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Mijikenda agriculture in Coast Province of Kenya



Ontvangen

14 JAN. 1994

UB-CARDEX

Henk Waaijenberg

Propositions

- * Agrarian history can contribute to the sustainability of agriculture. Dealing with sustainability without taking into account the historical dimension is like extrapolating from a single point. (Referring to "Het wordt allemaal wat harder: Rector Van der Plas over duurzaamheid, kwaliteit en samenwerking", Wageningen Universiteitsblad, 13 mei 1993: 5)
- * From fieldwork it appears that farmers perceive three kinds of problems. The first cannot be solved and so are conditions, not problems. The second can be solved easily and so are not problems either. The third kind are those in between; when questioned, farmers choose them subjectively, and their interpretation by scientists is liable to prejudice. Therefore, by focusing on farmers' problems the farming systems approach has set itself a difficult task.
- * The fact that a recent conference of Wageningen Agricultural University was called "the future of the land" instead of "the future of the farmer" illustrates a major change in the orientation of this university.
- * The proof of the pudding is in the eating. Therefore, researchers who claim that their work is relevant for the improvement of agriculture in the tropics should be given the obligation and the opportunity to test their ideas and put them into practice.
- * Agronomic field work without household studies in Africa makes as little sense as taking soil and crop samples in Europe and concluding that yields are high because of intrinsically fertile soils.
- * It is artificial to distinguish between sociology and agronomy, and harmful to separate them.
- * Politicians depend more on values and interests than on facts and scenarios for their decisions. (After R. Pirsig, 1991. Lila: an inquiry into morals. Bantam Books. New York, USA. p. 40)
- * Fear and greed, not ignorance, are the greatest obstacles for the sustainability of agriculture.
- * The happiness of the farmers is a condition but not a guarantee for sustainable agriculture.
- * Kazungu Majembe, the Kaloleni blacksmith, has contributed more to Mijikenda agriculture than the author of this thesis.

Henk Waaijenberg

*Mijikenda agriculture in Coast Province of Kenya:
peasants in between tradition, ecology and policy*

Wageningen, 21st January 1994

**Mijikenda agriculture in Coast Province of Kenya:
peasants in between tradition, ecology and policy**



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**Mijikenda agriculture in Coast Province of Kenya:
peasants in between tradition, ecology and policy**

Proefschrift

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Abstract

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Additional keywords: *kaya*, traditional agriculture, agrarian history, household, agronomy, maize, staple food, coconut, tree of life, cashew, cassava, rice, cowpea, livestock.

The Mijikenda live in the hinterland of the southern Kenya coast. They are peasants with small farms growing maize, rice, cassava and cowpea, coconut palms and cashew or fruit trees for the household and the market. A few households own cattle, most keep some goats or sheep and nearly all have a flock of chickens. As the farms are small and the yields of the crops and livestock low, most households have one or more members with off-farm work in the coastal towns. The Mijikenda are generally considered as traditionalists who are reluctant to adapt their society and agriculture to the ways of tomorrow.

Between 1981 and 1985 a series of field studies was conducted to describe and analyse Mijikenda agriculture, to identify bottlenecks limiting its performance and, if possible, to explore ways for its future development. The studies combined a farming systems approach with awareness of the constraints imposed by ecological conditions and the role of historical processes in shaping today's reality. The research methods included literature review, formal and informal interviews, qualitative and quantitative observations in farmers' fields, and several small researcher-managed experiments in farmers' fields. The work was concentrated in four villages in the area around Kaloleni, Kilifi District, Coast Province of Kenya.

After an introduction about the Mijikenda people and the research approaches, the results are presented in five papers. The first is a collection of short stories about one day in the life of a typical household on a typical farm just south of Kaloleni. The narratives introduce the principal actors and show the stages on which they perform the play called agriculture. It is argued that stories belong not only to fiction but can also be used as research and extension tools.

The second paper goes back into history and reveals remarkable patterns of change in the traditional society and agriculture of the Mijikenda people. Within a couple of centuries the actors, the stages and the play have been transformed almost beyond recognition. These changes are all the more striking against the background of apathy often attributed to Mijikenda farmers.

In the third paper the present agriculture in the Kaloleni area is described, both as a spatially differentiated land use determined by ecological conditions and as farms characterized by a pattern of settlement, the composition of the household and the organization of the fields. It is explored whether all farms studied are similar or whether distinct classes of farms or farming systems can be distinguished. The implications of the coincidental and deliberate differences are discussed in terms of prospects and strategies for the future.

The fourth paper presents a case study of maize production in the Kaloleni area, the major maize growing area of Kilifi District and Coast Province. In the 19th century maize replaced sorghum and millet as the staple food of the Mijikenda. Various aspects of maize production are examined, from the choice of planting material to the use of the harvest, and from ecological bottlenecks to food security. At present, productivity is low and research and extension efforts are poorly focused, but there are options for improvement.

The last paper deals with the coconut palm, the dominant element in many landscapes and the economic mainstay of numerous farmers. Although also attention is paid to ecological and agronomic aspects of the crop, the emphasis is on the conflicting uses of the palm, for the harvest of nuts, the production of copra or the tapping of palm wine. On the latter the Mijikenda and the Government have often held diametrically opposed viewpoints. For more than a century more energy has been spent on bickering about the abuse of palm wine than on improving the cultivation of the palm or marketing its other products.

The general discussion touches on the methodologies used and suggests improvements. It also ventures to translate the acquired understanding of past and present agriculture into pathways and scenarios for the future. There is ample evidence that the Mijikenda have never let their traditional attitude obstruct necessary or profitable changes. Soil and rainfall conditions limit the distribution and productivity of farm activities, but the Mijikenda have developed numerous agronomic practices that are well adapted to the various ecological niches of their area. There is a need for appropriate research, extension and marketing policies and practices, i.e. ones that take account of the requirements and opportunities of the Mijikenda.

Acknowledgements

This thesis and the research it is based on have a long history. The field work was carried out in the Coast Province of Kenya between 1981 and 1985. The analysis and reporting were delayed by my work for the Atlantic Zone Programme in Costa Rica from 1986 to 1992. To my regret the late Professor A. Franke could not see the results of the research in whose initiation he played a major role. I thank my promotor Michiel Flach for his stimulating patience and his articulate comments on the drafts of this thesis.

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The households visited most often for field surveys and formal interviews were those of Karisa Baya, Gonyo Chongah, Tsuma Gona, Mwanyamba Jasho, Justin Jilani, Gabriel Kahindi, Samuel Kaingu, Mwakitengo Katana, Mtsanga Kuchacha, Christopher Masai, Daniel Milala, Mzungu Mrima, Kitsao Musha, Gambo Mwachai, Dzombo Mwasambo, Lewa Mwatela, Kahindi Nyamawi, Harrison Rondo, Ngumbao Tsangwe and Katana Tsuma. During long talks Lawrence Bennett, Baraza Chome, Chea Gunga, Samuel Kazungu, Kiti Kombe, Reuben Kombe, Biryama Masha, Ramadan Matano, Andrea Otieno, Gambo Wakanyoe and Mai Mwaringa increased my knowledge of the history and practice of Mijikenda agriculture. I thank all farmers and their families and neighbours for their cooperation and hospitality.

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This thesis is dedicated
to my parents and to
Josefa and Tabu

1 General introduction

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1 UNIQUE AND UNIVERSAL

The hinterland of the southern Kenya coast is the stage on which a unique people have performed a remarkable play. In the 16th century the ancestors of the Mijikenda appeared out of the blue after an epic exodus from a mythical place called Shungwaya. On a range of hilltops the newcomers established complex societies and built nine sacred towns which they called *makaya*. They gathered fruits and greens from the forest, planted sorghum, millets and cowpea in small clearings, became experts in arrow poison, and ventured into the ivory trade. During the 19th century they left their *makaya* and spread over the countryside of what today are Kwale and Kilifi Districts of Coast Province. They adopted maize, rice and cassava as new staple foods, and planted ever larger numbers of coconut palms and later also cashew trees. In the early 20th century they had colonial rule forced onto them. As they were reluctant to accept all the changes that came with it, they were soon considered backward, a reputation they never lost. In the mid 20th century they chose for themselves the name *makaya chenda* or *miji kenda*, referring to the nine towns or villages their ancestors had lived in.

The author of this study entered the stage from 1981 to 1985. His task was to describe and analyse the present agriculture of the Mijikenda, to identify the bottlenecks that limit its performance, and if possible to explore ways for its future development. The results of field work and literature review are summarized in this thesis in the form of five studies of facets of Mijikenda agriculture. These are case studies that deal with a unique people, history and culture. However, there are similarities with agricultural societies all over tropical Africa. Areas with poor soils and unreliable rainfall, with small farms and needy households, that combine annual and perennial crops with some small livestock and off-farm work are very common. Conflicting views on agricultural development, and farmers that do not yield to every wind of change and therefore are labelled traditional or backward, are the rule rather than the exception.

2 PRINCIPAL APPROACHES

In each of the studies in this thesis three viewpoints and approaches were present, although there was variation in their proportions and in how they were elaborated into concrete methodologies. The methods of data collection and analysis have been specified per study and per paper.

The agriculture of the Mijikenda was primarily studied from a farming systems analysis (FSA) viewpoint. This means that instead of being focused on specific components, attention is focused on the farm as a whole and on the farmer as its coordinator. The concept of the system is central to this approach: it may refer to the farmer's practices (systematic) or to

the farm itself (agroecosystem). The objective is to improve the system by identifying, analysing and removing bottlenecks (Ruthenberg 1980).

The field work was carried out from March 1981 to July 1985 as part of a soil survey and land evaluation project (Boxem *et al.* 1987), and in a country with a relatively strong concern for the conservation of wildlife, trees and land. These conditions stimulated an examination of Mijikenda agriculture from the viewpoint of natural resources management (NRM), to ascertain how ecological resources influence the productivity and profitability of farm activities, which in turn affect the future quantities and qualities of these resources.

The farming system and resource management viewpoints are both incomplete, unless they take into account the historical dimension of these "moving targets" (Maxwell 1986: 65). Without knowledge of the past it is difficult to understand the present, and impossible to extrapolate from there into the future. The awareness of the historical roots of today's conditions and processes is probably the most distinctive feature of the studies in this thesis.

3 MAIN UNITS OF ANALYSIS

The levels at which agriculture was studied in the papers that constitute this thesis varied from person and field to people or region. Per level the analysis referred to one or several single units, one or more aggregates of units, or the total population. Some information, mostly from the literature consulted and numerous casual observations and informal conversations, covers the Mijikenda people and region as a whole. The field work was concentrated around Kaloleni, in the southern part of Kilifi District. This area includes the most common soil types, rainfall conditions, population densities and land uses of the Mijikenda, and moreover it is one of the principal maize and coconut production areas of Coast Province.

Within the Kaloleni area 4 villages were selected that cover most of its agro-ecological and socio-economic variation. Of the 91-121 households per village, a random sample of 31-37 participated in a baseline interview about the composition of farm and household, 8-10 in repeated and detailed interviews about farm activities, and 4-5 in quantitative observations of fields with annual crops. The information from farmers' fields was complemented by the results of small researcher-managed experiments at 1-4 sites per village. In addition to the formal questionnaire interviews or random samples of farmers, a number of selected key informants were interviewed by means of open-ended informal conversations. Details about methods are given per paper.

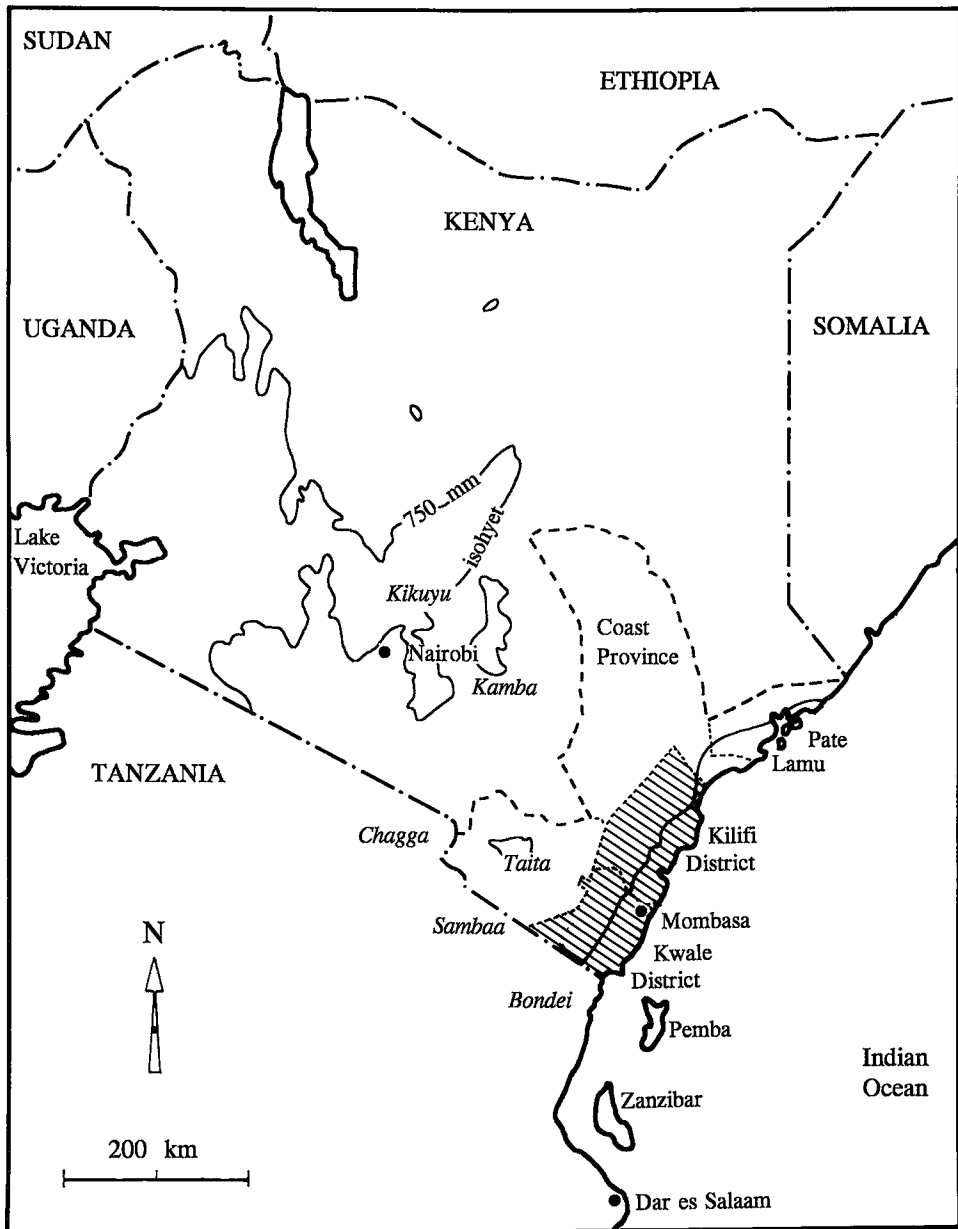
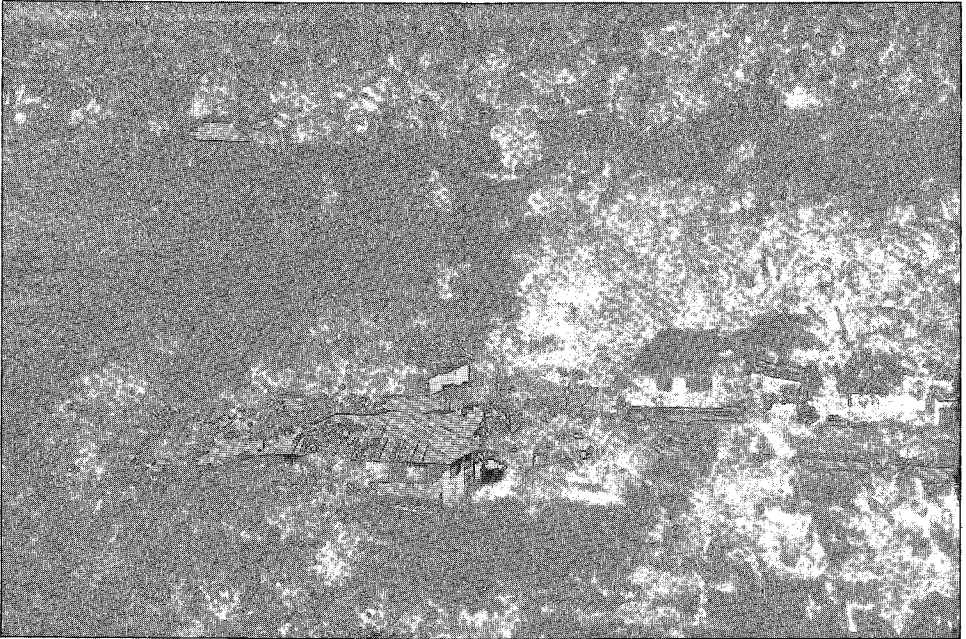


Figure 1.1. The Mijikenda area: Kwale and Kilifi Districts of Coast Province of Kenya.



Photograph 1.1. Maize fields and coconut palms in the Kaloleni area, Coast Province of Kenya.



Photograph 1.2. Mohamed Salim (left), a local expert in the difficult art of interviewing.

4 OUTLINE OF THIS THESIS

This general introduction is followed by a collection of short stories about one day in the life of a typical household on a typical farm just south of Kaloleni. The narratives introduce the principal actors and show the stages on which they perform the play called agriculture.

The second paper goes back into history and reveals remarkable patterns of change in the traditional society and agriculture of the Mijikenda people. Within a couple of centuries the actors, the stages and the plays have been transformed almost irrecognizably. These changes are all the more striking against the background of supposed apathy and stagnation often attributed to Mijikenda farmers and agriculture.

In the third paper the present agriculture in the Kaloleni area is described, both as a spatially differentiated land use determined by ecological conditions and in terms of farms characterized by the pattern of settlement, the composition of the household and the organization of the fields. Then the question is explored whether all farms studied are similar or whether distinct classes of farms can be distinguished and what the differences mean.

The fourth paper presents a case study of maize production in the Kaloleni area, the major maize growing area of Kilifi District and Coast Province. In the 19th century maize replaced sorghum as the staple food of the Mijikenda. The paper deals with various aspects of maize production, from the choice of seeds to the use of the harvest, and from ecological bottlenecks to food security.

