more thinly populated hinterland than in the wetter and relatively densely populated areas nearer to the coast. This may partly be due to climatic conditions (less water means fewer mosquitos, for instance), population density (fewer people makes diseases less communicable) and food habits (more hunting and gathering in the hinterland) (Waaijenberg,1985: 20).

Some authors emphasize, however, that malnutrition is not only related to poverty, but also to ignorance regarding the nutritional needs of children and traditional food practices (Blankhart,1982: 409). For instance, Digo children are not fed on green vegetables and meat because otherwise they will end up stealing these items. "This denial of high quality (...) food to children causes a very high infant mortality rate in Kwale District". Also pregnant Digo and Duruma women are subject to food restrictions which deny them protein (Were et al,1986: 50). And finally, it has been noted "that even within families with high income, malnutrition is still prevalent because of ignorance in preparing diets for the family" (MOENR,1984a: 166).

3.6. Preventing seasonal stress

Traditionally, the Mijikenda were able to cope with seasonal food shortages and/or famines by the collection of wild plants, by hunting, by collecting and selling forest products, by trade, and by the social ties between themselves and with neighbouring tribes. In particular,

trade was an important element in the Mijikenda economy, and it took three forms: firstly, the usual exchange of surplusses - like grains, palm wine, clay pits, salt, and livestock - for necessary goods produced by others; secondly, the sale of forest products, with or without processing; and thirdly, acting as middlemen in the long-distance trade between the interior and the coastal towns. During the nineteenth century, many Digo, Duruma, Rabai and Giriama traders participated in the ivory trade and became quite wealthy. Gradually, however, the Mijikenda lost their profitable middlemen position, first to Kamba, later to Arab and Swahili, and finally to English and Indian traders. The completion of the Uganda railway (1901) ended the caravan trade completely (Waaijenberg, 1985: 10-17).

But the other trade forms went on, at least for some time. In good years, the Mijikenda were able to produce important maize surplusses with which the coastal towns were fed (Geist, 1981: 267-268). In bad years, which occurred on average once a decade, forest products were exchanged for grains which the Swahili traders imported from other places along the East African coast.

Over the past century, however, both agriculture and trade seriously declined. Hunting and the ivory trade were forbidden by the colonial government. The collection of forest products like copal, orchilla and wild rubber was regulated and later became unprofitable because of falling prices. Grain exports declined as well, partly due to material causes (droughts, floods, locusts) between 1925 and 1937, partly due to falling prices in this period, but also because of trade regulations by the government (quality control, cheap railway and shipping rates for maize from the white settler areas). In fact, only two rewarding items were left open to the Mijikenda, i.e. copra and palm wine, although this trade was also troubled by government regulations. It explains why, since the 1920s, the distribution of coconut palms in the two districts has expanded enormously and why many people migrated from the drier areas in the hinterland (where coconut palms do not thrive) to the coconut zones. Finally, heavy hut taxes (especially from 1921 onwards), to be paid shortly after the harvest, forced many Mijikenda to sell maize when prices were low and to buy maize for food later on when prices were high (Waaijenberg, 1985: 17-20).

The results of these and other (see below) developments have been that the two districts are by far unable to feed themselves, despite the expansion of cassava production since the 1940s and the growing importance of rice, which can be grown on wet land unsuitable for maize. Nowadays, 50,000 tons of maize have to be imported yearly into Kilifi District alone from other parts of the country (MOENR, 1984a: 56; 1984b: 40). This equals about half of the total requirements or 100 kg per head of the population (Waaijenberg, 1985: 20).

It will be clear, then, that in order to feed themselves, many people have to rely on the purchase of food. Nevertheless, there are other mechanisms as well to cope with (seasonal) food shortages. The role and importance of the individual coping mechanisms are discussed in the following sections.

Agriculture

A first mechanism to prevent agricultural risk concerns the local practice of cultivating different plots of land in different areas, often in different agro-ecological zones. This reduces the risk from unreliable rainfall and also offers the opportunity to spread labour more evenly throughout the year (Geist,1981: 99-100; Waaijenberg,1987: 213).

The cultivation of drought-resistent crops is another way of diminishing risks. The best known example in the two districts concerns cassava. Although maize is the most popular food crop, cassava is also grown widely. It serves to overcome periodic food shortages, either during the annual season of food shortage or during relatively dry years. Among the Digo, however, cassava is the main element in their staple diet. Some tree crops like coconuts and cashewnuts may also serve as a 'hungry season' crop; particularly coconuts because these can be harvested all year round. During the last decades, the function of the tree crops has shifted from secondary food crop towards cash crop, but in a way this has the same purpose, i.e. to overcome seasonal food shortages (Geist,1981: 148; MFP,1984b: 21).

Another possible adaptation lies in modern cultivation methods. Improved varieties of maize like Coast Composite and Pioneer Hybrid have been introduced long ago. Although it is clear that higher inputs (like tractor or ox-ploughing, fertilisers, seeds of improved varieties, plant protection methods, etc) lead to much higher yields (but also to higher risks), very few smallholders have adopted them. Probably, that is why in Coast Province smallholders "perform strikingly poorly, illuminating the low productivity in food production". Furthermore, there is little difference between the various ecological zones: the major input remains labour (Jaetzold & Schmidt,1983: 321-324,363-366; Geist,1981: 170,172).

A final adaptation consists of mixed farming, i.e. rearing livestock in addition to crop cultivation. Especially in the drier zones, livestock constitutes a major asset to overcome periods of food shortages. Among the Digo, livestock is rare, while Duruma farming can

best be characterised as "smallholder rain-fed mixed farming". Findings for Central Kilifi confirm this picture: the proportion of farms having cattle ranged from less than 10% in the CL3-4 zones to 64% in the Bamba area (CL5) (MOENR,1984b: 43; Waaijenberg,1987: 212; Were et al,1986: 67) .

Redistribution of resources

There is little knowledge about the existing exchange relationships - such as patron-client relations, gift-giving and cattle-borrowing - in the two districts. In relatively densely populated, long-settled areas such as the Kaloleni area in Kilifi District, a system of land-lending existed. The "lender" was permitted to use the land in return for some symbolic payment. However, "with increasing monetization and market penetration, this mode of diversification has come under increasing strain; the economic value of such exchanges is increasingly emphasized, their social function discounted" (Geist,1981: 108).

Cattle-borrowing seems to be a common practice in Kilifi District and this form of spreading risks through social interrelatedness is not without significance. Some Digo farmers own cattle but do not keep the cows themselves. The Duruma take care of them and use the milk. When the owner needs one or more cows (for school fees or a marriage, for instance), they are returned (Geist,1981: 108; Were et al,1986: 76).

A third redistributive asset concerns tree crops. Trees are mortgageable, i.e. the rights to the produce from trees can be loaned by the owners in exchange for some symbolic rental. This practice was not only widespread in the Arab coconut plantations in the coastal strip after slave labour was abolished, but also among the farmers in the African hinterland. In the southern part of Kilifi District, coconut and doum palms have traditionally been mortgaged by the Giriama as part of the indigenous mechanisms for spreading risks (Geist,1981: 111-112).

Certain social organisations which function on a more or less seasonal basis can be considered as coping mechanisms in the social sphere. Organisations like women's groups and youth clubs are not only involved in agrarian activities, but also in such topics as home economics (nutrition, for instance). According to the Annual Report of the Ministry of Agriculture in Kilifi District, there were some 165 women's groups and 170 youth clubs functioning in agriculture and/or livestock in 1985. The Ministry of Agriculture uses these groups also as contact groups, i.e. training focused on crop production and home

economics is passed to such groups (MOA,1986: 67-94). In Kwale District, some 300 self-help farmers' groups exist, of which 210 are active. The groups have an average of 30 members (men and women). Although they can be engaged in all sorts of economic activities, virtually all practise agriculture and livestock development (Were et al,1986: 28).

Income earning

The time when African farmers could remain subsistence farmers if they chose is since long left behind. Ready cash is needed for school fees, clothes, housing as well as certain food items such as tea, sugar and fat, not to mention various luxury items. In the case of Coast Province, as we have seen, substantial amounts of money are furthermore required for food purchases, because of the structural deficits in food production. Producing cash crops and selling livestock is one way of earning an income. Usually, however, this kind of farm-income is not enough to cover the various expenses, because:

> - Hectarages (...), yields (...) and prices (...) of simsim are (too) low.
> - Farmers with large numbers of fruit trees or bananas are a small minority. The production is very sensitive to the weather, often limited to a short period of the year, and varies strongly from year to year. In productive years prices tend to be low.
> - Cashewnut yields are low (...), confined to a short period of the year, and very variable. Poor yields in past years and a price drop in January 1983 caused many farmers to cut their trees to make place for maize. The district government prohibited this practice and so tries to preserve a stock of already too old and low productive cashew trees.
> - Only few farmers have livestock in siginificant numbers and livestock productivity is low. (Waayenberg,1987: 225-226)

In fact, there is only one cash crop which always yields something: coconuts. Still, the annual income per palm (fresh nuts, copra and makuti) is no more than KSh. 30/=. An exception forms the tapping of toddy and selling of palm wine, but this trade is illegal. So, in general "one needs more than the average number of palms to cover (...) household cash needs" (Waayenberg,1987: 226).

Beside producing and selling palm wine, there are other ways of exploiting natural resources, either farm-related or not. Examples are homecrafts, honey production, charcoal-burning, etc. Traditionally, the Kwale population was involved in pot-making, iron-smelting, salt-collecting and making of handicrafts. Honey-production is growing in importance in Kwale, witness the growth in so-called Kenya Top Bar Hives (MFP,1984b: 25). Charcoal-burning is a lucrative activity because of the high demand in towns like Mombasa, Kwale, and Kinango, etc. for cooking purposes. In Kwale District, the charcoal is mainly derived from communal lands or group ranches where nobody

lives. In comparison with other provinces, these income sources are quite important in the district(s) (Geist,1981: 189; MOENR,1984b: 107; Were et al,1986: 24).

Where agricultural opportunities are limited, off-farm employment is essential for making a living. However, off-farm employment opportunities in the region are limited as well, especially in the dry hinterland where only 6.4% of household incomes is derived from regular employment, against 15.9% in the coastal strip (Geist,1981:185). Most employment is to be found in Mombasa. For Kwale, Kilifi and Mombasa Districts together, more than three-quarters of the total wage employment is found in Mombasa, 14% in Kilifi and 9% in Kwale (CBS,1987: 229). Less than 20% of the potential labour force in Kwale and Kilifi Districts is engaged in wage employment (MOENR,1984a: 181; 1984b: 141).

As mentioned earlier, many wage labourers in Kwale and Kilifi Districts have left their homesteads and are working in Mombasa or somewhere else in the coastal strip (i.e., in the hotel areas or in towns like Kilifi and Malindi). Only people from areas with good communications to one of these places can afford to stay on the farm. According to Waaijenberg (1987: 214-215), it has become increasingly difficult to find off-farm employment in the past years. This should have stimulated many male school leavers to take more interest in agriculture, for instance by growing vegetables for the town markets. Women often engage in *vipande,* i.e. piecework for other farmers, especially land preparation and weeding.

Table 3.8 summarizes the household income situation in Coast Province in 1974-75. Only one-quarter of the total income was derived from the farm, in the wetter as well as the drier parts (although the value of the farm operating surplus in the wetter areas was substantially higher because total household incomes were much higher there). The wage share, either from regular or casual employment was limited, especially in the drier regions. In the latter areas, remittances from relatives formed an indispensable element in obtaining cash.

Figures for 1981/82 reveal a declining importance of farming (33% in both Kwale and Kilifi Districts) and a growing importance of wage labour: salaries and wages contributed 45% and 43% of the average household income in Kwale and Kilifi, respectively (CBS, 1988: 34).

Table 3.8
COAST PROVINCE: HOUSEHOLD INCOME, BY SOURCE OF INCOME AND REGION (1974-75)

	Coast	dry regions	wet regions
- Total household income (in KSh)	3,325/=	2,857/=	4,077/=
- Sources (in %):			
1. farm operating surplus	24.9	24.5	25.5
2. non-farm operating surplus	18.8	20.6	21.6
3. regular employment	13.5	6.4	15.9
4. casual employment	14.3	16.4	14.9
5. remittances from relatives	24.9	28.7	18.7
6. other gifts	3.5	3.3	3.5
- total % wage share (3+4)	27.8	22.8	30.8
- wages + remittances (3+4+5)	52.7	51.5	49.5

Source: Geist, 1981: 185.