The last paper deals with the coconut palm, the dominant element in many landscapes and the economic mainstay of numerous farmers. Although attention is also paid to ecological and agronomic aspects of the crop, the emphasis is on the conflicting uses of the palm, for the harvest of nuts, the production of copra or the tapping of palm wine.

The general discussion touches on some aspects of the methodologies used and suggests improvements. It also ventures to translate the acquired understanding of past and present agriculture into pathways and scenarios for the future.

The studies in this thesis were intended to fit together as the pieces of a jigsaw puzzle which together show a full panorama of Mijikenda agriculture. Each piece was written to stand on its own. This procedure caused a certain overlap between some of the papers. The desire to present as full and wide a view as possible, for those who work in the Mijikenda area, led to the inclusion of some information that may not be equally relevant for all readers.

5 NOTES ON TERMINOLOGY

The Mijikenda people consists of nine distinct tribes whose names appear to have remained fairly constant between the 16th and 20th century. The names *Kashuru*, *Musungulos* and *Wanika* or *Wanyika* have been successively used to refer to the Mijikenda people as a whole (Spear 1978). The last two terms have the pejorative meaning "people of the wilderness". Therefore in the mid 20th century the tribes chose the term Mijikenda as a common name, referring to the nine *makaya* (towns) or *miji* (villages) their ancestors had lived in. This term is used throughout this thesis.

It is not easy to find a single comprehensive term for the diverse population of male and female farmers, labourers, housekeepers etc. described in this thesis. In the title they are indicated as peasants: farm households with access to land, utilizing mainly family labour, and partially engaged in the commodity or labour market (simplified after Ellis 1988). In the text, which deals mainly with farm activities, the word "farmer" is used. This term does not refer solely to the male head of the household or owner of the farm but to any household member involved in farming.

Swahili or Giriama terms are used for notions that have no equivalents in English, and for easy reference with the local people. These words are spelt as in the literature or in accordance with the advice of Giriama assistants. The use of prefixes and suffixes has been avoided as much as possible. For example, instead of the terms *Mkamba*, *Wakamba*, *Ukamba* and *Ukambani* the descriptions a Kamba, several Kamba, the land of the Kamba and in the land of the Kamba were used. Prefixes and suffixes could not be omitted in several plural forms and site names.

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2 Kadzo: stories about the daily life of peasants in Coast Province of Kenya

Marjo Vervoorn & Henk Waaijenberg

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1 INTRODUCTION

Most studies of small farmers in tropical Africa consist of formal descriptions and quantitative models. This one comes in the form of a story that narrates a single day in the life of a farm household in the Kaloleni area of Coast Province of Kenya. The narrative illustrates that apart from being the makers of land use, the human components of farms, or the objects of classification exercises, farmers are also normal people who do not like to eat cassava twice a day, who have their daily worries and pleasures, who grudgingly toil under the hot sun, and like to sit in the shade to gossip or drink palm wine.

The other papers in this thesis have a certain male bias. They focus on farmers, elders, traders, hunters, tappers and off-farm workers, with a few notes that some of these functions are carried out by women as well. In this paper there is more attention to **her** story as mother, gatherer, cultivator, carrier of water and firewood, preparer of food, farm manager and daydreamer.



Photograph 2.1. A young farmer: female labour and management are cornerstones of Mijikenda agriculture.

2 METHODOLOGY

How the story, or stories, came into being seems to be out of place in a formal methodology. The authors met the actors by chance during a Sunday walk in the environs of Kaloleni. The meeting resulted in a long-lasting friendship. The first edition of the stories was written for a series of sessions to acquaint young members of a Dutch NGO with the lives of small farmers in the tropics. These more sociological accounts were revised for an introductory course about the role of agronomists in rural development. After further changes they found their way into this thesis.

The stories are true in so far that the people really did exist and that the events related did happen. The actors live on a homestead just south of Kaloleni. They did not participate in the formal research programme, but were met by chance. We became friends, visited each others fields, partook in work, sorrows and feasts. The narratives are fabricated in that they are our interpretation of what happened to the actors and of what they thought. However hard we tried to put ourselves into their shoes, the stories remain our models of their reality. The actors would never have told this story themselves. We borrowed some persons and topics from other households and experiences. All actors knew each other but they would be surprised to learn how we related them to each other. The pictures we painted are coloured, because the persons involved are our friends. For reasons of privacy we present them under other names so that they may continue the story without being unduly hindered by this part of their "history".

3 SHE WENT ON WEEDING

It is early May, one month after the start of the rainy season. Kadzo is weeding in the *munda mbomu* (family plot) in Ngamani. She is tired; the weeds grow faster than a woman can weed. Although she started early in the morning, progress is slow. During the night it rained and the soil is wet. Every time she forces the *jembe* (hoe) into the soil the heavy clay sticks to the blade. She looks around; she dares not wait for drier weather: the maize has to be weeded now, otherwise it will soon be overgrown by the weeds. Normally three women work in this field: Kadzo herself, Esther the elder wife of her husband Jira, and Tabu the wife of Katana the son of Jira and Esther. This morning Esther stayed at home; her legs hurt and the field is a long walk from the homestead. Kadzo likes working with Esther; she is pleasant company and although she is growing old she is a hard worker.

Kadzo stretches her back and then resumes work with renewed vigour. Tomorrow she will work in her own *koho* (small personal plot) near the homestead. The sandy soil there is easier to cultivate. She has already planted some maize and vegetables; later in the season she will plant some cowpeas and beans. Kadzo likes working for herself in her own little

plot, but the work in the large family field takes priority. This field is planted first and all members of the household are expected to work there. Only later in the afternoon, if there is time over, and every fourth day, family members are free to work for themselves. Last year Kadzo had bad luck; she got malaria and could not weed her *koho* in time, so it yielded nearly nothing. Fortunately the yields of the *munda mbomu* and of the *makoho* of the other wives were quite good, so that the family did not have to buy maize for seven months.

This year the maize does not look good. The plants are small and the leaves are yellowish green. The soil is tired; they have been growing maize here for eight years. Long ago when there were few people in this area, after a few crops of maize they left the soil for a long rest, but nowadays little land is unused. Growing better crops with fertilizer is too expensive; fertilizer costs over one hundred shillings per bag! And you have to buy it in Mombasa and to pay a lot of bus fare for yourself and for the fertilizer. And then, if there is not enough rain, all the money and work are wasted. It is better to try to get a piece of fallow land. Along the path to the shamba there are two acres which have been lying idle since the death of Jira's father and are nearer the homestead. Last week, the wives of Jira's elder brother were talking about that field. So sh'd better hurry and talk to Esther tonight so that Esther can propose the idea to Jira, who can arrange the matter with his brothers. Kadzo often deals with Jira via Esther, because Esther is the senior wife.

Kadzo also has to ask Esther's advice about how to get cowpea seeds for her *koho*. As soon as the maize has flowered she wants to plant the seeds between the maize plants. There is no cowpea in the family store. Last year insects ate the flowers and young pods. The only thing Kadzo got for all her work were some tender young leaves for putting in soup. Normally Kadzo could borrow seeds from other women in the neighbourhood, but this year there is none to spare. So she will have to buy cowpeas at the market in Kaloleni at Ksh 8 or more per litre tin, as the seeds have to come from as far away as Machakos. Kadzo does not have the money. She might ask Jira, but he won't be very pleased, because last week he had to buy a school uniform for her little daughter. So she had better should look for a way of earning the money herself. One way would be *vipande*, weeding on a piecework basis for better-off neighbours. By working hard and long she could earn enough in one day, but she would leave her *koho* unweeded. Another way to earn the money is by making *makuti*, pieces of thatch plaited from fallen coconut palm leaves. That would take much longer. On days that she does not have to cook after coming back from the field she could make up to four pieces; it may take up to two weeks to make the twenty needed for one tin of cowpeas. And then she would have to wait for a buyer to pass in his truck ...

A greeting brings her out of her reverie. It is Jeremiah, the local extensionist, on his way to a field of Dzombo Ndovu, who is one of the richest people in the village. Dzombo owns a *duka* (shop) and a maize mill, and wants to modernize his farming methods. Kadzo doubts whether Jeremiah will be of much use for that. The few people he visits (he does not even have a bicycle) already know his story by heart: work harder, cultivate deeper, plant in rows, give fertilizer, kill the insects with chemicals, and plant modern varieties of maize and

cassava. Well, they are working very hard already, planting in rows makes things very complicated, and fertilizer and insecticides are very expensive. The seeds of "Coast Composite" maize cost much more than those of the local "*Mdzihana*" and you have to go to Kaloleni or even Mombasa to get them. For cassava cuttings it is even worse; to get to Mtwapa you have to change buses and then walk all the way to the experimental station and back. And Dzombo's wife has tried the new cassava and says that it does not taste nice; Jira had already heard that this was why the people at the market in Mombasa did not want to buy it. It would be better if "Agriculture" could do something about the weeds and the backache they give you! Kadzo stretches herself. working bent double all day is too tiring. No wonder that Tabu complains so much.

4 NICE TO WORK IN TOWN

Tabu grumbles, she hates this clayey soil. On the sandy soils of Kinarani, where she lived before she met Katana at a dance party and got married, weeding was much easier. After Katana had paid most of the dowry her father asked, she went to live with his family. She works now under supervision of her mother-in-law Esther, who gave her a piece of land for a *koho* and taught her the Jibana ways of cultivating. Like Kadzo she has to participate in the work in the large family field.

She pulls angrily at the handle of her hoe. Terrible soil! When it rains it sticks to your feet and hoe, and when it is dry it is hard like stone. Thank goodness Jira hired the tractor of a *Mhindi* (Indian) for ploughing. It would be terrible to have to do all the work by hand! Not that it was easy to convince Jira of the need. He does not have to do that work himself and did not like to have to pledge ten of his beloved coconut palms to raise the Ksh 500 needed to plough the two acres. Until Jira has repaid the loan he cannot tap wine or harvest nuts, and who knows how he will ever be able to repay!

Soon after ploughing, Esther and Jira decided to plant the maize in the dry soil. The wind came from the right direction, and sure enough, a few days later the rains started with vigour. If that had not happened the seeds or the young plants might have died. Tabu is happy that they planted in dry soil; three days after the start of the rains the field was like a mud pool, nearly impossible to plant anything.

Tabu would prefer to work in town, like her friend Mary, who after primary school and a few years of secondary school went to work in a fashion shop in Malindi. You should see her beautiful dresses! Even her father, who is doubtful about the life she leads in Malindi, never says so to her face, as the family needs the money. Before marrying, Tabu worked for several months in the cashewnut factory in Kilifi. The work was boring, but she could buy nice dresses and go dancing. Jira and Katana do not want her to go to town. Her father-in-

law says that she that won't get work, as she did only a few years of primary school, and that they need her on the farm. Katana says the same, but he probably is afraid that in town she would spend too much money or get too "free". As if Tabu knows all that he does in Mombasa!

Katana works in a shop near the market, where they sell beans, green grams, chickpeas from India, dates from the Middle East, and much more. He lives with two friends in a room at the outskirts of the town. At the moment they share the room with his cousin Peter, who is looking for work. Peter spent three years in secondary school, where he learned too much to go back to primitive farm work but not enough to get an easy job. He passes most of his time smoking *bhang* (marihuana) and reading seditious pamphlets inciting against the capitalist government. Katana is worried, he wonders how Peter gets the money to buy the drugs, and is afraid that somebody will see the pamphlets and call the police. Katana goes home at weekends only. Sometimes he brings Tabu a small present, but most of the time all the money he has not spent in Mombasa is needed to buy maize and paraffin.

Kadzo calls her. The sun is already low; they have to go home and fetch water before it is dark. The women walk to the baobab tree at the edge of the field, where their children are sleeping. They put them onto their backs and put the bundles of firewood they collected earlier on their heads. Kadzo also carries a small basket of *mutsunga*, a wild spinach which grows abundantly in Ngamani and is a much appreciated vegetable. In single file they trudge along the narrow paths. It will take them more than an hour to walk to the homestead, through maize fields, over hills covered with coconut palms and citrus trees and through small valleys planted with rice.

5 EDUCATION AND FARMING

Meanwhile, their nephew Stanley is on his knees between his tomato plants, looking for the caterpillars which are eating the ripening fruits. Like Peter, he did some years of secondary school and then tried to find work, first in Kilifi and later in Mombasa, but when he did not succeed he went home to try his luck in farming. As he did not see much future in the traditional methods of his parents, he joined the local 4-K club to learn more about scientific farming methods. The members do not want to loiter around, but to build the country by modern farming. They regularly invite Samuel, who works as a Technical Assistant (TA) in the Agricultural Office in Kaloleni, to look at their crops and give advice.

Some months ago Stanley planted a small plot with tomatoes. He went to the Kenya Farmers Association (KFA) shop in Mombasa to buy certified seeds and fertilizer. So far the crop has grown quite well; Stanley has already harvested the first few tomatoes. When there are more

he wants to go and sell them in Mombasa. But a few days ago, to his dismay, he discovered that some caterpillars were eating their way into the unripe fruits and spoiling them.

For over a year there has been a white agronomist in Kaloleni. He does experiments with crops, visits the farmers' fields and asks them all kinds of questions about local farming. Stanley went to ask him what he could spray to kill the pest that is eating his tomatoes. The *mzungu* (white man) advised him to pick the caterpillars by hand as long as there are not too many, as spraying makes the tomatoes less healthy for the people to eat, and may also kill the good insects. Indeed, there are not very many caterpillars and the *mzungu* has a lot of books on agriculture, but all the same ...

To be sure, Stanley would prefer to use a chemical medicine and to care well for his crop. He has heard that in Mikiriani there is a Kauma, who has a large *shamba* (field), with tomato just planted between the maize and given no care. It is true that this Kauma in spite of getting only a few tomatoes per plant does sell a lot of tomatoes, but his system is too primitive! He is like those few people who followed the example of an old Luo instructor and turned to ploughing with oxen or donkeys instead of hiring a tractor. No, tomorrow Stanley will go to Kaloleni to ask Samuel what to spray. The TA will be happy to help, being tired of talking in the wilderness, to old-fashioned farmers who do not want to change, but prefer to let their wives do the work while they spend their time tapping and drinking palm wine.

6 PALM WINE AND RESPONSIBILITY

Jira walks towards the homestead. He has been tapping, making the afternoon round along his palms, and his somewhat unsteady walk shows that he has been sampling his merchandise. He greets his two brothers who are sitting in the shade of a mango tree. This morning another tapper was arrested by the *askari* (policeman). The new DO (District Officer) takes the prohibition on toddy tapping much more seriously than his predecessor, who for a small bribe would overlook the offence and did himself often enjoy the local "brew". The new DO comes from up country and drinks "Tusker" beer. That may be fine for him, but poor people cannot afford such a luxury. Tapping and selling toddy does not come cheap; those caught risk a fine of Ksh 150 or a month in prison. Jira complains: "Why did the President ban us from drinking palm wine? Why do those people in Nairobi want to bother us?" He sits down and takes the *mboko* (small calabash cup) his brother offers him.

Esther, while winnowing rice, listens to the grumbling of her husband. He talks too much, but he is right. Before the ban on toddy, two years ago, Jira tapped many palms. Every day they carried a full jerrican of toddy to the main road. There it was collected by Jonathan, who transported it in his pickup truck to Mombasa, to be drunk by the many poor who could not afford beer. After the ban, life became difficult. Smuggling toddy to Mombasa is

dangerous and there is not much demand in the neighbourhood. Nowadays Jira taps only five trees and earns very little. And life is very expensive; the family needs money for maize meal, paraffin, soap, salt, sugar, clothes and many other things. Jira just gets drunk, but it is the women who have to see how to make ends meet. It is many years ago since the fields gave enough maize to live on, and the prices in the shop are going up all the time. A good thing that Katana every month contributes a part of his salary. But last month he bought a dress for spoiled Tabu, and now he wants a concrete floor in his house. Jira has already been grumbling that there is very little maize in the store and that they urgently need the money for buying food.

7 THE OLD AND FAMILIAR

Esther rubs her legs; the sores are hurting and do not want to heal. This morning she went to a diviner. Katana and Tabu wanted her to go to the hospital in Kaloleni, but Esther does not like these new-fangled things, she trusts her own people more. A long row of patients were waiting outside the hut, but Esther did not mind this opportunity to exchange local gossip. The "doctor" is a young woman being trained by two elder women. You do not have to tell her the reason of your visit. She calls up spirits who tell her what is the matter with you. Then she sends you to a herb doctor who knows the medicines you need and where to find the plants needed for it.

Esther had to put Ksh. 5 in a calabash in front of the diviner. The young woman then sniffed tobacco and lighted some sticks of incense. Esther always is very impressed when the doctor invokes the spirits; she rolls her eyes and sings unintelligibly. While singing she turns over the leaves of a Koran full of Arabic symbols. Finally she tells Esther that she has to go to the herb doctor and gives her a piece of paper torn out of the Koran. She has to carry the text in a small bag on her upper arm in order to protect herself from the forces that prevent the sores from healing. Tomorrow she will go to the herb doctor for a medicine that she has to rub on the sores of her legs. She feels reassured, the medicine will certainly help.

Jira will not be pleased that she has visited the doctor; he has to pay. Last time she went to a famous Giriama witchdoctor Jira was charged one hundred shillings and he was very angry. For two weeks he kept mumbling: "bloody fucking Giriama!". Esther did not understand the English words, some of the few which he learned during his work in "Kenya Casmiti" in Mombasa. There he earned the money to pay for Kadzo, his second wife. Esther is not jealous, she has her own children, Kadzo is obedient and helps her with many difficult tasks, and Jira respects her as his first wife. He will give her money for the doctors; although he blasphemes them outside of their hearing, he thinks it wise to keep them on his side.

In a few weeks Esther will have to go to another witch doctor. Along the path to the homestead there are two mango trees full of fruits. They are of the new "Apple" variety and will fetch one or even two shillings each. To prevent theft she will ask the doctor to give her a medicine to put near the trees so that thieves may be warned that the trees are protected. Esther cannot prevent a smile; Jira brought the small trees six years ago when he worked for a *mzungu* near Malindi, and she wonders if they were bought or stolen. Just as well the *wazungu* do not protect their trees with witchcraft ...

8 AND LIFE GOES ON ...

Kadzo and Tabu return from the field. They are late and have to hurry to prepare the food. Today it is Kadzo's turn to prepare the meal for the family. Fortunately, she had pounded and ground the maize yesterday; Jira does not like to eat cassava. She calls her eldest daughter to help Tabu fetch water. During the rainy season they fetch water from a small stream in the rice field, just below the homestead. In the dry season they have to walk to the main road, where somebody with a tap sells water for 10 cents per bucket. Now Kadzo's daughter is growing up, she can take over part of the work, after school. Kadzo is glad that her daughters can go to school; she herself never learnt to read and write.

Jira's cousin Karisa drops in with sad news: this afternoon his father Ndege died. He invites the family to the funeral. Kadzo is stirring the *ugali* (stiff maize porridge). She will go with Esther. It is long time since they went to Kaloleni. The family there is rich and there will be plenty of meat and toddy for at least three or four days of ceremony. Jira receives the message with tranquillity; his uncle was already very old. After Karisa has left, Jira walks to his jerricans of toddy. He mixes the new and sweet sap of today with the old and bitter of yesterday. He will take some as a contribution to the funeral ceremony, as he is expected to do. The rest he will take to a friend in Kaloleni, who will sell the drink for him to his nephews, so that Jira can earn some money without people being able to accuse him of being greedy. At funerals people always drink a lot, as funerals are the only occasion that the government allows palm wine to be drunk.

It is dark already. Kadzo lights the paraffin lamp. For a moment she remembers the day's work; after the funeral the weeding will go on.

9 DISCUSSION

Stories are a little-used genre in science. However, to restrict their use to fiction would overlook their potential as a tool for modelling reality, alongside formulae, tables, diagrams and simulation programmes. One of their strongest points is the possibility of combining situation, reason and action in a harmonious whole. Stories are not only apt vessels to store information but also graceful and effective channels to convey a message. Well-known examples of such stories are the parables of the fig tree and of the sower and the seed. As with many parables, the moral of the stories presented is not elaborated in detail but left to the reader.

Stories are used at times in history or sociology to analyse the changes that have occurred during one's lifetime or to present the results of case studies in an attractive way (Njau & Mulaki 1984; Groot 1990). They have potential for much wider use. During the writing process we came to realize how much information is needed and how many questions must be asked just for a short narrative of seven pages. The writing of short stories is a useful tool to discover gaps in our knowledge about the what, when, how and why of farming practices. In early stages the tool can be used to order what we know about the farms and farmers we study. Why not follow certain persons throughout the seasons of the agricultural cycle? Later on the stories can be told to the farmers represented and they will certainly arouse more interest than abstract presentations of research findings. People will start laughing, point out errors, amplify the plot, provide details, and dwell on the implications. Stories, like maps and diagrams, may contribute to the analysis of small farmer agriculture (Conway 1989). In that way the understanding between farmers and researchers will be improved which may result in more realistic technologies, scenarios, policies and programmes for development.

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**3 Mijikenda history, Coast Province of Kenya:
changes in traditional society and agriculture**

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1 INTRODUCTION

The Mijikenda people

The Mijikenda (derived from *miji* or *makaya chenda*: nine villages or towns) are a Bantu people, numbering about one million persons and consisting of nine tribes: Digo, Duruma, Rabai, Ribe, Kambe, Jibana, Chonyi, Kauma and Giriama. They live in the hinterland of the southern Kenya Coast, from the Tanzania border to halfway between Sabaki and Tana rivers, in an area roughly coinciding with Kwale and Kilifi Districts of Coast Province of Kenya (figure 3.1).

On the east the area is bordered by a narrow coastal plain, where for more than one thousand years small ports maintained a lively trade with peoples from other shores of the Indian Ocean. At present, with the exception of Mombasa which has good railway and road links with Nairobi, most of these ports have declined or depend on tourists who come for the coral beaches. In the west the area fades into a mostly flat, semi-arid and sparsely populated wilderness known as the Taru desert, in which the land use is wild parks and cattle ranches. In between lie the coastal uplands and plateaus, an undulating landscape with a few prominent hills and ridges. Most soils are sandy, dry and poor, but there are numerous small valleys and bottomlands, and locally some larger pockets of fertile clay soils. The average annual rainfall ranges from more than 1,200 mm in the southeast to less than 600 mm in the west and north, with large differences between years and seasons. The original vegetation, little of which is left, consisted mostly of forests and woodlands.

According to oral traditions, the Mijikenda settled in the coastal uplands behind Mombasa about four hundred years ago. Until the 19th century they lived in nine *makaya* (singular *kaya*), i.e. fortified settlements on densely wooded hilltops (figure 3.1). They grew sorghum, millets and cowpea, kept some cattle and goats, and traded surpluses, forest products and some ivory with their neighbours in the coastal strip and the interior of the country.

In the course of the 19th century the Mijikenda left the protection of their *makaya* and spread over the surrounding countryside. Most of them still dwell in the uplands and plateaus, but large numbers have spilled into the coastal strip. Nowadays, the Mijikenda live in scattered homesteads on small farms of a few hectares. They grow maize, rice, cassava and cowpea, and harvest the produce of their coconut, cashew, citrus or mango trees. A few households own cattle, most keep some goats or sheep, and nearly all have members working away from the farm.

Traditional agriculture

In spite of hard work, most Mijikenda farmers fail to produce enough food for their households, and have to buy part of the maize meal which is the staple food. Some are able to pay for this from the sale of tree crop or livestock produce, but in most cases people have to work off-farm to earn the money required. In general, they have little formal education and are employed in poorly paid jobs. Nevertheless, some people may do quite well and for various reasons rather pretend to be poor (Gerlach 1961). However, for the majority the hardships are real and difficult to escape from. The underlined words have often been questioned or contradicted. Numerous visitors and even residents, apparently underrating the difficult conditions, ascribed the poverty to laziness or drunkenness and to an innate reluctance to change.

"The local farmers are generally unwilling to change their traditional ways of planting and harvesting their crops or to experiment with the introduction of new plants or animals. Most Giriama and some of the Arabs are still using the same agricultural practices that have been employed for hundreds of years." (Martin 1973: 129)

The Mijikenda were considered traditional, hanging on to outdated approaches to life in general and agriculture in particular. If only they would improve their attitude, and more readily accept new cultivars, breeds, tools, inputs and techniques, things would soon become much better (New 1873; Hobley *et al.* 1914; KNA 1925; Warui 1982; Times 1983b).

"The most striking example of this is to be found where a Nyamwezi and a Giriama have neighbouring shambas. In spite of the fact that the Giriama must be conscious of the better results obtained by the Mnyamwezi, he will continue to follow his old methods and trust in Providence." (KNA 1940a)

Several colonial officials considered the Mijikenda to be more backward than other tribes. Some thought that they might be improved by contact with enlightened farmers, but others were convinced that even after seeing they still would not believe, let alone be converted. Gillette (1978) put the idea to the test in the Kikoneni area of Kwale District. She found that where local Digo farmers and recently settled Kamba, lived side by side, contrary to expectations the Kamba adopted the practices of the Digo, so that over time their farms became more similar. She argued that non-adoption of modern technology was nothing to do with farmers being traditional, but rather with well-founded wariness based on lack of evidence that the innovations would work well in their own fields (Gillette 1980).

The present study does not aim to prove whether the Mijikenda are more or less traditional than other people or to justify the occasions that they did not change. It describes the numerous and enormous changes that they did bring about or undergo during the past four centuries. Their ancestors came from far away and adapted themselves to a new and strange environment. The *makaya* they established there were highly complex, quite open, and rather democratic societies. In time many Mijikenda became successful traders that skilfully exploited their strategic position between the coastal towns and the peoples of the interior.

They shifted quickly and completely from sorghum and millet towards maize and cassava as their staple foods. By deforestation and the planting of millions of coconut, cashew and fruit trees they transformed their landscape irrecognizably. These and other changes in the environment, organization, production and commerce of the Mijikenda are the themes of this paper.

An agricultural history

There are already numerous historical studies about the peoples of the Kenya coast, including several dealing with the Mijikenda. Most of these covered shorter periods or smaller areas and populations than the present paper. Another difference of this study is the emphasis on agriculture, although both halves of the word agri-culture did not receive the same degree of attention throughout all sections of this paper.

This is not a normal historical study. The first part deals with mythical events, the exodus from Shungwaya and the arrival in the Mombasa area around 1600, about which we know almost nothing. However, whether historical or not, the happenings played a key role in the self identification and political life of the Mijikenda until today. Apparently, they also challenged the imagination of students of "history" (Morton 1972; Spear 1978; Allen 1983).

We know a little more about the second part, covering the 17th and 18th centuries. Most of that is based on observations made by missionaries and explorers during the 19th century, when the *makaya* were already in decay, and on oral traditions collected even later. With both sources there is the danger of wrongly projecting later conditions and opinions back into the past. The period that the ancestors of the present Mijikenda lived in *makaya*, whether seen as golden age or dark misery, is used as a point of reference or traditional situation.

The *kaya* period serves as a background for the numerous changes that happened during the 19th and 20th centuries. The Mijikenda spread out over the coastal uplands and the Taru desert and into the coastal strip. There were shifts in the balance of political and economic power. The Mijikenda saw colonial rule come and go and poverty come and stay. While in the previous period they had wielded some political and economic power, now they slid into an unimportant backwater or hinterland.

The uneven quantity and quality of the information made it often difficult to separate fact and view or observation and opinion. Although I judged and wrote with caution the result is no more than an agricultural history. It is written by an outsider with little experience in historical sciences and a limited grasp of local languages, cultures and interests. I did not intend to give final answers, but to evoke questions, and challenge others to dig deeper in the intriguing history of agriculture in Africa. A more direct purpose was to construct a background or mirror against which to reflect the present state of Mijikenda agriculture, with emphasis on maize production and coconut palm growing.

2 METHODOLOGY

This study of the history of the Mijikenda and their agriculture is a by-product of research focused on today's households, farms, fields and crops. During field work and afterwards I collected whatever information I could lay my hands on, although the search was by no means exhaustive. For the reconstruction of past conditions and happenings mostly secondary sources were used. My interpretation of them is strongly coloured by the impressions of four years (1981-1985) of agronomic studies and daily life among Chonyi, Jibana and Giriama farmers in the area around Kaloleni (figure 3.1).

Written sources

The backbone of this study consists of information from an extensive and diverse literature written by missionaries, explorers, colonial officers, foreign researchers, civil servants and newspaper reporters. It must be emphasized that several authors were involved as actors or otherwise interested in the situations or events they described. The views of others may have been clouded or sharpened by their education or professional prejudices. Some use was made of the wealth of 20th century materials in the Kenya National Archives, Nairobi. Most of the information studied there dealt with the occurrence of food shortages and the related attempts of the colonial government to affect changes in the cropping patterns of the Mijikenda.

Interviews and observations

Question: They did not grow crops? **Translation:** So they were not used to cultivate? **Answer:** They used cows for meat, they are like the Masai. **Translation:** You see, they did not like digging, they used cows for eating. (interview with Samuel Kazungu, Kwa Demu, 3rd August 1985; interpreter Stanley Gunga)

Historical data were collected as side-information of agronomic studies of stratified random samples of farmers and by means of specific interviews of key informants. Oral histories appeared more concerned with tales of origin, trade and battles than with the more boring subject of agriculture. Moreover, most were told as free stories which allowed the narrators to mix past and present, or facts and views. The author understood just enough Swahili and Mijikenda dialects to follow the outline of the stories. To pick up details use was made of translators who often and with enthusiasm assumed the roles of interpreters, as illustrated by the above quotation. References to interviews are given in italics (e.g. *Kombe 1984*). Historical processes were not only remembered but some left also traces in the field. The *kaya* of the Jibana and Kwa Demu, Mangea hill and other old settlement sites were visited. Deforestation and settlement patterns and the distribution and age composition of coconut palms and cashew trees were observed. A botanical collection of problem weeds, minor crops and wild useful plants was made and deposited at the East African Herbarium in Nairobi.

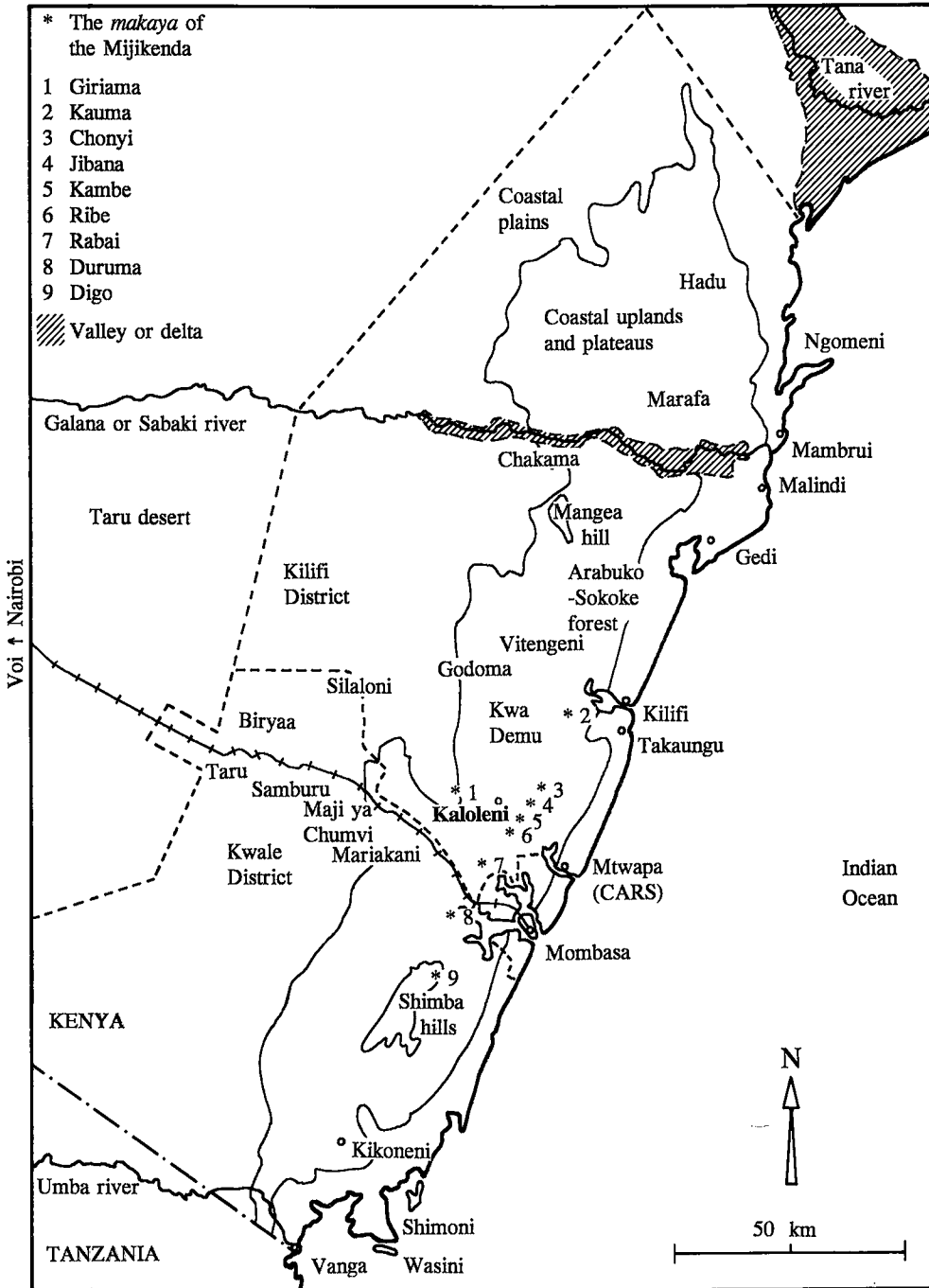


Figure 3.1. Geography of the southern Kenya coast.

3 EXODUS FROM SHUNGWAYA (-1600)

3.1 The East African Coast

Little is known about the early history of the Mijikenda themselves but their setting, the East African coast, has a long and relatively well documented history. For two thousand years the coastal strip has been a contact zone between many civilizations (Hollingsworth 1951; Sutton 1966). There Africans met with people as diverse as probably Egyptians, Assyrians, Israelites and Phoenicians, and certainly Greeks, Romans, Indians, Chinese, Persians, Arabs and Portuguese. Most of them came for trade only, but some settled, and the present Swahili population, language and culture are the result of intermarriage and integration between local peoples and foreign visitors.

Some of these travellers recorded their experiences in writing. Their documents show the people, towns, agriculture and trade of the East African coast as seen through the astonished eyes of Greek, Arab and Portuguese travellers. These sources mention trade in a diverse range of items. The East African towns mainly imported industrial goods such as cloth, glass beads, iron and brass ware and exported raw materials such as ivory or rhinohorn and slaves. For more information on the East African trade before 1600 see Sheriff (1976, 1981), Chittick (1970, 1977) and Matveiev (1982).

The contacts also led to the exchange of **crops and ideas**. Whereas Watson (1983) describes the Arabs as major distributors of crops and agricultural innovations, Hromnik (1981) claims that Indians played a larger role in East African history and agriculture than usually acknowledged. Whoever is right, the crops and ideas imported did have a strong impact. The Muslim traveller Ibn Battuta, who visited the town Mombasa in 1331, remarked on the importance of crops of Asian origin and on the practice of Islam:

"We arrived at Mombasa, a large island two days' journey from the land of the Swahili. The island is quite separate from the mainland. It grows bananas, lemons, and oranges. The people also gather a fruit which they call jammun (*Eugenia jambu*) which looks like an olive. It has a nut like an olive, but its taste is very sweet. The people do not engage in agriculture, but import grain from the Swahili. The greater part of their diet is bananas and fish. They follow the Shafi'i rite, and are devout, chaste, and virtuous." (Freeman-Grenville 1975: 31)

The quotations indicate abundance of foods, produced by the towns themselves or brought from elsewhere. Probably the peoples of the hinterland played an important role in the provision of the coastal towns with food stuffs and trade articles. Duarte Barbosa, a Portuguese who visited Mombasa in the second decade of the 16th century, was one of the first who explicitly referred to the relationships of the town people with the inhabitants of the hinterland:

"Mombaça ... This is a place of great traffic, and has a good harbour, in which are always moored craft of many kinds and also great ships ... This Mombaça is a land very full of food. Here are found many fine sheep with round tails, cows and other cattle in great plenty, and

many fowls, all of which are exceedingly fat. There is much millet and rice, sweet and bitter oranges, lemons, pomegranates, Indian figs, vegetables of divers kinds, and much sweet water. The men thereof are oft-times at war and but seldom at peace with those of the mainland, and they carry on trade with them, bringing thence great stores of honey, wax and ivory." (Freeman-Grenville 1975: 131-132)

During the **Portuguese period** (1498-1729), vividly described by Strandes (1899), the prosperity of the coastal towns decreased. At several places the Zimba (cannibals from southern Africa) and the Galla (Oromo speaking pastoralists from Ethiopia) caused havoc. The Indian Ocean trade between Africa, Arabia and India was suppressed and the gold trade was forcibly directed towards Europe. The Portuguese brutally sacked every town which refused or even hesitated to accept Portuguese supremacy. From 1498 onwards the history of the rebellious Mombasa was one long succession of revolts and sackings, until in 1729 the Portuguese were thrown out of Fort Jesus for good. One of the parties in the Mombasa-Portuguese struggles were the Musungulos (Strandes 1899). These are a warlike people that lived in the Mombasa hinterland and they are thought to be ancestors of the present Mijikenda. However, where did the Musungulos themselves come from?