3.7. Meeting acute seasonal stress

When rains fail, serious food problems are likely to occur. People adapt to this situation by such measures as the consumption of alternative ('famine') foods, the rationing of daily meals, the exploiting of redistributive relationships, the selling of personal possessions and labour, etc. If everything fails, migration of the whole household may become inevitable. Beside this, external interventions like food relief from the government and/or missionary organisations is likely to ease the stress.

Hardly any literature exists on this topic regarding the Coast. There is one exception, however, namely an historical study of how people responded to famine situations which occurred from about 1880 up to 1960 (Herlehy,1983). The study was carried out in the Mazeras-Kaloleni-Mariakani triangle, thus including representatives of different Mijikenda groups (Rabai, Ribe, Kambe, Giriama and Duruma) and of different farming systems (coconut palm cultivators, cattle herdsmen, grain farmers, and several mixtures of these occupations). What follows is a short description of the various famines in the 1880-1960 period, based on this particular study. For clarity's sake, a famine is defined as "a specific period of time when there is such a scarcity of food, widespread and/or extreme in character, that a significant proportion of the population of the afflicted area face the threat of starvation". Each famine (*nzala* in Kiswahili) has a specific name, derived from a main characteristic of that particular famine.

1. *Nzala ya Mwakisenge* (1883-1885). The year 1883 was very dry, causing a crop failure. Food shortage endured until 1885. Cattle owners could sell or slaughter livestock, but cereal farmers were less fortunate. Many of them migrated to the coastal strip (which was less severely affected by the drought) to work for Arab or Swahili estate owners and European missionaries. Other people pawned their wives, children and even themselves in exchange for food from coastal plantation owners. Nevertheless, many people belonging to this group of cereal growers perished.
Meanwhile, the Rabai palm wine producers did very well during this famine. Coconut palms can survive a dry year without loosing much of their productivity (coconuts and palm wine). So, the Rabai palm owners could eat their own coconuts and obtain food by selling palm wine, not only to surrounding Mijikenda but also further upland (the Kamba, for instance).

2. *Nzala ya Mkufu* (1889-1890). Although less severe than the preceding famine, it was still quite a harsh time, inducing many people to sell their jewelry (*mkufu* in KiSwahili). Capturing and selling neighbours as slaves, or pawning dependents in exchange for food at the coast were some other coping mechanisms.

3. *Nzala ya Bom-Bom* (1894-1895). A drought in 1894 was followed by an invasion of locusts in the next year, destroying many crops. The famine was not so severe as the previous ones, and most people could survive by trading activities or labour migration. In that same year 1895, a war was going on in the area, which gave the famine its name.

4. *Nzala ya Magunia* (1898-1900). For two years (1898-99), there was virtually no rain. And to make things worse, this famine was accompanied by epidemics of smallpox and dysentery as well as a plague of jiggers. As a result, many people died. A lot of grain, primarily rice, was imported from India to Mombasa, transported in gunny-cloth sacks (*magunia* in KiSwahili). For the first time, external interventions took place, in that the colonial government and missionary organisations offered food in exchange for labour on specific projects. Most Mijikenda, however, tried to survive by migrating eastward, either to the palm belt or to the plantations in the coastal strip to work for the Arab and Swahili owners (slave labour had been abolished by the British, so many hungry Mijikenda could easily obtain access to food and land in return for labour in the estates). Some other people survived by helping Asian merchants transport the imported grain to their shops. Coconut palm owners again had good business. Many of them actually increased their sales by hiring destitute tappers. It not only induced many people to settle temporarily in the palm belt, but also to try their luck with palm seedlings after returning home.

5. *Nzala ya Madzungu* (1910-1912). This was a minor famine, due to below-average and erratic rainfall in three successive years. Many people went foraging for additional food, one of these being the gourd (*madzungu*). As before, some Giriama and Duruma families migrated to the palm belt in order to work for food.

6. *Nzala ya Faini* (1916-1919). A drought started late 1915 and endured until 1920. Furthermore, the few crops cultivated in 1917 were attacked by locusts, while during 1918 and 1919 an epidemic of influenza weakened and killed many Mijikenda people. Especially the Giriama were severely hit, because after their rising against the colonial government in 1914-15 the British punished them by forced evacuation from their rich farm lands, confiscation of their livestock, and a large fine (*faini*). Thus, the Giriama had no assets left to sell. Many of them tried to survive by hunting, eating edible roots and working for friends or relatives.
Even in the palm belt, the situation was worse than during previous famines, because the continuous drought caused many coconut palms as well as many other fruit trees to suffer. As a result, it was very difficult to feed the many immigrants concentrated in areas like Rabai (Rabai was a local administrative centre at that time). Still, by trading palm wine for some maize and by purchasing some of the confiscated livestock, most Rabai families managed to survive.
The colonial government imported large quantities of maize and millet, but rations could only be obtained in return for cash or labour on a government project. The latter was something any Mijikenda would try to avoid as long as possible, so only few people pursued this surviving possibility.

7. *Nzala ya Dzua Bomu* (1921). After one wet year (1920), the driest year ever recorded followed. The resulting famine was therefore called "famine of the fierce sun" (*dzua bomu*, Mijikenda vernacular). Grain and vegetable crops dried up and even coconut trees died. Cattle herders were forced to slaughter their animals and sell the beef and hides. This time, the government did not wait for the hungry people to come but forcibly recruited Mijikenda labourers to work on water conserving projects.

8. *Nzala ya Nzije* (1934-1935). The year 1934 was wet, but there was no rain for three months and after that rains were so excessive that many crops were destroyed. Farmers tried second and even third plantings but again crops were destroyed, this time because of a very widespread plague of locusts (*nzije*, Mijikenda vernacular). Diseases like smallpox, trypanosomiasis and malaria did the rest. Again, the main answer of hungry Mijikenda

consisted of migrating to less affected areas, despite the extensive famine relief measures embarked by the British.