3.2 Traditions and myths

Spear (1978, 1981, 1982) answers the question as follows. Rabai elders say that they came from Rombo in Chagga (North Tanzania). The Duruma claim mixed Digo (neighbouring Mijikenda tribe), Makua (slaves of the Portuguese, from Mozambique) and Kamba (central Kenya) origins. Most oral traditions of the other Mijikenda are variations on the theme "**we came from Shungwaya**" (Spear 1978, 1982). Shungwaya is thought to have been somewhere behind the southern Somalia coast. There the ancestors of the Mijikenda, then called "Kashuru", lived together with Galla, Pokomo and some groups of the Swahili and Taita. In the 16th century the other inhabitants were chased by the Galla and moved southwards in separate groups. Around 1600 the ancestors of the Mijikenda entered the Kilifi-Mombasa-Vanga hinterland, a forested area where only small scattered groups of nomadic *Laa* or *Waata* hunters lived. Some traditions suggest that the latter also came from Shungwaya (Spear 1982). The newcomers settled in *makaya* and learned to use bow and arrows against marauding Galla. They absorbed part of the hunters and later other people and gradually the main *makaya* differentiated into the nowadays nine Mijikenda tribes. Their names illustrate the long dispersal, travelling and settlement process. For example, Kauma refers to "we have come and we remain" (Fitzgerald 1898), Duruma to "this is the end of our journey" (Griffiths 1935) and Rabai to "we are happy here" (Bennett 1985).

Other historians give quite different interpretations of Mijikenda answers to questions about their origins. They consider the Shungwaya story in varying degrees a myth rather than a history. Morton (1972, 1977) points out that oral traditions recorded in the 19th century indicated Manglea hill (west of Malindi) or other places as original homes of the Mijikenda.

The earliest reference to Shungwaya origins was the *Kitab al Zanuj* (Book of the Zenj), a late 19th century compilation of earlier Arab chronicles.

"... scripts by one Fazil bin Omar Alhuri, compiled presumably from native traditions and embellished very likely from his own imagination ..." (Elliot 1925/26: 150)

The compiler is supposed to have inserted the Shungwaya myth to justify certain malpractices with regard to marriage and slavery. The myth could also have originated among Muslim proselytizers, who for propaganda reasons wanted to stress the ancient relations between Mijikenda and Muslim peoples. It did not work out that way: except for the Digo the Mijikenda tribes rejected Islam and used the Shungwaya story to emphasize their own common origins rather than their ties with the Muslims of the coastal towns (Morton 1972). The appearance of the Shungwaya theme in traditions recorded in the 20th century can be explained as an appendage onto earlier versions of traditions of origin (Morton 1972). The Mijikenda today believe not to hail from Mangea, but to have travelled from Shungwaya via Mangea to their present homes, just like some Mijikenda under Christian influence place an exodus from *Misri* (Egypt) before the Shungwaya episode (*Gunga* 1983).

Allen (1983) also doubted the literal interpretation of Shungwaya traditions defended by Spear (1982). However, instead of rejecting them as falsification he opted for another interpretation. From the 9th to the 13/14th century there was a large and loosely structured African state in the East African hinterland, called Shungwaya. It contained numerous linguistic and cultural groups and its territory maybe stretched from Juba river in Somalia to Mangea hill behind Malindi. Its centre was on the mainland opposite the island Pate; many Swahili claim to hail from that area. When the Swahili became Muslims the name Shungwaya with its Afro-religious association was no longer acceptable to them, so they gave it the alternative name *Shirazi* (Persian), frequently encountered in tradition and literature. The large state broke up into several successor states. These included a 15th and 16th century state centred on the town Malindi, visited by Vasco da Gama in 1498, and Vumba, sited along the Uмба river outside the original Shungwaya. Various successor states also had a Shungwaya cult based on a sacred settlement or ritual centre. At least five such sites are known, all near crossing places in major rivers.

Between 1550 and 1700 the arrival of new groups of pastoralists caused strong disturbances in northeast Kenya, which led to the displacement of a pastoral people indicated as "Segeju". Some moved to the Vumba hinterland, where they still maintain a separate identity. Others moved into the Mombasa hinterland and established sacred capitals modelled after Shungwaya or even based on earlier Shungwaya or Laa shrines or sanctuaries. The existing non-Segeju population absorbed the Segeju newcomers and their "we came from Shungwaya" legend. That was easy as in some sense they all came from there: they had lived near Shungwaya or in successor states, they probably already had some kind of Shungwaya belief system, and the *makaya* were life duplicates of the original Shungwaya. When from the end of the 19th century the Mijikenda were threatened by severe environmental (famines, pests) and political (colonial oppression) problems, the Shungwaya legend became an article of faith. It stressed

the unity of all Mijikenda and provided for their background an empire comparable to those where the Muslims and Christians came from.

3.3 Glimpses of history

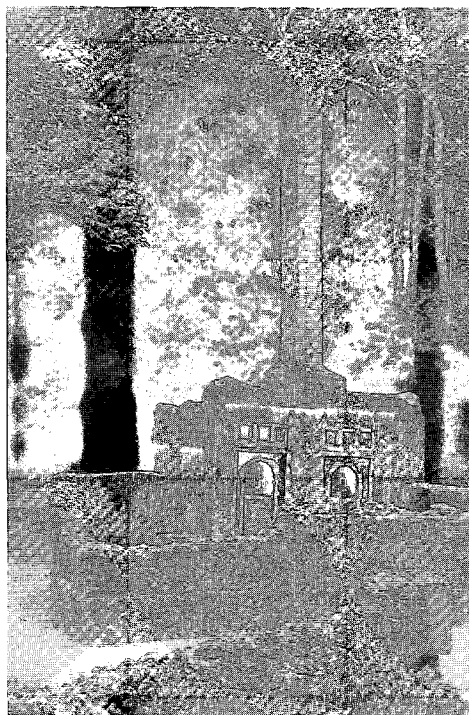
"Probably we should assume that in the mid eleventh century the inhabitants of the Nyika hills were indistinguishable from the "Swahili" mentioned by Ibn Battuta in the early fourteenth century as those who supplied the inhabitants of Mombasa island with their grain". (Oliver 1977: 667)

After the epic exodus from Shungwaya (Spear 1982) and an almost mythical Shirazi empire (Allen 1983) the above quotation sounds prosaic. Although Oliver (1977) also suggested an early occupation of the coastal hinterland and later immigration of Segeju, he did not link them with Shungwaya. His cautious view appears nearest to the proven truth. To go much farther may prove risky, but nevertheless it can shed some light on the probable course of history or on ways for further study.

It is indeed unlikely that until the late 16th century the hinterland remained empty apart from a few gatherers and hunters and a limited area immediately behind Mombasa (Rabai). Prosperous towns with an, in spite of a favourable environment, nearly empty hinterland make little sense. There are indications that before the supposed Mijikenda arrival there was a numerous and organized **population in the hinterland**, with established links with Mombasa and Malindi. In 1505 the Mombasa townsmen were supported by 1,500 African archers from the mainland, and in 1528-1529 the Swahili ranks were reinforced by at least 5,000 black archers (Strandes 1899; Guillain 1856). According to Spear (1978) these may have been Rabai, but if we assume that the numbers were not too much exaggerated and that the warriors had wives, children and old people at home, that would imply that the Rabai were more numerous in the 16th than in the early 20th century, and that they equalled the population of Mombasa in numbers. Therefore, the black archers probably came from a much larger populated area. Around 1590 Malindi was saved from ferocious Zimba cannibals by 3,000 Segeju warriors, appearing out of the interior. Although the Segeju were first reported in 1569 (Strandes 1899), it appears that they had sufficiently well established (old) links with Malindi to come to its succour.

Written records are scarce, and with time oral traditions become more diffuse and polluted. Therefore, linguistic and archaeological research, including study of changes in soils and vegetation (Templer 1954), are also needed. Excavations at supposed Shungwaya sites have proved inconclusive (Morton 1972; Chittick 1975). Recent **archaeological research** at *kaya* sites indicated that several were already settled by the 10th century and enlarged during the middle of this millennium (Mutoro 1987). This confirms that the hinterland was not empty and indicates a marked increase of the *kaya* population, but does not answer questions about the identity or origin of the newcomers. Attention should also be paid to the places that line

the route from Shungwaya -- whatever and wherever it may have been -- to the *makaya*. Oral traditions recount that most groups wandered widely before they reached their final destination. Of special interest is Mangea hill, a prominent landscape feature and the original home of many Mijikenda tribes (Morton 1977), or a mayor resting place on their wanderings (Spear 1978). Another worthwhile site is Kwa Demu, the last place where most Mijikenda were still together before they split into the various tribes. The site can be recognised by a concentration of baobab trees, soils with dark A horizons (maybe accumulation of ashes), *mitsara wa amwendo* (waterholes dug by the first generation from Shungwaya) and pieces of fired brick (used to make house walls impenetrable to Galla spears).



Photograph 3.1. History has left clear traces in the coastal strip: ruins of the 16th century town of Gedi.

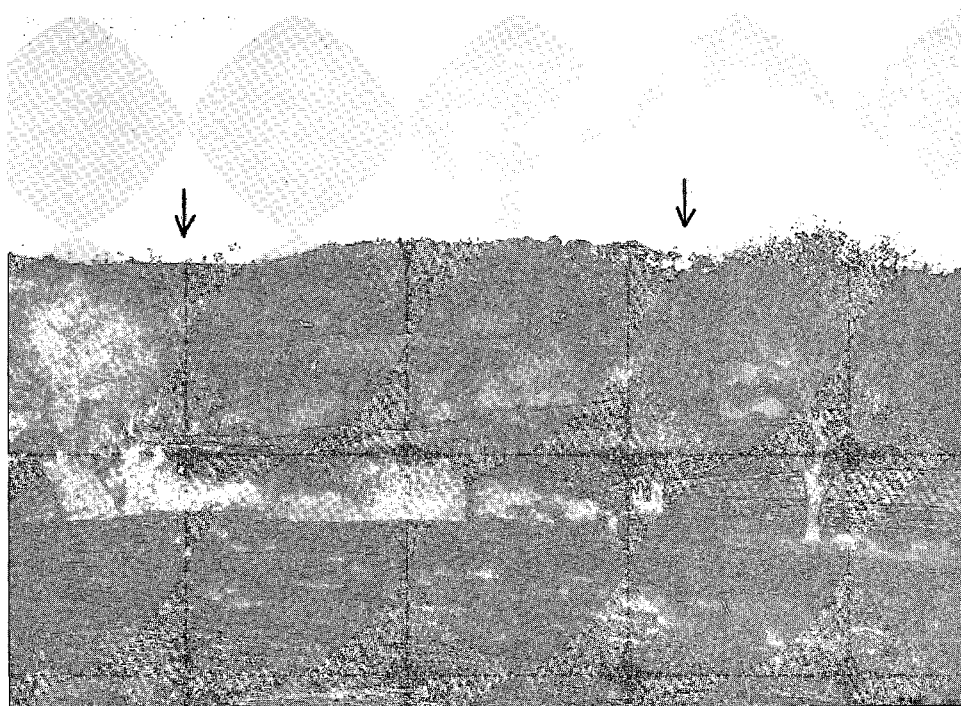


Photograph 3.2. In the hinterland the traces of history are less evident: baobab tree and pieces of brick at an abandoned settlement near Kwa Demu.

Most speculations focused on where the ancestors of the Mijikenda came from and how they travelled, but what did they do for their **living in Shungwaya**? The Galla no doubt were pastoralists. Oral traditions agree that the Laa were hunters or gatherers. The Portuguese described the Segeju as pastoralists who lived on blood and milk and did not cultivate (Freeman-Grenville 1962). According to the *Kitab al Zanuj* the Kashuru kept cattle, goats,

sheep and chicken and lived on millets and wild fruits (Elliot 1925/26; Morton 1972). This description is not very convincing as it boils down to what most Mijikenda did at the time the document was written; the compiler may simply have left out crops like coconut, cassava and maize of which he could know they were introduced rather recently among the Mijikenda. Oral traditions were not very helpful. Some informants, maybe projecting the present into the past, mentioned crops like maize or tobacco, which had not yet arrived in East Africa by the time (*Masha 1984*). Others gave as a reason for the dispersal from Shungwaya the killing of a Galla boy; the Mijikenda buried his body in a cattle kraal, which suggests that they kept cattle (*Wakanyoe 1984*). Still others stated that their ancestors did not keep cattle but obtained livestock products from Galla in exchange for grain (*Gunga 1983; Kazungu 1985*). It is possible that not all informants referred to the same period or that there were various subcultures in Shungwaya -- townsmen, cultivators, herdsman, hunters and gatherers -- like recorded this century in Lamu (Prins 1952).

Concluding, as long as there is no clarity about the location and nature of Shungwaya and its population, no more than speculations can be made about the economic activities of the Mijikenda during the Shungwaya or pre-*kaya* period.



Photograph 3.3. The *kaya* of the Chonyi seen from the southeast; the once dense forest on the slopes has become very open (arrows). On the foreground grass thatched huts.

4 PEOPLE OF THE MAKAYA (1600-1850)

4.1 Structure and organization

A *kaya* was much more than a settlement; its physical structure, social organization and function so strongly interacted that it also represented a way of life and death. The following is a summary of descriptions in Krapf (1860), New (1873), Champion (1914), Brantley (1978), Spear (1978), Hawthorne *et al.* (1981) and Mwangudza (1983).

Most *makaya* were sited on the tops of a ridge of hills which stretched from the Shimba hills in the south to Mangea hill in the north, from where they overlooked the coastal plain with its Swahili-Arab trading towns (figure 3.1). They were small **towns or villages** in a circular clearing several hundred meters across and surrounded by a palisade or thorn fence.

"Kayas are stockaded villages, always, for greater security, built in the midst of the forest, and generally speaking on elevated ground." (New 1873: 76)

The clearing was enclosed by densely forested slopes through which one to three tortuous paths led to the village. Each path had three heavy wooden gates, made by Swahili craftsmen, which served for defence and as a symbol of prosperity (Harries 1960). Inside the *kaya* the houses were grouped around the *lwanda*, the meeting houses of the clans.

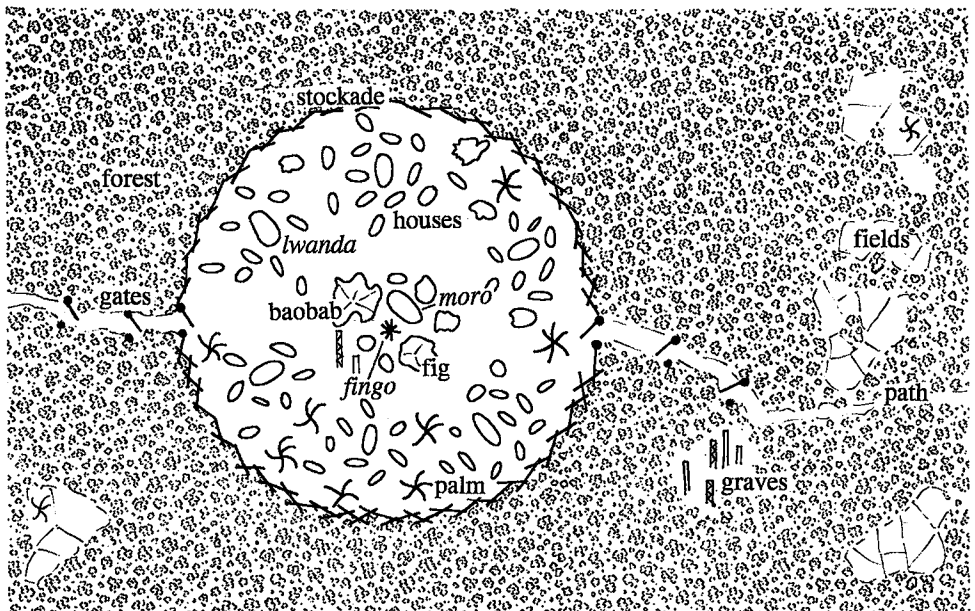


Figure 3.2. Schematic plan of a *kaya* of the Mijikenda, Coast Province of Kenya (after Spear 1978).

The houses had an oval beehive shaped basketwork frame of thin stakes, supported by some heavy poles and thatched with tall grasses like *muchuchi* (*Hyparrhenia rufa*). They measured about 6 m x 3 m, had one door and consisted of a single room with a *lutsaga* (raised grain bin), a hearth place, a few beds, and utensils like clay pots and a mortar for pounding grain. Smoke from the cooking fire kept the mosquitoes at bay, dried the grain and protected it against insects. For details on housing and furniture one is referred to New (1873) and Hawthorne *et al.* (1981).

In the centre of the *kaya* was a small uncleared circle. There the *finjo* was buried, a protective magic brought from Shungwaya, usually a pot with "medicines". Nearby was the *moro*, a meeting house where the elders met, situated between a *mugandi* and a *mbuyu*, a fig and a baobab tree. Here the most important ritual symbols like the sacred *mwanza m'kulu* drum were kept.

The following simplification of the **social organization**, mainly after Spear (1978), applies to the Ribe, Kambe, Jibana, Chonyi, Kauma and Giriama, who had a patrilinear descent system. The organization of the Digo, who had matrilinear descent, and of the Duruma and Rabai, who had both, was somewhat different. For details see Champion (1914), Gerlach (1961, 1965) and Brantley (1978, 1979, 1981).

The *makaya* were segmentary communities subdivided in *mbari* (clans and subclans), *mariyango* (lineages) and *nyumba* (homesteads). The clans were supposed to have been formed in Shungwaya and their number remained fixed, in most *makaya* between three and six. Each had its own history and magic, and ritual, social and political function (Mkangi 1975). Subclans developed after establishment of the *kaya* through lineage segmentation and assimilation of strangers; their number could increase. Those founded by strangers were considered to belong to one of the original clans, as settlement in the *kaya* was necessarily around the *bwanda*. A subclan consisted of one or more lineages, which in turn consisted of one or more homesteads, the smallest residential units, composed of nuclear or extended families. At each level elders exercised leadership over the group, and they represented the group in the meetings of the next higher level. Every Mijikenda knew to which homestead, lineage, subclan, clan and *kaya* he or she belonged, but the higher the level the more difficult or impossible to trace the exact genealogy.

The division in clans etc. was crossed by one in *marika* (singular *rika*, age set). Every three or four years all boys of the right age (8-12 years) were initiated together as a sub-*rika* in a ceremony called *mwanza m'kulu*. According to Giriama informants this initiation was not related with the circumcision all boys had to undergo (Brantley 1978). When thirteen of such sub-*rika* had formed their members, between 10 and 60 years old, were corporately initiated into a new *rika* by dancing *mung'aro* whereby they became *nyere*, grown up men. Soon thereafter the senior sub-*rika* by dancing *sayo* and *kirao* became *kambi*, ruling elders. In the course of the next decades the members of the other sub-*rika* also became *kambi*. By the time that all had been elevated to that status the ranks of the *rika* had been thinned by old age.

The few remaining *kambi* retired and a new *rika* -- meanwhile thirteen new sub-*rika* had been formed -- was installed.

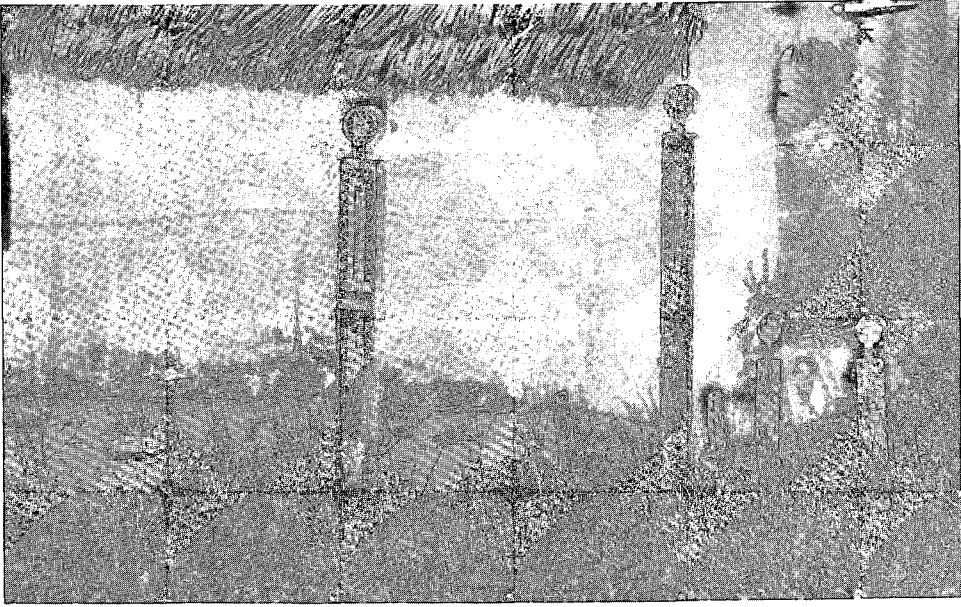
According to Spear (1978) each *rika* ruled for $13 \times 4 = 52$ years or 2 generations. Champion (1914) and Brantley (1978) estimated durations of 45 and 39 years respectively. The actual number of years may have depended on a good harvest to provide the quantities of food required for the initiation ceremonies. Each *rika* had its own characteristic name, for example, the Giriama called the *rika* which left Shungwaya *amwendo*, the going (Spear 1978). Their names and the approximate duration of 40-50 years make the *rika* useful as a rough calendar for dating historical events.

The *nyere* led their own homesteads and lineages. The higher level leadership in the *kaya* was exercised by the *kambi*, who met every fourth day in the *moro*. The Mijikenda *jumwa* (week) had four days. On the first three the people worked; the Giriama names *kuramuka*, *kurima hiri* and *kuisa* refer to the start, second day and end of cultivation (Fitzgerald 1898; Bennett 1985). On *jumwa*, the fourth day they relaxed, went to markets and arranged ritual, social and political affairs. The foregoing may have created the impression that the *kaya* community was rather equable and democratic:

"... a parliament composed of almost the entire population, which has but little to do but to govern itself." (New 1873: 110)

In reality power was concentrated. The senior sub-*rika* ruled much longer than the later ones, so that they were called fathers and sons (Spear 1978). Per clan, leaders of the *kambi* were selected; one of the criteria was a substantial contribution to the fees required for the initiation ceremonies. Moreover, there were partly secret societies, and the more important ones like *gohu* and *vaya* had high initiation fees, to be paid to their senior members, so that only wealthy *kambi* could join them. The most powerful was the *vaya* society selected from the leaders of the *kambi*. Of the *vaya* two members per clan learned the terrible and feared *fisi* (hyena) oath and one member per clan was selected to the *enyetsi*, the men of the land. This was the executive council of the *kambi*, chaired by a *mwanamuli* or *mtawala* drawn from the clans in rotation. The *enyetsi* often also had knowledge of the *fisi* oath. Therefore the ultimate power was concentrated in a very small group. These men had large ritual knowledge, took decisions on land use, provided and received bridewealth for the wives of young men, controlled the external trade, and kept political power. In short, the *kaya* was ruled by a small and wealthy gerontocracy.

Little is known about the role of women in the social life of the *kaya*. They had their own *kifudu* society, of which men could also be members, but not partake in the proceedings (Champion 1914). Female elders had a role in the ritual control of ecological problems, like plagues of rats, and women could be diviners and diagnose causes of illness, among which was witchcraft (Hawthorne *et al.* 1981).



Photograph 3.4. Decorated vigango (large grave figurines) for initiated elders; the triangles are characteristic of Mijikenda art.



Photograph 3.5. Simple msala (small grave figurines) for common men and women; coloured strips of cloth indicate the gender of the deceased.

The *kaya* had several **functions** and still retains some. The foremost was the defence against wild animals and Galla, Kwavi (Masai) or Arab/Swahili attacks. Apart from their fence and gates they were protected by densely wooded slopes, where the Mijikenda with their bows and poisonous arrows had an advantage over their enemies who were armed with spears. Other Mijikenda weapons were the *njoma* (club) and the *lupanga* (short sword) (New 1873). Fitzgerald (1898) also mentioned the *kipungu*, a defensive weapon shaped like the head of a pickaxe; the description suggests similarity to the *fimbo*, the forked staff some elders still use.

The unity of the segmentary community was promoted by exogamy between clans and by the *agesets*, which crossed clan boundaries, and was further enforced by residence in the *kaya*. At night everybody had to be in the *kaya* and after the beating of the *mwanza* drum they had to stay in the houses. This enabled the leaders to deal with opponents one by one; by persuasion, by fear for their oaths, or even by force.

The *kaya* was and still is a ritual centre, where the *finjo* was buried, the sacred drums were kept, rituals and sacrifices were organized for rain, cleaning of land, control of epidemics, ecological problems, enemies and witchcraft. The rituals took place near the central fig tree and at selected places in the forest (Hawthorne *et al.* 1981).

People were buried near the *moro* in the *kaya* or at special places in the forest. As a rule people who died outside were buried outside. According to Mwangudza (1983) such people could be buried inside only after special ceremonies. The graves were marked by trees, notably coconut palms, or by wooden grave posts. Graves of members of the *gohu* society were marked by *vigango*, decorated with carvings. Less important men and women had *msala ya koma*, smaller and simpler posts often draped with strips of blue, red and white cloth, the colours depending on the sex of the person they represented (Griffiths 1935). Sometimes the grave posts were grouped in a *nyumba ya koma*, a small house for the shades (Champion 1914; Adamson 1957; Hawthorne *et al.* 1981).

4.2 Agricultural production

Inside the *kaya* people had their houses, cattle pens and small gardens. As the protecting forest belt had to be preserved, most farming took place at some distance. Topography, soils and rainfall around the *makaya* varied strongly over small distances (Michieka *et al.* 1978; Jaetzold & Schmidt 1983; Boxem *et al.* 1987). Some *makaya* were surrounded by lowland rain forest (Chonyi, Jibana, Kambe, Ribe, Rabai and Digo), others by lowland dry forest (Kauma, Giriama and probably Duruma). Other vegetation types within walking distance of the *makaya* were lowland woodland, lowland moist savanna, lowland cultivation savanna, and in the case of *kaya* Giriama *Acacia* thorn-bushland (Moomaw 1960).

The classic Mijikenda views on **land tenure and use** are summarized in the following quotations:

"... land is inalienable, belonging only to God. Man may occupy it and, by agreement, regulate its occupation." (Salim 1973: 125) and "... all land (*mitsanga*) belongs to God, grass (*vuwe*) belongs to the occupier of the land..." (Kayamba 1947: 90)

They express that the land could not be owned by man, who only could derive rights to use it -- in agreement with others. These rights were based on his efforts and were transferable as long as the results (e.g. crops planted, grass that grows after clearing of a forest) were visible. The land was under the jurisdiction of the *enyetsi* (Spear 1978; Mwangudza 1983). Each clan had its own land on which all members, notably married men, could get cultivation and grazing rights.

The basic **economic unit** of the Mijikenda was the household, consisting of one or more nuclear families. The men built the houses and cleared the bush or forest. The women collected the grass for thatching, did most of the cultivation, carried water and firewood, and prepared the food (New 1873; Mwangudza 1983). People probably spent much time walking to wells or rivers at the bottom of the hill and to fields far outside the protective forest belt. The long rotation forced people to cultivate new land far away from their homes, while it was forbidden and dangerous to live in the fields. Each household had several fields under a wide range of conditions to assure a stable production. For increased safety the fields of various households often were close together. The Duruma, Giriama and Jibana had two types of fields (Griffiths 1935; Bennett 1985; Chome 1985). It is not known how far the other tribes also made the below distinction:

- A *dzumbe* or *munda mbomu*, worked by all members of the household together during the first three days of the week. The harvest was stored in the central household store and controlled by the head of the household. Daily management was by the senior wife.
- Several *makoho* (singular *koho*), small fields usually worked on the fourth day by individual persons, who were free to use the harvest as they wished.

Households used to help each other in several ways. They cultivated in groups, helped each other to carry the harvest home, contributed grain when someone's store burned down and cooperated in the building of houses. In that way the work was rendered more pleasant and the people had some kind of insurance against marauders and natural calamities. Terms used to indicate mutual cooperation were *kikola* and *mwerya*, the latter possibly a Kamba word (Bennett 1985).

The main **farming tools** of the Mijikenda were:

- *Ndoyo* or *kigongo*, a stick used for planting and digging holes for house construction, at first entirely of wood, later provided with an iron point (Chome 1985; Kazungu 1985).

- *Jembe*, a small hoe used for planting and weeding. This hoe appears to have had a narrower blade than the present one, a change related to the increasing weed population caused by shortening of fallows (*Kazungu 1985*).
- *Mundu*, a large curved knife with long wooden handle, used for cutting vegetation and enemies, later replaced by the *panga* (cutlass) with straighter blade and shorter handle (*Bennett 1985; Chome 1985*).
- *Kitsoka*, an axe used for cutting trees, an activity which in the course of deforestation gradually lost its importance.

There is little information on **agronomic practices**. Fields were rotated after three to four years of use, and left fallow for ten or more years (Spear 1978). The soils were still fertile and friable and several crops which today are planted with the hoe were sown broadcast, such as finger millet, pearl millet and green grams (*Kazungu 1985*). Other crops, like cowpea, were planted with the planting stick or hoe. Because of the long fallows, weeds did not cause much trouble. For protection against animals fields often were surrounded by a fence of thorn branches. The following observation, made early in the 20th century, gave a picture of how agriculture may have been during the *kaya* period:

"The soil is extraordinarily fertile, especially in its virgin condition. Full advantage is taken of this by burning down the bush, taking about two or at the most three crops off the area and then leaving it to recover. The soil under the bush is frequently soft, loamy and full of decaying vegetable matter - so that no cultivation is necessary at all, the seeds, some two or three together, being pushed into holes made with a small hoe. The seeds spring up rapidly and a heavy crop is obtained often without the necessity of even one weeding. Weeds do not grow under the bush as a rule so that the seeds of the weeds are not present. Thus a crop is not infrequently obtained with a minimum of labour. The Agiryama will never cultivate grass land if there is any bush at hand. He says that the soil is hard and would have to be turned up and weeds would be plentiful, both involving much unnecessary labour." (Champion 1914: 8)

4.3 Annual crops and livestock

In the mid-19th century, when the first missionaries arrived in Rabai and Ribe, they observed a large number of crops. Erhardt (1860) listed rice, sorghum, maize, finger millet, pearl millet, cowpea, pigeon pea, lablab bean, sweet potato, yam, banana, foxtail millet, green gram, pumpkin, African eggplant, calabash, groundnut, bambara nut, turmeric, castor, pineapple, sugar cane and sesame. Several of these crops, such as maize and pineapple, are from the new world and most likely were introduced by the Portuguese (Miracle 1965; Purseglove 1968, 1972; Martin 1973).

During the *kaya* period sorghum and finger and pearl millet were the **annual staple foods**. Sorghum was the most common and finger millet the most valued (*Kombe 1984*). The latter

was used for brewing alcoholic drinks and for paying *mahunda* (bridewealth); it required more work and gave lower yields than sorghum. In the 19th century these cereals were largely replaced by maize and rice. Maize was grown on the island Pemba by 1643 (Miracle 1965), it arrived in Mombasa before 1729 (Guillain 1856), and had become "the favourite article of food with the Wanika [Mijikenda]" by 1863 (New 1873: 86). Rice probably was introduced among the Mijikenda in the same period. It was a major crop of the Vumba of Wasini and Vanga, who taught the Digo how to grow it (McKay 1975; Ochieng 1975). By the mid-19th century it had become one of the chief cereals of the Wanika, and it was grown for sale at the coast markets (New 1873).

"The leguminous plants are tubazi [pigeon pea], kunde [cowpea], fiwe [lablab bean], and pojo [green gram], but they are all very inferior kinds." (New 1873: 86)

Of the grain legumes cowpea is mentioned most often by Mijikenda informants. This may be in part a projection of its present importance into the past. Of the other food crops none seems to have been of importance, with the exception of cassava (sometimes spelt as cassada). In 1750 the Portuguese introduced the crop in Mozambique, from where it spread to other parts of East Africa (Strandes 1899). Early in the 19th century cassava was already grown by the Wanika [Mijikenda]: "cassada is the chief produce of their grounds" (Emery 1833: 282). As there are no other references to the importance of the crop, he may have referred only to the Digo. By 1891 cassava was their staple food (Prins 1952), while they grew maize, sorghum and beans as cash crops (Kjekshus 1977). The other Mijikenda adopted the crop much later (Ngala 1949).



Photograph 3.6. A small patch of pearl millet near a Giriama house north of Kaloleni.

The Mijikenda also produced **annual cash crops**. The term may need some explanation. During the *kaya* period the Mijikenda probably did not grow specific cash crops, but rather sold surpluses of crops they cultivated in the first place for themselves, whether grains, vegetables, fruits, tobacco or oil seeds. The Mijikenda used tobacco for snuff although some smoked it (Krapf 1860). This new-world crop must have been introduced early: Chonyi and Galla supposedly knew it already in Shungwaya (*Wakanyoe 1984*). In the ruins of the town of Gedi pipe bowls dated AD 1550-1600 were found (Kirkman 1966), and in 1634 Rezende reported Mijikenda trading tobacco to Mombasa (Gray 1947). In 1848 it was an important trade article; the Mijikenda grew it themselves, but the Digo also bought it in Usambara, for resale to the Galla who lived north and west of the Giriama (Krapf 1960). According to Spear (1978) the Galla also produced tobacco themselves.

Oil crops were also produced. In the mid-19th century the Mijikenda grew some sesame for sale (Erhardt 1860; New 1873). Sesame is of East African origin, but according to Giriama the crop was introduced to them by the Arabs. Later in the 19th century sesame became an important cash crop (Spear 1978). Castor seeds were collected from plants growing wild. The oil was used in initiation, wedding and funeral ceremonies, for rain praying and for anointing bodies (New 1873; Johnstone 1902; Champion 1914; Kayamba 1947). Seeds or oil were also sold (Spear 1978).

Erhardt (1860) also listed a large number of **tree crops**: cinnamon, tamarind, jackfruit, mango, guava, soursop or custard apple, coconut, orange, lemon, lime, pawpaw, clove, kapok, cashew and jambolan. It appears that they were of minor importance, apart from coconut palms. The Digo, in the 17th century, were the first Mijikenda to grow the palms. At the end of the 18th century also the Rabai started to plant them, and in the mid-19th century they were observed in most *makaya* (Krapf 1860; New 1873; Herlehy 1985). As the first palms were planted around the houses, today *makaya* are still recognizable from the air as rings of palms in the forest. Although the Mijikenda also consumed the nuts, and people near Mombasa sold copra, the tapping (*kugema*) of palm wine (*uchi*, *pombe* or *tembo ya mnazi*) was the most popular use. Palm wine was used on nearly all social and ritual occasions, for example, when receiving guests, paying bridewealth, in funerals, offerings to the spirits of the dead, and during initiation ceremonies. It was mainly taken by elder men, drunkenness being regarded as their "special privilege" (New 1873: 96).