9. *Nzala ya Ngano* (1943-1945). A drought in 1942, locusts in 1943, and erratic rainfall in the two following years were the main causes of this famine. Due to few possibilities of local relief, many Mijikenda had to rely this time on imported wheat (*ngano*, Mijikenda and KiSwahili) provided in large amounts by the colonial government. The British distributed wheat flour to the Chiefs in all Locations, making the Chiefs responsible for rationing out portions to local families. In return, however, the British extracted much "forced" labour, reason for many Mijikenda to rely upon traditional coping mechanisms (labour on plantations, tapping palm trees).

10. *Nzala ya Kabushutsii* (1948-1954). Failure of the late rains in 1947, followed by inadequate rains in 1948 caused a food crisis. This situation persisted up to 1954 because of several more relatively dry years (1949, 1950, 1952) and an extremely dry year (1954). This period is remembered as one of the most stressful, in which for instance all redistributive mechanisms failed. There was so little food that people were not able to share any with others. In Rabai this famine was called *kabushutsii,* which means to avert one's eye from another person by gazing down at the ground. Many families survived as they had survived previous famines: eating their own coconuts, selling palm wine, migrating to the coast, selling livestock, eating wild plants, etc. But for those with nothing to eat and nothing to sell except their own labour, government relief was this time most welcome. A total of 11.5 million kg of cereals was distributed in Kilifi District alone. This famine was so severe that even women and children came out to work on government projects.

After 1960, several more periods of serious food shortages occurred: 1964-65, 1969-70, 1973-76, 1979-80, and 1982-84. In most cases, inadequate long rains and/or completely failing short rains were the main causes. In other years, rainfall was very sporadic and/or unevenly distributed, making the farmer's timing of planting very problematic and forcing him to do several replantings of maize. Sometimes excessive rains, causing waterlogging of the soil, destroyed many crops. Generally speaking, the drier hinterland is harder hit by droughts and famines than the coastal strip. In some years, hardly any pasture and water was to be found, forcing many livestock owners to sell their cattle, if the animals survived at all. Several times, the situation became even worse because of the infiltration of Taita and Maasai herdsmen in search for pasture and water (own data).

In summary, the main survival mechanisms during the colonial era were related with coconut trees and with access to land and work in areas less affected by drought. For instance, since the beginning of the twentieth century, the area under palm trees has rapidly been expanded. Government assistance, not only in the form of food imports but also by providing basic health services (e.g., smallpox innoculations, latrines) has also grown in importance. Especially during the post-independence periods of famine, food relief by the government has become a major coping mechnism.

4. 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.

The findings regarding Kwale and Kilifi Districts do not confirm this hypothesis, however. The highest seasonality indices were found in the coastal strip, i.e. in areas with relatively high rainfall figures. More inland, Kwale town and Chonyi appeared to have the same seasonality index as the much drier locations of Kinango and Samburu further inland. Data regarding interannual variability show no correlation with mean annual rainfall either. Thus, climatic seasonality and unreliable rainfall are more or less equally felt in the different agro-ecological zones in the two districts. Still, in the drier areas, agricultural production is more risky because only a very limited range of crops can be grown there.

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.

Also in Coast Province, there is a clear distinction between wetter and drier areas as regards agronomic measures to cope with climatic seasonality. Notably, this concerns the coconut

palms in the wetter areas and livestock in the drier areas. In periods of food shortages, the owners of coconut palms were relatively well-off, not only because they had a 'famine food' readily available, but also because the copra and particularly the palm wine was sold in order to buy food. In the drier areas, livestock offers the main coping mechanism in the agronomic sphere and people without livestock are in a very vulnerable position.

In general, however, Mijikenda agriculture is by far unable to produce enough food for the population. Waaijenberg summarizes the present causes of this failure as follows.

> - Population growth and scarcity of land. High population densities lead to intensive use and exhaustion of land. In many locations of Kilifi and Kwale Districts, population densities are above 200 persons per km2.
> - Tree crops like coconut palms, cashew and fruit trees claim much land and labour which otherwise might be used for food growing.
> - The large demand for cash income (maize flour, schooling, clothes, taxes, etc.) forced many people, often the best, into off-farm work. Most of the food is grown by women, who have limited access to land and cash inputs. Women do the farming, but men control most resources.
> - Laziness and non-acceptance of "improved farming methods", involving fertilizers, modern cultivars, line planting, ploughing, etc. are often quoted as causes of low production. Indeed, these methods often - but not always - increase yields per ha, but mostly they require high cash and labour inputs, involve large risks, and still give low gross margins. (Waaijenberg, 1985: 20-21)

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).[15] 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.

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[15]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.

From Chapter 3 it will be clear that such 'traditional' rural societies do not exist anymore in Kenya's coastal lowlands. For an important part of their existence, people nowadays have to rely on cash income. Agricultural production lags far behind the needs. In other words, cash is needed to overcome seasonal stress.

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).

Regarding Kwale District, Blankhart (1982) found that malnutrition of young children is widespread among poor farmers in the relatively dry hinterland, and almost non-existing among the wealthier farmers in the relatively wet coastal area. Implicitly, she points to two important relationships. In the first place, poor farmers are significantly more numerous in drier areas. Secondly, poor farmers are less able to cope with the adverse effects of climatic seasonality and rainfall unreliability. Hence, malnutrition is fairly common among their children. In the following reports, more light will be shed on these relationships.

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 '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 (Niemeyer et al,1985). In case of famine, morbidity and mortality are first to increase among young children.

To what extent the effects of seasonality in Coast Province are age and gender-specific is not clear from the existing literature. Where many men are labour migrants (resulting in the skewed sex ratios in the areas where the research took place), their wives may be more vulnerable regarding seasonality than the men themselves. In the case of both husband and wife (or wives) living on the compound, we do not know if - as Schofield showed for some villages in other parts of Africa - men are better nourished than women, and women better than (young) children. Our own research may give an answer to this question.

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 are 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 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).