"The liquor is a favourite beverage with the Wanika [Mijikenda]; many of them almost live upon it" (New 1873: 85)

The Mijikenda also kept **livestock**: cattle, goats, sheep, chicken, ducks and donkeys (Erhardt 1860; Mwangudza 1983). The goats, sheep and cattle were herded by young boys. Goats and sheep slept in the house; when they became too numerous a special shelter was built. Cattle were kept in a corral at night (Emery 1833). In the early *kaya* period the numbers of cattle were probably limited due to the risk of seizure by the Galla. During the 18th and particularly the 19th century the Mijikenda acquired more cattle through trade. Consequently livestock replaced millet as the payment for bridewealth (*Kombe 1984*). In the second half

of the 19th century the Mijikenda lost large numbers of cattle due to raids by Kwavi (New 1873). In 1845, after their children who herded the cattle had been killed in a raid, the Kambe vowed to give up the keeping of cattle (Hawthorne *et al.* 1981). The Chonyi took a similar oath (*Wakanyoe 1984*). In the 1880s several famines and rinderpest epidemics ended the power and threat of the Kwavi, but also decimated the herds of the Mijikenda (Spear 1978).

4.4 Fishing, hunting and gathering

The diet was complemented, especially during famines, by fishing, hunting and gathering of wild plants in forest, bush and fields. **Fishing** took place in the few rivers that crossed their area and in the nearby coastal creeks, with nets, barrier fences and non-return basket traps (Mwangudza 1983). These methods maybe were like those observed, this century, in the floodpools, lakes and streams of the Sabaki valley (Whitehead 1960).



Photograph 3.7. The Mijikenda are skilful hunters: traps for the rodents which threaten their crops and enrich their diet.

The Mijikenda hunted with bow and poisonous arrows and with traps (Champion 1914; Mwangudza 1983). **Hunting** was needed to protect the fields and to provide meat, hides, skins, excitement and interesting stories. It was not all innocent: quarrels about the theft of preys caused intertribal fighting (*Wakanyoe 1984*). The Mijikenda were skilful trappers, using noose traps (snares), non-return traps, falling log traps and pit falls. They caught mostly birds and small animals, but occasionally even a buffalo was trapped. Larger animals like elephants were usually hunted by Waata hunters, who traded meat, hides, skins and ivory for agricultural products. The Mijikenda also collected honey: in the 16th century the people of the hinterland sold wax and honey to Mombasa (Freeman-Grenville 1975), and early in the 19th century the Wanika did the same (Emery 1833).

The ecologically diverse Mijikenda area was rich in **useful plants** yielding a wide range of products. Some with particular historical interest are discussed in this section. For lists and descriptions of other species and products one is refer to Glover *et al.* (1969) about the Shimba hills, Hawthorne *et al.* (1981) about *kaya* Kambe, Fitzgerald (1898) and Champion (1914) about the Giriama area, and Kelly (1960) about Kilifi District.

The Giriama were known for the production of *utsungu*, a lethal **arrow poison** powerful enough to kill an elephant with one single shot. They used it themselves and also sold it to Waata and Kamba hunters (Walker 1957; Spear 1978). The archers who in 1505 assisted the people of Mombasa used poisonous arrows (Strandes 1899), and Rezende mentioned the poison in 1634 (Gray 1947). In the mid 20th century it was still used so much by elephant poachers that there was reason to fear for the extinction of the *mutsungu* tree (Walker 1957). For more information about the production and use, including 124 blood curdling cases, of African arrow poisons one is referred to Karimi (1973).

The main active principle, the glucoside ouabain, came from the bark and roots of the tree *mutsungu*. According to Karimi (1973) and Spear (1978) this is *Acokanthera longiflora* or *A. oppositifolia*, but in Coast Province of Kenya this species is only found on the Sagalla and Taita hills, whereas all collections made in Mijikenda territory are of *A. schimperi* (Kupicha 1982). Another ingredient was the sap of *Aloe rabaiensis* which caused irritation of the wound and made the poisonous paste less brittle (Walker 1957). The Giriama also employed *mugulove* (*Excoecaria madagascariensis*) in arrow poisons (Karimi 1973).

There are several unanswered questions with regard to the making, trade and use of *utsungu* arrow poison. According to Kupicha (1982), *A. schimperi* was introduced by the Giriama from their place of origin. Oral traditions indeed mention the use of bows and arrows in Shungwaya, but suggest that the arrows had no iron heads (*Wakanyoe 1984*), or were not poisoned (Spear 1982). Some Giriama traditions tell that the Waata taught them how to use bow and arrows, others that Giriama sold arrow poison and arrowheads to the Waata (Spear 1978, 1982). Had the pupils surpassed their masters in the technology or did *mutsungu* only occur in Giriama territory? Why did the Waata who themselves also produced arrow poison

(Champion 1922) or the Kamba who made and traded it (Raymond 1947; Lamphear 1970; Karimi 1973), buy it from the Giriama?

A major trade article, especially for the Giriama, was **gum copal** (*chandarusi*), an exudation from the trunk and roots of the tree called *msandarusi*, *m'ongolo* or *mong'odo* (Fitzgerald 1898; Champion 1914) or *Trachylobium verrucosum*, *T. hornemannianum*, *Hymenaea verrucosum* (Krapf 1860; Champion 1914; Greenway 1941; Kelly 1960; Martin 1973; Hawthorne *et al.* 1981). The tree was abundant around *kaya* Jibana and in Arabuko-Sokoke forest, and was also found in Godoma and Biryaa. Most of these places were in Giriama territory, which made them the main suppliers.

In commerce a distinction was made between *utokazi* (fossil copal) and *chakazi* (green copal) (Prins 1967). Fossil gum exuded from the roots in a sandy soil was considered the best. The gum from the Mijikenda area was considered to be of lesser quality than that from Zanzibar (Guillain 1856). In the 16th century copal was used to caulk ships and water vessels (Strandes 1899; Freeman-Grenville 1962). In 1770 it was a trade product in Mombasa (Spear 1978); in 1832 a first major shipment was sent to Salem, USA (Koffsky 1977); and throughout the 19th century it was exported to India and England for the production of varnish (Martin 1973).

Recent visitors to the Mijikenda country may hardly believe it, but once the area was rich in valuable **timber trees**. Krapf (1860) saw lofty woods around *kaya* Jibana and reported the sale of timber to Swahili from Mombasa who lived in Magombani, a village at the foot of the hill. The timber was used for house construction and boat building. Emery (1833), Erhardt (1860), New (1873), Champion (1914) and Kelly (1960) list the main species.

4.5 Local and regional trade

Next to their agricultural activities the Mijikenda were also involved in local and regional trade, but the nature and volume of the trade was not the same for all tribes (Spear 1978). The Kambe and Ribe traded little, probably mainly when pressed by famine, and the Chonyi mostly engaged in local trade. Jibana and Kauma traders were not allowed in their *makaya*; they had to settle in or near coastal towns and usually converted to Islam. The Digo, Duruma, Rabai and Giriama dominated the profitable trade between the coast and the interior of Kenya.

Amongst themselves the **Mijikenda** exchanged grain, palm wine, clay pots, salt and livestock (Spear 1978). Between the 18th and the 20th century the coconut palm and therefore the palm wine "trade front" gradually moved northwards. Nevertheless, until well into the 20th century the Rabai remained the main tappers and sellers of palm wine (Herlehy 1984b, 1985). Most clay pots came from Kidutani in Jibana territory, where they were made by

Jibana and Ribe, and by Swahili from Jomvu, near Mombasa. Later the Giriama discovered good clay in Godoma. Salt was extracted from marshes and from salt grass in places like Maji ya Chumvi (Mwangudza 1983), and later also from the sea, especially the Ngomeni area (Spear 1978).

After settling in the *makaya* the Mijikenda gradually developed social, political and economic ties with their neighbours (Spear 1978). Initially these were **sectional relations**: each *kaya* was linked with and traded with its immediate neighbours. In years of abundance the Mijikenda traded grain surpluses, sesame and other agricultural products with the Swahili for cloth, beads and iron for the production of arrow heads and hoes. In poor years they exchanged forest products like gum copal for grain, which the Swahili imported from other places along the East African coast, notably Pemba. The Giriama exchanged grain, livestock and arrow poison with the Waata for ivory, skins and meat, and tobacco and cloth with the Galla for ivory and cattle. The ivory in turn they sold to Swahili, who exported it to Asia, Europe and North America (Beachey 1967).

The latter case is an indication of how from the middle of the 18th century and into the 19th century the sectional trade pattern developed into an **extensive network** (Spear 1978). This stretched from the Sambaa in the south to the Galla in the north, and from the Swahili in the east to the Taita, Taveta, Chagga and Kamba in the west. The latter peoples again had further links with Kikuyu, Embu, Mbeere and Masai. Because of their geographical position the Mijikenda could play a major role in this trade. The main routes in the network ran east-west: the trade of cloth, beads and iron and copper wire from the coast against ivory, cattle and some slaves from the interior. There was also north-south trade: in palm wine and grain amongst the Mijikenda and in tobacco from Sambaa via Mijikenda to Galla.

The **Digo** were the first to establish markets to trade with the Swahili, mainly Mombasa and Vumba. The markets were near the sub-*makaya* they built in the 17th and 18th century: Mtawe, Kiteje, Ukunda, Tiwi, Pongwe, and others south of the Uмба river. They kept daily markets for internal trade in subsistence goods, and others every fourth day which were also open for outsiders and where agricultural and forest products were sold. Although by 1850 combined Vumba-Digo caravans brought ivory and some slaves from Taveta and Chagga, and later went as far as lake Victoria, most of the Digo trade remained regional, with other Mijikenda, Mombasa, Vumba, Bondei and Sambaa (Salim 1973; Spear 1978). This may have been due to their relatively ample opportunities for agriculture and the fact that they kept little livestock and were a settled people (Gillette 1978).

The **Rabai and Duruma**, favoured by their proximity to Mombasa, were market traders and brokers. In the first half of the 19th century the Rabai market at Jomvu became the most important border market around Mombasa (Guillain 1856). Apart from general trade throughout the year, there was an annual ivory market in July and August, where Giriama and Kamba brought their ivory for sale to Swahili, with Rabai acting as brokers. After the planting of coconut palms the Rabai sold coconuts and copra to Swahili, and exchanged palm

wine with other Mijikenda for grain, which in turn they sold to Swahili. The Duruma had a smaller market at Changamwe where they sold grain and copal and acted as brokers for the Kamba. Krapf (1860) experienced to his dismay that the Duruma were also ready to use force to get a share of the goods passing through their country.

The **Giriama**, whose *kaya* was farthest from the coast, were the main long distance traders. They connected the Waata, Galla and Kamba of the interior with the Swahili of Mombasa. Throughout the 19th century, their old-time Waata friends were their main suppliers of ivory, in exchange for arrow poison, iron wire, livestock, cloth and grain. Trade with their Galla enemies was conducted on an individual basis and at yearly markets in Biryaa, on neutral ground. The Galla sold ivory, rhinohorn and livestock for tobacco and cloth. By 1800 the first Giriama caravans were travelling to the lands of the Chagga and Kamba to obtain cattle and ivory for cloth, arrow poison and beads; these people had no interest in iron and copper, which they produced themselves (Guillain 1856). The Giriama dominated the caravan trade until the 1840s, when Kamba and later also Arab/Swahili caravans replaced them.

4.6 Integration and disruption

The Mijikenda trade was **integrated** into large networks connecting the East African coast with Asia (Oman, India), Europe and America. Since 1500 Mombasa had been a major East African port. Its economic power was largely based on good relations with the hinterland, for which it at times had to pay tribute (Berg 1974; Spear 1978). In the Portuguese period Mombasa received military aid from the Mijikenda. Each *kaya* was allied to and traded with specific Swahili groups (Guillain 1856). The Digo and Segeju had ties with the Vumba of Wasini and Vanga (McKay 1975), and other *makaya* had links with one or more Swahili groups in Mombasa, but not with Mombasa as a whole (Prins 1967). It is possible that these connections antedated the arrival of these Swahili in Mombasa and/or of the Mijikenda in their *makaya* (Berg 1968; Alpers & Ehret 1975; Chittick 1977).

After the defeat of the Portuguese the Imam of Oman appointed governors in Mombasa and other coastal towns. When in 1741 the Busaidi family seized power in Oman, the governor of Mombasa, who belonged to the rival Mazrui family, declared the town independent (Ochieng 1975). The Mazrui managed to unite the perpetually quarrelling factions of the Mombasa Swahili and so obtained the support of all Mijikenda in trade and war (Berg 1974). They used these resources to build a trading network stretching from Malindi to Tanga and including the islands Pate and Pemba; the latter was of special importance for its rice production (Ochieng 1975). In East Africa, only Zanzibar remained loyal to the Busaidi dynasty of Oman. Between 1813 and 1837 the Mazrui gradually lost terrain (Berg 1974; Ochieng 1975). In 1822 Pemba was taken, and at last in 1837 Mombasa was defeated, as much by internal division as by Omani force. The town became part of the empire of the

sultan of Oman, which after 1840 had Zanzibar as its capital (Salim 1973). In Zanzibar all international trade of the East African coast from Kilwa to Lamu was concentrated.

Compared with the contemporary ivory and slave trade in Tanzania, and with the later caravan trade by Arabs, Swahili and the Imperial British East Africa Company (IBEA Co.) in Kenya, the Mijikenda trade was rather **peaceful** (Sutton 1966; Spear 1978). That does not mean that there was no violence. There were skirmishes amongst the Mijikenda themselves. The Galla were their common archenemies. During the Portuguese period the Mijikenda received tribute to prevent them from raiding Mombasa (Gray 1947), and also in later periods battles with Arabs and Swahili were fought (Spear 1978; *Gunga* 1983). At times also the relations with the Kamba were strained; the famous Kamba trader Kivoi complained:

"... you must send away your Wanika [Mijikenda], for I do not like them, because they rob me of my ivory when I go through their country." (Krapf 1860: 294-295)

In all probability he was referring to the charging of *hongo* (toll) for goods which passed through Mijikenda territory (Salim 1973). In the 19th century, especially after a famine in 1836, some groups of Kamba settled themselves on Mijikenda land, notably amongst the Duruma, Rabai and Giriama (Lamphear 1970). Sometimes they were met with hostility, but usually mutual interests brought peace in these quarrels:

"These were always however amicably settled, as the Wakamba accustomed to the cocoa-wine [palm wine] and other luxuries of the coast did not care to return to their own country in the interior, and the Wanika [Mijikenda] imbibed too great a liking for their cows, sheep, &c. to let them depart." (Krapf 1860: 142)

Several factors may account for the relatively peaceful character of the trade (Spear 1978). Slaves constituted only a minor part of it, and the caravans were mostly small, some ten to forty men, and armed with only bows and arrows for self defence. However, the main factor was probably that the Mijikenda trading network was built up gradually from relations between neighbours, so that there was time to establish social relations which promoted peace. The Waata were friends of the Giriama, and "trade" often consisted of the exchange of gifts. The exchange with the Galla took place via Waata and at markets in neutral areas, where rituals at the start of the business served to maintain peace (Brantley 1981). Between individual Kamba and Giriama blood-brother links were forged, which gave each one support, protection and access to the relations of the other (Herlehy 1984b). Such ties were so strong that during the famines of the 1890s Kamba received food from their Giriama friends, and a Kamba could inherit the wives (levirate) of a Giriama blood-brother without biological brothers (Herlehy 1984b).

The relations with Arabs and Swahili have been mentioned already. The Mijikenda played a role in the politics of the Vumba (McKay 1975) and of Mombasa (Guillain 1856). They supported their allies in war, traded with them and maintained ritual links, although with the exception of the Digo they declined to become Muslims. Swahili doctors were welcomed in

the *makaya*, and Swahili craftsmen constructed *kaya* doors. The Mazrui family especially had the confidence of the Mijikenda and several of them were initiated Giriama elders. During famines, Giriama pawned wives and daughters to them for grain. In a famine early in the 19th century the Mazrui shipped them to Pemba, fed them and returned them afterwards. After the 1836 famine the new Busaidi governor of Mombasa sold many wives and daughters as slaves to Arabia (Krapf 1860; Spear 1978). As a consequence the Giriama shifted their trade to Takaungu, where members of the Mazrui family had fled after their defeat in 1837 (Koffsky 1977).

Another feature of Mijikenda trading were the links with their own **subsistence economy** (Spear 1978). Several trade articles were surpluses of agricultural products they also used themselves (grains, sesame, tobacco, palm wine, coconuts, copra, castor oil). Palm wine was sold among the major trade routes, especially in Rabai (Herlehy 1984a). Trade complemented agriculture by providing the people with goods they did not produce themselves: clay pots, salt, palm wine, iron wire, cloth, beads, etc. Gathering and trade offered a way to cope with the risks of farming; in the Mijikenda area drought and excessive rainfall are common. The returns of trade reinforced the local economy. Cattle meant bridewealth and wives meant agricultural production. When during the 19th century their prosperity increased many Mijikenda bought slaves. These were treated well and their children shared the rights of those of the owner (New 1873; Barrett 1911; Champion 1914). Marrying foreign women and female slaves was particularly popular among the matrilinear Digo, Duruma and Rabai, as such unions gave the husband strong claims on the labour of the wives and the descent of the children. For the effects of slavery on Mijikenda views of marriage see Gerlach (1965), Gomm (1972), Gillette (1978) and Brantley (1981).

How important were trade and the wealth acquired by means of it in the local economy? The accounts of the first missionaries did not give the impression of large scale involvement in trade. The Wanika [Mijikenda] mainly depended on agriculture, with most work being done by the women and with the men once they had been able to marry one or two wives "eschewing work as if it were sin" (New 1873). In order to raise the bridewealth poor young men dedicated themselves to the hard labour of cultivation, the more popular tapping of palm wine, and portrage. Whereas the Rabai and Ribe had several alternatives, for a young Giriama the way to marriage led through the land of the Kamba (*Gunga 1983*). For most Mijikenda portrage and/or trade were probably related to a specific phase of their life or a part time activity. For the rest of time commerce remained restricted to the sale of surpluses produced by their wives or of forest products gathered during famines.

A few successful traders did acquire considerable economic and political power, which contributed to the **breakdown** of the *kaya* societies (Spear 1978). At first the external trade was controlled by the *kambi* through their *wanandia* or agents (Brantley 1981). The elders dealt with all external relations and they were the only ones allowed to wear the *kitambi* (coloured cloth) and the *luvoo* (ivory bracelet), both proceeds of trade. Moreover, they controlled the cattle needed for the payment of bridewealth; a Giriama could not even hold

property until after his marriage (Trimingham 1964). However, the hard and dangerous long distance trade required strong men. Young men of several descent groups joined a *mudhiani* (caravan leader) whom they trusted to be capable. This meant a change of power structure: successful young traders could amass wealth, buy wives and slaves, obtain bonds across (sub)clan and ageset divisions, and acquire an independent outlook on the world (Cummings 1973). They often settled outside of the *kaya*, the sphere of influence of the *kambi*, and with the years they also learned ritual knowledge. They became independent from the *kaya* way of life and wielded the economical, social, political and ritual power which formerly was reserved to the now powerless *kambi*.

"... the government of the Wanika [Mijikenda] is not now what it must have been in earlier times. Everything in connection with them is falling into decadence. ... Every man does what is right in his own eyes; liberty, fraternity, and equality being the order of the day." (New 1873: 113-114)

The **new leaders** had acquired their power in a quite untraditional way, by trade instead of by growing old. However, they used it in a more traditional way, viz to invest in livestock and dependents (Spear 1978). A few successful traders acquired hundreds of followers, consisting of a mixture of free people from their own and other *makaya* and of purchased or fugitive slaves. Famous leaders of the 2nd half of the 19th century were Abe Ngoa (Giriama), Ngonyo wa Mwavuo (Giriama of Digo origin), Mwasangombe (Digo), Mtondomera (Digo) and Mwakikonga (Digo) (McKay 1975; Spear 1978). Most followers dispersed after the death of the leader, but Mtondomera and Mwakikonga installed themselves as *kubo*, a form of government that lasted into the 20th century (McKay 1975; Gillette 1978). The traders assumed part of the authority of the *kaya* elders, but most were unable to institutionalize their leadership. This led to a power vacuum, and increasing influence of individual elders based on fear of witchcraft (Champion 1914). The Mijikenda were to confront the changes of modern history without political leadership.

5 FARMERS OF THE HINTERLAND (1850-1985)

5.1 From *kaya* to village

The prominent feature of Mijikenda life during the 17th to 19th century was the *kaya* residence. From the 17th century onwards the Digo established several sub-*makaya*, an example later followed by the Duruma, Rabai and Giriama (Spear 1978). Such settlements were mere residences; they missed the social and ritual functions of the main *makaya* and the related physical structures such as the *moro* and *fingo*. In the establishment of several sub-*makaya* disputes between and within clans played a role (Spear 1978). Increasing scarcity of resources (land) may have been one of the causes; several traditions mention lack of forest

or land and quarrels about hunting prey (Spear 1982; *Wakanyoe 1984*). Also trade may have stimulated the establishment of sub-*makaya*; many were sited favourably near Swahili towns.

The sub-*makaya* did not affect the function of the main *makaya*, but between 1830 and 1880 these were abandoned on a large scale. The people settled themselves in their crop fields or at places where they could conduct trade. They only returned during occasional raids and for ritual purposes. When the people dispersed farther the *makaya* became less and less important. The Mijikenda who engaged most in external trade (Digo, Duruma, Rabai and Giriama) accumulated wealth, attracted followers, bought slaves, and married women from outside. Part of the assimilated people came from other Mijikenda tribes. Therefore, in the 19th century the trading groups had a higher rate of population growth, they were the first to leave their *makaya* on a large scale, and they occupied the largest areas. The Giriama, in particular, became numerous and around 1900 their territory stretched from Mariakani along the Mombasa-Nairobi railway to Hadu north of Sabaki river. However, most of their land and that of the Duruma is dry and only suitable for extensive grazing. When in the 1890s many Arabs and Swahili abandoned their plantations due to lack of slave labour the Mijikenda also moved into the coastal strip.

One of the factors behind the dispersion process was the expansion of **trade**. Markets (Jomvu, Mariakani, Biryaa) and villages to provision caravans (Silaloni) were established at the borders of Mijikenda territory. Many people moved into the Takaungu or Malindi hinterland. Others settled far west and north in Waata and Galla areas in pursuit of ivory and forest products, which became scarce near the *makaya*. Successful traders built their own villages out of the reach of *kaya* authority and security.

It was the comparative **safety** of the 19th century that made it possible to leave the protection of the *makaya*. The relations between Galla and notably the Giriama had improved. They conducted a lively trade and for *jivu* (payment) Giriama could get settlement rights in Galla areas. Between 1858 and 1869 the Galla were defeated by the Kwavi and Somali, and robbed of women and cattle. At the end of the 19th century they lost most of their cattle to rinderpest epidemics and withdrew to the Tana river area. Incidental Kwavi raids between 1824 and 1887 were apparently not able to halt the dispersion process. The Kwavi lived far outside the Mijikenda area and mostly attacked in the dry season. Often the people were able to withdraw in time and occasionally they even managed to hit back (New 1873). Kwavi raids could even have stimulated Giriama migration from the fertile southern *Weruni* (near Kaloleni) towards the drier north (Taylor 1891). With the rinderpest epidemics of the late 19th century the Kwavi threat also came to an end.

Trade and peace made it attractive and possible to abandon the restrictions of the *kaya*. However, the main cause of the process no doubt was the growth of the **population** beyond the carrying capacity of their environment.

"... The AGiryama say that the *kaya* became overpopulated and that all the suitable ground in the neighbourhood had become exhausted by cultivation." (Champion 1914: 5)

Before they were left most *makaya* housed up to some 1500 people, that of the Giriama probably even more (Spear 1978; Brantley 1978). With such a large population at one site a stable shifting cultivation system is hardly possible. The area for food production was limited by the forest belt around the *kaya* and by the obligation to sleep inside, which meant that all fields had to be within daily walking distance. Within that area part of the land was not suitable due to steep slopes and rock outcrops. Later on coconut palms and other tree crops further reduced the area for food crops, with the exception of *kaya* Giriama where it was too dry for palms. The establishment of permanent coconut fields made it attractive to live outside the *kaya*. The herds of cattle acquired by trade may also have pressed the need for fresh pastures.

Several *makaya* experienced **lack of water** for humans and livestock (New 1873; Champion 1914; Hawthorne *et al.* 1981). Nearly all rivers in the area are intermittent and most people depended on *mitsara* (waterholes) which in the dry season became brackish and muddy and finally might dry out completely:

"... the water supplies are few and far between, and some of them speedily dry up, and remain dry for months. Geriama is worse of than any district. In the dry season the women leave their homes at early dawn to fetch water, and do not return till night. At the same time pools of salt water, temptingly clear, are to be found everywhere in Geriama and Duruma. Were not the rain-falls regular and certain, the people could not exist. Any diminution in the amount of rain is instantly felt, and a season of drought occasions a famine." (New 1873: 81-82)

The further dispersion of the people was stimulated by **famines and epidemics** of smallpox, cholera, rinderpest, rats and locusts during the 1880s and 1890s (Fitzgerald 1898; Herlehy 1984a). Hungry people spread out in search of productive land or trade products to barter for food. Apparently, trade did not only give new opportunities but also brought new dangers, as pests and diseases followed the trading routes (McKay 1975; Spear 1978).

The dispersion of the Mijikenda was accompanied by the **breakdown** of the central *kaya* institutions: living per clan, *kambi* government, and *rika* initiation. The clans were mixed throughout the areas, the *kambi* had lost their power, and the last *rika* was initiated around 1870. British attempts to have a new one installed in 1919, and so provide some kind of government they could deal with, failed. Even the knowledge required for the ceremonies had been lost (Brantley 1981). The few remaining *kambi* still had jurisdiction, but their judgements were often ignored. The defeated would try his luck before another elder or even go to the colonial government. Moreover, anybody who did not accept the authority of the local elders could simply leave and start a new homestead (Champion 1914).

At first the **new settlements** were rather large *miji* (villages) surrounded by (thorn) bush through which a few tracks were cut. Some villages near the Sabaki river had stockades against the Galla and *Watoro* (fugitive slaves) and they were called *makaya*: Bate, Bura, Maiowe, Shingwaya, Dagamura, Kilulu, Starehe (Champion 1914). Dating of pottery excavated at Shingwaya indicated that the site had been occupied already during the 15th and 16th

century (Mutoro 1987). Probably, we will never know whether the site was resettled incidentally or whether the people, from Kauma, did return to a place they had heard about. Gradually the new settlements became smaller, until lack of land forced married sons to continue to live on their fathers' homesteads. Therefore the following prediction never became completely true:

"We must expect therefore, to find the villages continue to decrease in size until eventually the individual peasant is found in his hut standing in the fields which he cultivates." (Champion 1914: 10)



Photograph 3.8. At present the Mijikenda are moving into the last remnants of forests.

5.2 Changing fortunes

In the second half of the 19th century the regional economy of the Kenya coast underwent several changes. The Mijikenda gradually lost their profitable **middlemen** position in the long distance trade, at first to the Kamba, later to Arabs and Swahili, and finally to English and Indians (Spear 1978). In 1825 the first recorded Kamba caravan reached Mombasa (Berg 1974) and by 1840 the Kamba had replaced the Mijikenda as major caravan traders (Spear 1978). This takeover was facilitated by the settlement of Kamba among the Duruma, Rabai

and Giriama; particularly the 1836 famine brought many Kamba to the coastal hinterland. From around 1850 large and heavily armed Arab/Swahili caravans, often financed by Indian merchants and moneylenders, in turn replaced the smaller Kamba groups. These caravans were less vulnerable to Kwavi attacks and could increase their profit by raiding for slaves and ivory. After 1889 the IBEA Co. came to dominate the upcountry trade. The completion in 1901 of the Mombasa--Nairobi--Kisumu railway meant the end of the caravan trade (Berg 1974; Spear 1978).

Another major change was that between 1822 and 1907 under British pressure step by step **slavery** was outlawed in the dominions of the sultan of Zanzibar (Hollingsworth 1951; Salim 1973). In 1822 the sale of slaves to Christian nations, in 1845 the export of slaves out of Africa, and in 1873 their transport by sea were forbidden and all markets were closed. In 1889 slave children born in or after 1890 were declared free and transfers of slaves were forbidden. In 1897 the legal status of slavery was abolished in Zanzibar and Pemba, and in 1907 also on the Kenya coast (Salim 1973). The first steps restricted only the export of slaves, but not slavery itself. In East Africa this made slaves cheaper and so promoted a switch to the export of products grown by slaves (Cooper 1977, 1981; Salim 1973; Martin 1973). Around 1818 the clove tree was introduced in Zanzibar (Alpers 1974), and by 1840 the island had well established clove plantations (Cooper 1981). During the same period the Arabs and Swahili on the mainland also began large slave worked plantations, producing for export to Zanzibar, Pemba and Arabia.

The main product of the **plantations** of Vumba of Vanga and Shimoni was rice, but sorghum, pearl millet and sugar cane were also cultivated (McKay 1975). Around Mombasa, where land was relatively scarce, coconut became the main crop, while farther from the town in slave villages, of which some were established on Mijikenda land, millet and sesame were grown (Salim 1973; Cooper 1981). Takaungu produced millet and sesame; its plantations reached up to 10 km south of Malindi (Koffsky 1977). Malindi, which had been abandoned around 1800, after a long period of decline and Galla raids, was formally resettled in 1861. Together with the nearby Mambrui it became the largest sorghum, millet, maize and sesame exporter of East Africa between the 1870s and 1890s (Martin 1973; Cooper 1977, 1981). The town was the granary of the East African coast, Arabia and the Persian Gulf (Salim 1973). Other crops were tobacco, cassava, mango, orange and coconut, with the exception of tobacco mostly grown for local use. The plantations of Malindi and Mambrui extended up to 12-20 miles inland and were worked by 5,000 to 10,000 slaves (Salim 1973; Martin 1973; Cooper 1977, 1981; Spear 1978).

References to the large areas under cultivation above must be seen in perspective. Each town had various satellite settlements, which formed the cores from where cultivation took place. These hamlets were separated by bush, and within the cultivated area shifting or fallow cultivation was practised. Therefore, at any given time only a part of the total area was under crops (Fitzgerald 1898; Koffsky 1977). For example, in 1896 of a total of 111,000 acres once cultivated by Malindi only 15,000 were being used: 10,000 for grain production and

5,000 for tree crops (Salim 1973). However, in 1896 plantation agriculture was already in decline due to lack of slave labour and the fields reverted to bush or were occupied by Mijikenda squatters or ex-slaves that had not run away (Cooper 1981; Memon & Martin 1976).

The above changes in the pattern of trade and the establishment of coastal plantation agriculture, did not too seriously affect the **Mijikenda economy** (Spear 1978). Although the Mijikenda had lost their leading role in long distance trade, they continued to work as porters. Moreover, most trade between the Kamba and Mombasa still passed through Rabai and Duruma markets or via Giriama blood-brothers, and until far into the 20th century the Mijikenda continued to travel to the Kamba to buy cattle. They also expanded the ivory trade with Waata and Galla to north of the Sabaki river. The dispersion from the *makaya* had opened up new and fertile land. The Giriama increased the production and sale of grain, especially in the hinterland of Takaungu and in the Sabaki valley, west of Malindi. Other tribes planted more coconut palms and sold palm wine and copra. Notably the economy of the Rabai became heavily, and successfully, dependent on palm wine (Herlehy 1985).

The Mijikenda continued to sell gum copal and arrow poison, and from the last part of the 19th century also rubber and orchella weed (New 1873; Fitzgerald 1898; Champion 1914; Prins 1967; Salim 1973). Wild or Indian rubber, *mpira*, was tapped from *mlimbo-limbo*, vines of the genus *Landolphia*; the best quality was obtained from *L. kirkii*. The rubber vines were most common in Arabuko-Soko forest. Orchella weed, called *mahuyi*, *marere* or *ndevu ya mwitu* (beard of the forest) was a lichen hanging from trees and used to make a deep purple dye. Of the two species, *Rocella fuciformis* and *R. tinctoria*, the first was the longer and more valuable. The lichen was collected during the dry season, in the Giriama area and north of Mambui, where Bajuni from the Lamu area had special settlements for the harvest of orchella weed.

A more serious blow for the Mijikenda were the famines and epidemics of cholera, smallpox, locusts, rats and rinderpest that followed one another between 1880 and 1900 (Fitzgerald 1898; Herlehy 1984a). Many people died and others were pawned as slaves in exchange for food. Rinderpest damaged the herds and took what Kwavi raids had left of the prosperity built up during decennia of trade (Prins 1952; Kelly 1960; Spear 1978).

5.3 Colonial experiences

The hardship years coincided with the introduction of colonial rule between 1888 and 1914. The Mijikenda had been among the first East Africans to meet with the Europeans, but these early contacts had hardly affected them. From the 16th to the 18th century they had fought against and sometimes sided with the Portuguese. The battles may have been fierce, but they were outside Mijikenda territory and did not threaten the security of the *makaya*.

In the 19th century they were the first Kenyans to receive the attention of **Protestant missionaries**. In 1844 Krapf started his work in Rabai. Later other mission stations were established at Ribe, Jilore, Kaloleni and Godoma. When the first missionaries arrived the Mijikenda economy was flourishing and little need for a new religion was felt (Krapf 1860; New 1873). In fact, the missionaries' disapproval of polygamy and palm wine was a potential threat for the culture and economy of the Mijikenda, notably the Rabai (Herlehy 1985). Moreover, the missions built up a bad reputation by taking land without paying and by making the runaway slaves they harboured work on it (Salim 1973; Hawthorne *et al.* 1981). Therefore the missions with their non-Mijikenda populations were resented and became foreign enclaves and by 1900 hardly any Mijikenda had been converted to Christianity and the European way of life (Temu 1972).

"The few who came under the influence of missions tended to leave their tribal homes, and failed to influence in their turn the general life of the tribe." (Leys 1924: 143)

In the second half of the 19th century, European interest in Africa increased and the so-called **scramble for territory** started. In 1886 a combined German/French/British mission agreed that the dominions of the Sultan included only the islands of Zanzibar and Pemba, the Lamu archipelago, some coastal towns and their surroundings in Somalia, and a 10 miles wide strip along the coast from Rovuma river in Tanzania to Tana river in Kenya (Hollingsworth 1951; Salim 1973). The arbitrary 10 mile boundary ran through the territory of the Mijikenda, although they never had been subjects of the Sultan. In 1887, the British East Africa Association (BEAA), forerunner of the IBEA Co., received from the sultan a concession for the administration and development of the coastal strip between Vanga (Tanzania border) and Kipini (Tana river delta). Three years later Zanzibar, Pemba and the coastal strip became a British protectorate (Hollingsworth 1951; Salim 1973). In 1895, the East Africa Protectorate was declared; the administration of Zanzibar, Pemba and Kenya was taken over by the Foreign Office and in 1905 transferred to the Colonial Office. In 1920 the interior of Kenya became a settler colony and the coast remained a protectorate, under the nominal authority of the sultan of Zanzibar (Sorrenson 1965). White settlement was considered necessary in order to make the Uganda railway between Mombasa and Kisumu profitable (Cone & Lipscomb 1972; Ogot 1974).

In 1895, the Mijikenda supported the last **Mazrui rebellion** against the Busaidi Sultan and the British. The revolt was triggered by British interference in the succession of the Liwali of Takaungu, and coincided with the takeover of the IBEA Co. administration by the Foreign Office (Salim 1973; Koffsky 1977). As that change threatened Mijikenda claims on parts of the coastal strip, the rebellion can be interpreted as a battle to preserve their freedom (Ogot 1974). If so, the fight for independence was fought rather halfheartedly, because as soon as it became clear that the British might win, Ngonyo wa Mwavuo persuaded the Giriama to make peace with them. The grateful British allowed him to live in Marafa, north of the Sabaki river (Brantley 1981).

Initially the colonial government did not interfere much with the Mijikenda; their attention was directed to the coastal towns and on the interior of the country. From 1901 onwards taxes were occasionally collected and some headmen were appointed, although often the contacts between the British and Mijikenda were through Swahili or Arab agents (Patterson 1970; McKay 1975; Koffsky 1977; Brantley 1981). Between 1895 and 1912, after the breakdown of the slave-worked plantations of the coastal strip, the Mijikenda again became major **suppliers of grain** to the coastal towns and the main contributors to the grain exports of Malindi and Mambui. Most of the grain was produced on land north of the Sabaki river, recently occupied by Giriama, Kauma and other Mijikenda. Indian traders collected and transported it to Malindi; as early as 1902 the Giriama organized a trade boycott to drive up the grain prices (Brantley 1981; Cooper 1981). The Mijikenda sold some copra to Mombasa, traded palm wine among themselves, and continued to collect and sell wild rubber, especially during bad years. They were quiet and early colonial officers generally had a positive impression of them:

"... the great agricultural tribes of the Wa-Giriama and Wanika [Mijikenda]" (Fitzgerald 1898: 207) and "... no Administrative Officer could wish for a more amenable or a better behaved tribe." (Malindi District Annual Report, 1910-1911, cited by Patterson 1970: 91)

Their only complaints were that the women did most of the work, and that the men were too fond of palm wine and therefore refused to leave their homes for labour on public works, in towns and on coastal plantations (Patterson 1970). Their contribution to the colonial economy was the sale of agricultural surpluses, whereas the government was more interested in cheap wage labour:

"This case of the Giriama disproves the common allegation that the tribes in Kenya cannot be got to engage in production for export themselves but must become wage-earners in order to become useful citizens of the world. It also proves that the Government does not, to say the least, smile encouragingly on Africans who prefer to grow crops for export on land in their own occupation rather than work for wages." (Leys 1924: 147)

However, the Mijikenda preferred to work for themselves and their economy was still strong enough to resist efforts to push them to the labour market. Moreover, their demand for imported goods was limited; most Giriama preferred to consume palm wine or to invest in cattle, palms and wives (Patterson 1970; Brantley 1981).