Appendix
Kwale and Kilifi Districts: some basic data

	KWALE		KILIFI		SOURCE
1) **Geography**					
- area (km^2)	8,257		12,414		CBS 1981
- % land per agro-ecological zone:					
- lowland sugarcane zone (CL 2)	3%		-		Jaetzold &
- coconut-cassava zone (CL3)	13%		7%		Schmidt 1983
- cashewnut-cassava zone (CL4)	12%		29%		
- livestock-millet zone (CL5)	32%		37%		
- ranging zone (CL6)	40%		27%		
- average hectarage per farming household	14.8		10.4		Jaetzold &
- minimum	1.6	(Tiwi Loc)	1.7	(Rabai Loc.)	Schmidt 1983
- maximum	58.7	(Mwereni Loc.)	140.9	(Adu Loc.).	
2) **Demography**					
- number of households (1979)	52,261		76,741		CBS 1981
- % female-headed households (1981/82)	18.8%		20.3%		CBS 1988
- population: 1979	288,363		430,986		CBS 1981
1988 (projection)	423,057		632,018		MFP 1984a,b
- population growth 1969-1979	40%		40%		CBS 1970,1981
- population density: - average	34		17		CBS 1981
(1979) - minimum	8	(Mwereni Loc.)	1	(Chakama Loc.)	
- maximum	315	(Tiwi Loc.)	290	(Rabai Loc.)	
- % of population < 15 years (1979)	46%		46%		CBS 1981
- rural population as % of total population (1979)	ca 90%		ca 90%		CBS 1981
- ethnic background of population (1979)					
- Mijikenda	82.1%		90.7%		CBS 1981
- Kamba	9.9%		1.8%		
- Luo	1.8%		0.8%		
- Arabs	0.0%		1.1%		
- Europeans	0.6%		0.4%		
- other	5.6%		5.2%		
3) **Wage employment**					
- nr. of employed persons (1985)	12,104		18,828		CBS 1986
- employed persons as % of population of 15 years and older (1979)	6.1%		6.1%		CBS 1981,1982
- employed persons: growth 1969-1979	46.5%		97.5%		CBS 1971,1982
growth 1979-1985	26.8%		32.9%		CBS 1986
4) **Crop production**	**1984**	**1985**	**1984**	**1985**	
- maize: - hectarage	28,198	20,600	37,241	36,500	MOA 1985,
- yield (tons/ha): local	]0.9	]1.8	1.2	1.0	1986,1987
improved			1.8	1.6	
- cassava: - hectarage	20,317	15,000	6,512	8,753	
- yield (tons/ha)	15	10	10	15	
- coconuts: - hectarage	15,410	15,800	16,641	16,941	
- yield (tons/ha)	6.0	6.0	0.5	0.7	
- cashewnuts: - hectarage	18,536	18,232	16,539	16,539	
- yield (tons/ha)	0.7	0.7	0.4	0.4	

	KWALE	KILIFI	SOURCE
5) **Education**			
- nr. of primary schools (1983)	197	256	MFP 1984a,b
- nr. of secondary schools (1983)	14	18	MFP 1984a,b
- nr. of teachers in primary schools (1983)	1,753	2,231	MFP 1984a,b
- primary school enrolment (1983)	60,008	91,308	CBS 1986
- primary school enrolment as % of population of 5-11 years (1979)	74%	75%	CBS 1981,1982
- nr. of pupils per teacher in primary schools (1983)	34	41	
6) **Health** (1983)			MFP 1984a,b
- nr. of hospitals	3	3	
- nr. of health centres	7	6	
- nr. of dispensaries	12	40	
- population per health facility	15,788	10,593	
7) **Nutrition***			
- % stunted children	38.5%	42.1%	CBS 1983
- % wasted children	4.9%	5.1%	
8) **Household income/expenditure*** (1981/82)			CBS 1988
- average net monthly income	Ksh 938/-	Ksh. 764/-	
- monthly income per source (%):			
- farm enterprise	33%	33%	
- non-farm enterprise	16%	15%	
- salary and wages	45%	43%	
- other sources	6%	9%	
- average monthly consumption expenditure	Ksh. 627/-	Ksh. 245/-(?)	
- monthly consumption expenditure per item (%):			
- food and beverages	64%	69%	
- alcohol and tobacco	4%	5%	
- clothing and footwear	9%	8%	
- household goods	14%	11%	
- health	0.8%	0.4%	
- transport and communication	3%	3%	
- education	5%	4%	

* The Kilifi figures include Tana River and Lamu Districts

References

AMREF (1982), **Report on the regional workshop on seasonal variations in the provisioning, nutrition and health of rural families, March 31-April 2.** African Medical and Research Foundation, Nairobi.

Apeldoorn, G. J. van (1981), **Perspectives on drought and famine in Nigeria.** George Allen & Unwin, London.

Bantje, H. & R. Niemeyer (1984), "Rainfall and birthweight distribution in rural Tanzania". **Journal of Biosocial Science**, vol. 16, pp. 375-384.

Bayliss-Smith, T. (1981), "Seasonality and labor in the rural energy balance"; in Chambers, Longhurst & Pacey 1981, pp. 30-38.

Beinum, G.G. van, T. Kliest, W. van Schie & M. Snijdoodt (1985), **Rural housing conditions in Kwale District, Kenya.** Housing Research and Development Unit, University of Nairobi - Department of Geography, University of Utrecht.

Blankhart, D.M. (1982), "Human nutrition"; in L.C. Vogel, A.S. Muller, R.S. Odingo, Z. Onyango & A. de Geus, eds., **Health and disease in Kenya**, pp. 409-427. Kenya Literature Bureau, Nairobi.

Booker Agriculture International Ltd. (1982), **Kwale and Kilifi Integrated Development Project.** Nairobi/London.

Boxem, H.W., T. de Meester & E.M.A. Smaling (1987), eds., **Soils of the Kilifi area, Kenya.** PUDOC, Wageningen.

Bradley, D. (1981), "Seasonal variables in infective disease: a summary"; in Chambers, Longhurst & Pacey 1981, pp.127-131.

Braun, H.M.H. (1982), **Exploratory soil map and agro-climatic zones map of Kenya 1:1,000,0000.** Kenya Soil Survey, Nairobi.

Braun, H.M.H. (1985), **Average monthly rainfall as a percentage of the annual rainfall in Kenya and Tanzania, with particular reference to the Kenyan Coast.** Ministry of Agriculture, Kenya Soil Survey, Nairobi.

Campbell, D.J. & D.D. Trechter (1982), "Strategies for coping with food consumption shortage in the Mandera Mountain Region of North Cameroon". **Social Science & Medicine**, vol. 16, pp. 2117-2127.

Carlsen, J. (1980), **Economic and social transformation in rural Kenya.** Uppsala: Scandinavian Institute of African Studies, Centre for Development Research, Publication no. 4.

CBS (1970), **Kenya Population Census 1969, vol. 1.** Central Bureau of Statistics, Ministry of Finance and Economic Planning, Nairobi.

CBS (1971), **Statistical Abstract 1971.** Central Bureau of Statistics, Ministry of Finance and Planning, Nairobi.

CBS (1981), **Kenya Population Census 1979, vol. 1.** Central Bureau of Statistics, Ministry of Planning and Development, Nairobi.

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

CBS (1986), **Statistical Abstract 1986.** Central Bureau of Statistics, Ministry of Planning and National Development, Nairobi.

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

Chambers, R. (1981), "Introduction"; in Chambers, Longhurst & Pacey 1981, pp. 1-8.

Chambers, R. & R. Longhurst (1986), "Trees, seasons and the poor"; **IDS Bulletin**, vol. 17, nr. 3, pp. 44-50.

Chambers, R., R. Longhurst, D. Bradley & R. Feachem (1979), **Seasonal dimensions to rural poverty: analysis and practical implications.** Discussion Paper, Institute of Development Studies, University of Sussex, Brighton.

Chambers, R., R. Longhurst & A. Pacey (1981), eds., **Seasonal dimensions to rural poverty.** Frances Pinter (Publishers) Ltd., London.

Cleave, J.H. (1974), **African farmers: labor use in the development of smallholder agriculture.** Praeger Publishers, New York/London.

Cooper, F. (1981), **From Slaves to Squatters; Plantation Labor and Agriculture in Zanzibar and Coastal Kenya, 1890-1925.** New Haven/Nairobi.

Dietz, T. (1987), **Pastoralists in dire straits. Survival strategies and external interventions in a semi-arid region at the Kenya/Uganda border; Western Pokot, 1900-1986.** University of Amsterdam: Institute of Social Geography.

Dyson, T. & N. Crook (1981), "Causes of seasonal fluctuations in vital events"; in Chambers, Longhurst & Pacey 1981, pp. 135-141.

Eerenbeemt, M.L. van den (1985), "A demographic profile of the Fulani of Central Mali with special emphasis on infant and child mortality"; in Hill 1985, pp. 79-103.

Ensminger, J. (1985), "The commercialization of pastoralists: effects of seasonality, age, gender, and wealth upon time allocation". Discussion paper presented at the IFPRI/FAO/AID workshop on **Seasonal causes of household food insecurity; policy implications and research needs**, Annapolis, Maryland.

Epp, H. & A. Kilmayer (1982), **Determination of the cultivation boundary in Kenya.** Kenya Rangeland Ecological Monitoring Unit, Technical Report no. 90, Nairobi.

FAO (1958), **Food and agricultural developments in Africa.** Food and Agriculture Organization, Rome.

Floor, J. (1981), **Coconuts around Kaloleni, Kilifi District, Kenya.** TPIP, Preliminary Report no. 2, Kilifi.

FNSP (1985a), **Nutritional conditions at Settlement Schemes in Coast Province - Kwale and Kilifi Districts** (Research outline). Food & Nutrition Studies Programme, Report nr. 12. Ministry of Planning and National Development, Nairobi; African Studies Centre, Leiden.

FNSP (1985b), **Women's associations and their importance for rural development: a study at two Settlement Schemes in Coast Province** (Research outline). Food & Nutrition Studies Programme, Report nr. 15. Ministry of Planning and National Development, Nairobi; African Studies Centre, Leiden.

FNSP (1987), **Nutrition and dairy development in Coast Province** (Research outline). Food & Nutrition Studies Programme, Report nr. 19. Ministry of Planning and National Development, Nairobi; African Studies Centre, Leiden.

Fortes, M. & S.L. Fortes (1936), "Food in the domestic economy of the Tallensi"; **Africa**, vol. 9, nr. 2, pp. 237-276.

Fortmann, L. (1985), "Seasonal dimensions of rural social organisations"; **Journal of Development Studies** 21, pp. 377-389.

Fowler, A.F. (1982), "Seasonal aspects of education in Eastern Africa"; in AMREF 1982, pp. 58-73.

Geist, J.K. (1981), **Coastal agrarian underdevelopment and regional imbalance in Kenya.** Ph.D. dissertation, University of California, Berkeley.

Goetz, J.P. (1981), "A study of childhood disease in Tanzania"; in Chambers, Longhurst & Pacey 1982, pp. 182-186.

GOK (1986), **Sessional Paper No 1 of 1986 on Economic Management of Renewed Growth.** Government of Kenya, Nairobi.

Herlehy, Th. J. (1983), **An historical dimension of the food crisis in Africa: surveying famines along the Kenyan coast, ca. 1880-1980.** Boston, Mass.

Hill, A.G. (1985), ed., **Population, health and nutrition in the Sahel. Issues in the welfare of selected West African communities.** Routledge & Kegan Paul, London.

Hoorweg, J., R. Niemeyer & W. van Steenbergen (1983), **Nutrition Survey in Murang'a District. Part 1: Relations between ecology, economic and social conditions and nutritional state of pre-school children.** ASC Research Report no. 19, African Studies Centre, Leiden.

Jaetzold, R. & Schmidt, H. (1982, 1983), **Farm Management Handbook of Kenya, Vol. II, Natural Conditions and Farm Management Information; Part A: West Kenya; Part B: Central Kenya; Part C: East Kenya.** Ministry of Agriculture, Nairobi.

Jiggins, J. (1986), "Women and seasonality: coping with crisis and calamity"; **IDS Bulletin**, vol. 17, nr. 3, pp. 9-18.

Kliest, T. (1985), **Regional and seasonal food problems in Kenya.** Food and Nutrition Studies Programme, Report no. 10. Ministry of Finance and Planning, Nairobi; African Studies Centre, Leiden.

Kumar, S.K. (1985), "Household production and consumption strategies for meeting seasonal labour needs". Discussion paper presented at the IFPRI/FAO/AID workshop on **Seasonal causes of household food insecurity; policy implications and research needs**, Annapolis, Maryland.

Longhurst, R. (1986), "Household food strategies in response to seasonality and famine"; **IDS Bulletin**, vol. 17, nr. 3, pp. 27-35.

Longhurst, R., R. Chambers & J. Swift (1986), "Seasonality and poverty: implications for policy and research"; **IDS Bulletin**, vol. 17, nr. 3, pp. 67-70.

Longhurst, R. & Ph. Payne (1981), "Seasonal aspects of nutrition"; in Chambers, Longhurst & Pacey 1981, pp. 45-52.

Loutan, L. (1985), "Nutrition amongst a group of WoDaaBe (Bororo) pastoralists in Niger"; in Hill 1985, pp. 208-224.

Lynn, C.W. (1937), "Agriculture in North Mamprusi"; **Gold Coast Department of Agriculture Bulletin**, no. 34. Accra.

Masai, W. (1983), The nutritional status of Kenyans and major factors influencing it"; in L.M. Wasonga & J.O. Otieno, eds., **Proceedings of a workshop on nutrition in agricultural development projects**, pp. 3-59. Ministry of Economic Planning & Development, Nairobi.

Mbithi, P.M. & B. Wisner (1973), "Drought and famine in Kenya. Magnitude and attempted solutions"; **Journal of Eastern African Research & Development**, vol. 3, nr. 2, pp. 113-143.

McGregor, I.A., A.K. Rahman, B. Thompson, W.Z. Billewicz & A.M. Thomson (1968), "The growth of young children in a West African (Gambian) village"; **Transactions of the Royal Society of Tropical Medicine and Hygiene**, vol. 64, pp. 48-77.

Messer, E. (1985), "Seasonality in food systems: an anthropological perspective on household food security". Discussion paper presented at the IFPRI/FAO/AID Workshop on **Seasonal causes of household food insecurity; policy implications and research needs**, Annapolis, Maryland.

MFP (1984a), **Kilifi District Development Plan 1984/1988.** Ministry of Finance and Planning, Nairobi.

MFP (1984b), **Kwale District Development Plan 1984/1988.** Ministry of Finance and Planning, Nairobi.

Michieka, D.O., B.J.A. van der Pouw & J.J. Vleeshouwer (1978), **Soils of the Kwale-Mombasa-Lungalunga Area, vol. I & II & Soilmaps 1:100,000.** Kenya Soil Survey, Ministry of Agriculture, Nairobi.

MOA (1985), **Kilifi District Annual Report, 1984.** Ministry of Agriculture, Nairobi.

MOA (1986), **Kilifi District Annual Report, 1985.** Ministry of Agriculture, Nairobi.

MOA (1987), **Kwale District Annual Report, 1986.** Ministry of Agriculture, Nairobi.

MOENR (1984a), **Kilifi District Environmental Assessment Report.** National Environment and Human Settlements Secretariat, Ministry of Environment and National Resources, Nairobi.

MOENR (1984b), **Kwale District Environmental Assessment Report.** National Environment and Human Settlements Secretariat, Ministry of Environment and National Resources, Nairobi.

Ndagala, D.K. (1981), "Pastoralists and cultivators in Bagamoyo District"; in Chambers, Longhurst & Pacey 1981, pp. 186-191.

Niemeyer, R., M. Geuns, T. Kliest, V. Ogonda & J. Hoorweg (1985). **Nutritional aspects of rice cultivation in Nyanza Province, Kenya.** FNSP Report No. 14. Ministry of Planning & National Development, Nairobi; African Studies Centre, Leiden.

Ogbu, J.M. (1973), "Seasonal hunger in tropical Africa as a cultural phenomenon"; **Africa**, vol. 43, pp. 317-332.

Ogot, B.A. (1976), ed., **Kenya before 1900: eight regional studies.** Nairobi.

Onchere, S.R. & R. Slooff (1981), "Nutrition and disease in Machakos District, Kenya"; in Chambers, Longhurst & Pacey 1981, pp. 41-45.

Oosten, C. van (1988), **Farming, food security and off-farm activities. A study of farming systems in Kwale District, Kenya.** M.A. Thesis, University of Utrecht.

Palmer, I. (1981), "Seasonal dimensions of women's roles"; in Chambers, Longhurst & Pacey 1981, pp. 195-201.

Peters, C. & R. Niemeyer (1987), **Protein-energy malnutrition and the home environment: a study among children in Coast Province, Kenya.** Food & Nutrition Studies Programme, Report nr. 22. Ministry of Planning & National Development, Nairobi; African Studies Centre, Leiden.

Prins, A.H.J. (1952), **The coastal tribes of the North-eastern Bantu.** International African Institute, London.

Raikes, Ph. (1981), "Seasonality in the rural economy (of tropical Africa)"; in Chambers, Longhurst & Pacey 1981, pp. 67-73.

Reardon, Th. & P. Matlon (1985), "The seasonality of calorie intake in rural Burkina Faso". Paper presented at the IFPRI/FAO/AID workshop on **Seasonal causes of household food insecurity: policy implications and research needs**, Annapolis, Maryland.

Rempel, H. (1981), "Seasonal out-migration and rural poverty"; in Chambers, Longhurst & Pacey 1981, pp. 210-214.

Richards, A.I. (1939), **Land, labour and diet in Northern Rhodesia.** Oxford University Press, London.

Rowland, M.G.M., A. Paul, A.M. Prentice, E. Müller, M. Hutton, R.A.E. Barrell & R.G. Whitehead (1981), "Seasonality and the growth of infants in a Gambian village"; in Chambers, Longhurst & Pacey 1981, pp. 164-175.

Ruigu, G.M. (1987), **Large-scale irrigation development in Kenya: past performance and future prospects.** Food and Nutrition Studies Programme, Report no. 23. Ministry of Planning and National Development, Nairobi; African Studies Centre, Leiden.

Schofield, S. (1974), "Seasonal factors affecting nutrition in different age groups and especially pre-school children"; **Journal of Development Studies**, vol. 11, nr. 1, pp. 22-40.

Schreurs, W. (1982), **Farming systems in the Bamba-Ganze area, Kilifi District, Kenya.** Training Project in Pedology (TPIP), Kilifi, Kenya.

Senga, W., R. Faruqee & B. Ateng (1981), **Population Growth and Agricultural Development in Kenya.** Occasional Paper no. 40, Institute for Development Studies, Nairobi.

Simmons, E.B. (1981), "A case-study in food production, sale and distribution"; in Chambers, Longhurst & Pacey 1981, pp. 73-80.

Smaling, E.M.A. & H.W. Boxem (1987), "Climate and agro-climatic zonation"; in Boxem, De Meester & Smaling 1987, pp. 9-20.

Spear, T. T. (1978), **The Kaya complex: a history of the Mijikenda peoples of the Kenya coast to 1900.** Kenya Literature Bureau, Nairobi.

Swift, J. (1981), "Labour and subsistence in a pastoral economy"; in Chambers, Longhurst & Pacey 1981, pp. 80-87.

Tomkins, A. (1981), "Seasonal health problems in the Zaria region"; in Chambers, Longhurst & Pacey 1981, pp. 177-181.

Toulmin, C. (1986), "Access to food, dry season strategies and household size amongst the Bambara of Central Mali"; **IDS Bulletin**, vol. 17, nr. 3, pp. 58-66.

Veldhuis, M. (1981), **Gevolgen van arbeidsmigratie voor het herkomstgebied. Een analyse van de effekten op de agrarische produktie, het inkomen en de positie van de vrouw in de migrantenhuishoudens in Matheini, Machakos District, Kenya.** ("Consequences of labour migration for the area of origin. An analysis of the effects on agricultural production, income and position of women in the migrant's households in Matheini, Machakos District, Kenya"). Doctoral thesis, University of Amsterdam.

Waaijenberg, H. (1984), **A cross-section of Mijikenda agriculture in the Coastal Uplands of Kenya, part VII: aspects of maize production and consumption.** Preliminary paper, Training Project in Pedology (TPIP), Kaloleni, Kenya.

Waaijenberg, H. (1985), **An agro-economic history of the Mijikenda of Kenya, 1600-1985.** Incomplete draft, Training Project in Pedology (TPIP), Kaloleni, Kenya.

Waaijenberg, H. (1987), "Agriculture in the Kilifi Area (Mapsheet 198), Kenya."; in Boxem, De Meester & Smaling 1987, pp. 195-247.

Waaijenberg, H. & M. Salim (1983), **Land and farming systems in Kilifi District, Kenya.** Paper presented at a farming systems workshop, Magarini Settlement Scheme, Dec 7-9, Malindi.

Waddy, B.B. (1981), "Poverty, housing and disease"; in Chambers, Longhurst & Pacey 1981, pp. 175-177.

Walsh, R.P.D. (1981), "The nature of climatic seasonality"; in Chambers, Longhurst & Pacey 1981, pp. 11-21.

Watts, M. (1981), "The sociology of seasonal food shortage in Hausaland"; in Chambers, Longhurst & Pacey 1981, pp. 201-206.

Were, G.S., D. Nyamwaya & H., Ipu (1986), eds., **Kenya socio-cultural profiles: Kwale District.** Draft report, Ministry of Planning and National Development, Nairobi - Institute of African Studies, University of Nairobi.

White, C. (1986), "Food shortages and seasonality in WoDaaBe communities in Niger"; **IDS Bulletin**, vol. 17, nr. 3, pp. 19-26.

World Bank (1983), **Kenya, Growth and Structural Change.** Washington, D.C.

List of FNSP-Reports

1. FNSP (1983a), **Nutritional Aspects of Rice Cultivation in Nyanza Province** (Research Outline). (out of stock)
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7. FNSP (1984b), **Seasonal and Regional Food Problems in Kenya.** Progress Report, March 1984.
8. FNSP (1984c), **Agricultural Pricing Policy in Kenya.** Progress Report, May 1984.
9. FNSP (1984d), **Nutritional Aspects of Rice Irrigation in Nyanza Province.** Progress Report, May 1984. (out of stock)
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11. Meilink, H. (1985), **Agricultural Pricing Policy in Kenya: Scope and Impact.**
12. FNSP (1985a), **Nutritional Conditions at Settlement Schemes in Coast Province - Kwale and Kilifi Districts** (Research Outline).
13. FNSP (1985b), **Seasonality in Food Production and Nutrition in the Coastal Lowlands of Kenya - Kwale and Kilifi Districts** (Research Outline).
14. Niemeijer, R., M. Geuns, T. Kliest, V. Ogonda & J. Hoorweg (1985), **Nutritional Aspects of Rice Cultivation in Nyanza Province, Kenya.**
15. FNSP (1985c), **Women's Associations and their Importance for Rural Development: A Study at Two Settlement Schemes in Coast Province** (Research Outline). (out of stock)
16. FNSP (1985d), **Progress Report: October 1985.** (out of stock)
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18. FNSP (1986b), **Women's Associations and their Importance for Rural Development: a study at three settlement schemes in Coast Province - Kwale and Kilifi Districts.** Progress Report: March 1986. (out of stock)
19. FNSP (1987a), **Nutrition and Dairy Development in Coast Province** (Research Outline).
20. FNSP (1987b), **Progress Report: February, 1987.**
21. Meilink, H. (1987), **Food Consumption and Food Prices in Kenya: A Review.**
22. Peters, C. & R. Niemeijer (1987), **Protein-Energy Malnutrition and the Home Environment: a study among children in Coast Province, Kenya.**
23. Ruigu, G. M. (1987), **Large-Scale Irrigation Development in Kenya: Past Performance and Future Prospects.**
24. FNSP (1987c), **Progress Report: December 1987.**
25. FNSP (1988a), **Food Supply and Nutrition among Farm Labourers in Trans-Nzoia District** (Research Outline).
26. FNSP (1988b), **Workshop on Studies in Coast Province: Preliminary Results. June 28-29, 1988, Bandari College, Mombasa.**
27. Hoorweg, J., T. Kliest & R. Niemeijer (1988), **Seasonality in the Coastal Lowlands of Kenya, Part 1: Research Objectives and Study Design.**
28. Foeken, D. & J. Hoorweg (1988), **Seasonality in the Coastal Lowlands of Kenya, Part 2: Introduction to Seasonality.**
29. Noy, F. (1988), **Nutrition and Rice Cultivation at Ahero Rice Irrigation Scheme.** (in preparation)

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