In 1912 the peace was disturbed. Giriama men refused to work on a water project for Mombasa, and provincial commissioner Hobley ordered assistant district commissioner Champion to bring them under **closer administration** (Patterson 1970). In 1913 a census was taken, taxes were collected, headmen and native councils were appointed and ordered to build roads and council houses. At Mangea a permanent government post was built and the Giriama received the order to replace their *kaya* to that place, under threat of burning the old one. Champion also tried to stamp out the illegal ivory trade whose proceeds according to Hobley only served to buy palm wine (Patterson 1970).

The Giriama were forbidden to hold any land within the coastal strip. They also had to evacuate the area north of the Sabaki river, although many had been living there for a long time and with British consent (Patterson 1970; Martin 1973; Brantley 1981). The land north of Sabaki river was considered more fertile than that south of it (Leys 1924) and the shifting cultivation methods of the Mijikenda were supposed to damage it (Champion 1914). However, the major motive behind all moves was the policy of increasing the supply of labourers by limiting alternative ways of making a living (Leys 1924).

"During this came Champion, who ... asked for a place to settle. The Giriama did not like the idea and they said that he could not enter the place and settle. Here it is that Champion put up resistance and fought it out with the Giriama." (*Wakanyoe 1984*) and "When he [Champion] was in Giriama land, he wanted to take the youth with him. The people refused and fighting began." (*Masha 1984*)

It is interesting that **Mijikenda oral history** did not relate what happened with anonymous government policy but focused on the men who carried it out. Champion was to be remembered as a rebel against Giriama authority. The Mijikenda saw him and other officials as independent chieftains, who under threat took taxes, required labour, stole their ivory, and finally wanted to take over their land (Patterson 1970). Therefore, it was not surprising that the Giriama did react with a "total absence of expressions of goodwill" (Champion 1913). They refused to provide labour, harassed hut counters, tried to poison Champion's interpreter and took an oath (*kiraho*) to kill headmen, government employees, and all who wore European dress (Patterson 1970). The resistance against colonial rule went hand in hand with attempts to preserve the threatened traditional way of life (Njau & Mulaki 1984). The opposition centred around the charismatic woman Me Katilili and the elders Wanje, Bogosho, Pembe and Ngonyo, although it is not clear which role each played. Most events took place far from the *kaya* and were started by "young" people, which shows the decline of *kaya* influence (Brantley 1981). In August 1913 there was a minor riot at Chakama, which was followed by the arrest and banning of Me Katilili and Wanje to Nyanza (west Kenya) and the conclusion of a truce at a meeting in Vitengeni (Patterson 1970; Brantley 1981).

When in August 1914 the evacuation of the north bank of the Sabaki river and the recruitment of porters was enforced, the people revolted again, the "**Giriama rising**" (Brantley 1981). They killed some policemen, burned a few government buildings and houses of its supporters, and took to the bush. From there they shot their arrows at the police and the soldiers of the King's African Rifles (KAR) and poisoned waterholes with *Euphorbia* branches and tobacco snuff (Dundas 1955). The military, unable to capture them, burned huts, destroyed crops, took more than 6,000 goats, and so forced the Giriama to conclude peace (Temu 1972). The Giriama had to pay a fine of 100,000 rupees or 33,000 goats, to provide 1,000 labourers, and the north bank of the Sabaki river was evacuated. These demands were harsh as the Giriama experienced severe drought in the years before and after the rising (Leys 1924; Patterson 1970; Brantley 1981; Cooper 1981; Herlehy 1984a). They were even more bitter as the British were unprepared too handle large numbers of goats, so that many died (Geist 1981).

Famines and a drop in Malindi's grain exports after 1914 prompted the institution of a commission of inquiry and a food production committee (Leys 1924). In order to increase food production and to prevent famine relief and court actions the government in 1918 allowed resettlement of the north bank of Sabaki river. In fact, many Giriama had stayed there in hiding and others had already returned. The result was renewed prosperity and the grain exports of Malindi soon returned to the pre-war level (Cooper 1981). For both sides the rising ended in a **Pyrrhic victory**. The colonial government had won the battle and explained the new rules. However, they never obtained all the labour they wanted, and every change they proposed, even if beneficial, was to be viewed with mistrust (Leys 1924; Patterson 1970). The Mijikenda had obtained several concessions: the Sabaki valley was resettled, the influx into the coastal strip was never effectively stopped, and their contribution to the labour market remained limited. The establishment of settlement schemes and the promotion of cash crops showed that the colonial government had come to see them as agricultural producers. However, the Mijikenda had lost their political independence and economic freedom, and they gradually moved into a spiral of underdevelopment, which most painfully expressed itself in recurrent food shortages.

5.4 Scissors of poverty

The end of the uprising heralded a new period of peace, but not of prosperity. In the decades that followed, the production of food failed to keep up with the demands of the population, which increased from less than 100,000 persons at the turn of the century to about 900,000 by 1985 (extrapolated after Spear 1978; CBS 1981). The majority of the Mijikenda fell in the grip of poverty and malnutrition. They became as if squeezed between a pair of scissors that on the one hand cut away their alternatives to make a living and on the other reduced the resources they had at their disposal.

Famines and shortages

Throughout their history the Mijikenda have suffered from incidental famines, with ecological or man-made causes (Herlehy 1984a). The major famines of the 19th and 20th century are well remembered, although there is some confusion with regard to their exact dating and names. The people did not invent the names for the purpose of dating the events, but rather to express how they experienced them. Some *nzala* (famines) indeed refer to a specific case like that of the *ngano* (wheat), when wheat was handed out. Others like *ndugu si mutu* (brother is no human) reflect a feeling that different people may have experienced at different periods, namely that the ties of family or friendship no longer counted and that one averted his eyes so as not to have to invite others to share the food:

"So when a person gets money he will go and buy that food and he is going to eat while there is another person just close to him, but he won't say *karibu* [welcome] to him. After finishing

the man who was eating will say: "Oh, my brother, so you were just here? Yes, my brother, I did not know". So they called it *ndugu si mutu* [brother does not count]; you have to eat first, and then you can look at your brother." (Bennett 1985)

In the second half of this century food shortages and the buying of maize in shops became so normal, that no longer names were given. The incidental famines of the past had turned into structural shortages, which became so normal that they did not deserve names any longer. An exception occurred in 1980, when also in the shops there was no maize. The names *pesa si kitu* (money is nothing), *makusudi* (shopkeepers hoarded food) and *changilo* (people jumped from shop to shop) clearly show what a shocking experience this was.

Nutrition and health

In the first decades after the rising and during good years some grain was still exported from Kilifi and Kwale Districts; in some areas this local trade was carried on until the 1960s. Since then households that produce a surplus have become rare, and now most have to buy about half of the maize they require. That means that a large proportion of the family cash income has to be spent on buying staple food and that little money is left for buying "luxury" foods like milk, fish, meat, eggs, fruit or vegetables. People who produce protein rich foodstuffs may even have to sell them in order to buy cheaper staple foods (Gerlach 1964, 1965).

The nutritional situation is made worse by beliefs and habits with regard to food consumption (Standard 1983a; Nation 1983). These include a strong preference for maize, the idea that beans cause constipation, a dislike of cooking bananas, and rules that restrict the consumption of some protein rich foods by women or children. For interesting analyses of views and practices with regard to food consumption, with emphasis on Digo and Duruma, refer to Gerlach (1961, 1964, 1965). However, there can be little doubt that poverty is the major determinant of the poor nutritional status of the Mijikenda population (Times 1984).

Inadequate food consumption is reflected in the poor health status of the population, notably of women and children. Farmers in the Kaloleni area often advanced illness of their wives as an excuse for too late planting, poor weeding and consequent low yields of crops. Women in Kikoneni also lost a large proportion of their potential working days due to illness (Gillette 1978). Although malaria is often blamed, it is likely that health problems due to poor nutrition are also involved. During peak periods in weeding most women in spite of an increased food intake loose weight (Niemeyer *et al.* 1991). Infant mortality is high, a large proportion of the children are under the weight or height normal for their age, and nutritional diseases such as marasmus and kwashiorkor are common (Blankhart 1970, 1974; Kambi 1984; MENR 1984; Nation 1984b; Foeken & Hoorweg 1991).

Limited alternatives

The inadequate production of staple foods would not have been a problem, if the households had earned enough money to buy food in the shops. However, most income generating activities had severe restrictions. Some were due to the ecological conditions of the area, others related to the growth of the population or the preferences of the Mijikenda, and several more were caused by government policy. In this section only a summary is given; for details refer to chapters 4, 5 and 6 of this thesis.

Before the colonial period **hunting and gathering**, locally also fishing, were important ways of coping with the shortfalls of agricultural production. The colonial government soon regulated the hunting of large game and the exploitation of forest products (Salim 1973; Cooper 1981). Later the demand for wild rubber, gum copal and orchella weed decreased. Nowadays, due to population pressure, there is little left of the natural vegetation and fauna of the Mijikenda area. Only in a few remote corners there remain some trees to provide poles for building or to be turned into charcoal. The main gathering activities left are the use of weeds as vegetables and the consumption of wild fruits by children.

With the regulation of hunting and the completion of the railway the opportunities for **trade** decreased. In the period around 1914 the Mijikenda were often harassed in the coastal strip. They became dependent on Indian middlemen who had a virtual monopoly in the distribution of imported goods such as the popular *merikani* cloth (Martin 1973; Cooper 1981). In the 1920s all buying and selling was restricted to trading centres. These were dominated by Indian and Arab traders; the Mijikenda could not get licences because they lacked capital and security. After the second world war, trade regulations were relaxed. Gerlach (1963) described the phenomenon of Digo and Duruma traders on bicycles, selling milk, fish, palm wine and vegetables. Enterprising Giriama went into copra production, formed marketing cooperatives, started kiosks and shops, and invested in buses, tractors or lorries (Parkin 1972, 1974). Rabai, Ribe, Chonyi and Kauma engaged in similar activities (Mkangi 1975; Herlehy 1985). Until today small-time trade is one of the first options of people with just a little bit of money above the very subsistence minimum.

During the 1920s and 1930s the government took several measures restricting the local trade and export of maize and other **staple foods**. In that way they discouraged farmers from planting more than was needed for their own families. Under conditions where yields were unpredictable this contributed to the incidence of food shortages. Attempts to alleviate these by means of selecting and breeding improved maize cultivars and by stimulating better crop husbandry failed to overcome the joint effect of population growth and land degradation. The other food crops failed to make up for the shortfall of maize production. Sorghum, apart from being more susceptible to stalk borers, suffers from attacks by birds. Meanwhile, children are going to school and have no time for bird scaring. Rice needs specific soil and rainfall combinations and requires more labour. Bananas need fertile sites, above-average water availability, and people do not like them very much. Cassava is appreciated for its

drought resistance, but the Mijikenda, with the exception of the Digo, do not like to eat it all the time. Grain legumes are more popular but they are seen as ingredients for side dishes and not as staple foods. Moreover, their yields are variable, due to climatic risk, pests and diseases.

Another economic activity of the Mijikenda that was restricted was the sale of **palm wine** (Hobley *et al.* 1914; Herlehy 1985). This popular refreshment was consumed locally and also sold to the Kamba near Mariakani, the Taita hills and the coastal towns and plantations. The exchange between palm wine and maize producers, e.g. between the Digo and Duruma or the Rabai and Chonyi, meant that growers of coconut palms often better survived famines than producers of food crops (KNA 1940bcd). However, ever since the arrival of the first missionaries many outsiders have seen the affection of the Mijikenda for palm wine as their major vice and the main barrier on the road to development. The colonial authorities restricted the profitability of palm wine by means of licenses, fees and fines regulating its production, transport and consumption. After independence these measures were at first relaxed, but in 1981 the popular "brew" was completely outlawed. Numerous palm owners and tappers lost their most lucrative cash crop and one of their scarce economic alternatives (O'Muga 1982). The harvesting of nuts for drinking or cooking and the production of copra give much lower returns per palm; very few farmers have enough palms to live on from the sale of nuts or copra.

In the course of the century several alternative **cash crops** were promoted, each of which had shorter or longer boom periods. However, in general soils and climates, pests and diseases or poor marketing and variable prices restricted their benefits to small areas, few farmers, or short periods. Cotton was promoted from 1904 onwards and for several decades was a major cash crop in the area around Malindi (Martin 1973; Talbott 1973). Farmers elsewhere were deterred by the labour requirements, numerous insect pests, risk of rain during the harvest, and marketing problems (Koech 1983; *Bennett* 1985; Herlehy 1985). The establishment of a factory in Kilifi in the 1930s stimulated the cultivation of cashew. The crop adapts well to dry areas and poor soils, requires little labour, and is easy to store. Disadvantages are susceptibility to high rainfall, low yields and at times low prices (Tsuma 1982; Eijnatten & Abubaker 1983; Oltremare 1983). Anatto or bixa was introduced early in the 1960s and became an important cash crop in the area east of the Shimba hills (Goldson 1970). It competes with cashew for labour, as their harvest peaks coincide, and low prices and lack of processing capacity caused neglect of the shrubs and a decline in production (Gillette 1978; MENR 1985). The main problems of fruit crops such as mango, citrus, banana and pineapple are lack of transport, dependence on middlemen, lack of access to the export market, and the absence of processing facilities (Standard 1982a; Times 1983c; Nation 1984a).

The contribution of **livestock** to the economy of the Mijikenda showed large fluctuations. The herds built up during many decades of trade (prosperity) and deforestation (pastures) were decimated by successively Kwavi raids, rinderpest, and the 1914 rising. In the dry hinterland

of Kwale and Kilifi the production of cattle was stimulated by the Mariakani Milk Scheme which operated there from 1931 to 1978. It rendered veterinary services, controlled tsetse flies by bush cutting, improved water supplies with dams and boreholes, and organized the collection, processing and marketing of milk (ALDEV 1962; Gerlach 1963, 1965). The scheme collapsed because of mismanagement and was hard to revive due to mistrust from the part of farmers (Nation 1982; Sauti 1984). For reasons too numerous to be dealt with here, the organization of cooperative ranches also proved difficult, and by the mid 1980s most were still in the "proposed" or "dormant" stage (Olang' 1982; TARDA 1983; MENR 1984, 1985).

In wetter areas, for example around Kaloleni, cattle lost their place in the farms due to population growth, expansion of tree crops and increasing scarcity of land. Nowadays few farmers have cattle, in several cases herded elsewhere. Goats are common; they can easily be kept tethered beneath the trees. In 1980 zero grazing -- already proposed in the 1890s and again in the 1930s -- was introduced in Kilifi District (Fitzgerald 1898; Humphrey 1939). This labour and capital intensive system owes its merits to land scarcity (Stotz 1983; Goldson 1985). After some fence sitting and watching several farmers, most relatively wealthy and able to employ hired labour, adopted the system. Its profitability depends on the price of milk, which in turn varies with the distance to urban centres. Most Mijikenda households have too little land or capital to have any cattle at all; many are even too poor to buy milk (Leegwater *et al.* 1991).

For a long period **off-farm work** in coastal towns or plantations was the last choice of the Mijikenda. Only severe famine or other threats could induce them to leave their farms (Champion 1914; Savage & Munro 1966). Gradually land scarcity and the need for cash to pay taxes, staple food, clothes, and later education forced them to change their attitude. However, until the mid-20th century in comparison with other Kenyans only few Mijikenda were involved in off-farm work. These showed a preference for casual work and returned to their farms as soon as they had made enough money (Heyer 1975; Janmohamed 1976; Cooper 1981). By 1981 in the villages studied in the Kaloleni area 52 to 81 % had one or more men working off-farm, in 19 to 38 % of the cases the head of the household was involved. Instead of people being reluctant to take up off-farm work, for most it is very hard to get it. The Mijikenda are favoured by their proximity to Mombasa, Kilifi, Malindi and the numerous tourist hotels along the beach. However, they are handicapped by their late entry in the labour market, with other groups already entrenched in strategic positions. Moreover, most Mijikenda have a low level of education and so only classify for poorly paid jobs. Of the little money they earn often a large part is spent in town or on transport.

Scarce resources

In the 20th century agricultural development was also restricted by stresses on natural and human resources. The Mijikenda proved inventive in adapting to changing conditions; an

illustrative example was the continuous adjustment of the rules and practices with regard to the use of land and labour (Waaijenberg 1993). Nevertheless, many factors and changes were beyond their control. Although some individuals and households did well and reached a certain degree of wealth, many others saw their resource base decline and their degrees of freedom reduced.

A major cause of the food shortages was the increasing scarcity of **land** due to population growth and the introduction of coconut palms and other tree crops. Shortening of fallow periods caused a decline in soil fertility, a deterioration of soil structure, and a build-up of noxious weeds in annual crops. These are major causes of the present low labour productivity and frequent food shortages. During the 19th century the people moved into almost virgin areas, where with little effort high yields could be obtained, which amply compensated for seasons with poor rainfall. Once all forest had been cut and the fertility related with the standing vegetation had been exhausted, many farmers moved into the coastal strip or migrated to more favourable areas near the original *makaya*. This reversal of history was stimulated by the events around 1914, the desire to plant coconut palms, and later also the attractions of infrastructure and off-farm work. By 1985 population densities ranged from less than 50 persons km⁻² in dry areas where grazing or browsing is the main land use to more than 400 persons km⁻² in wetter areas where the landscape is dominated by coconut palms or annual crops. In both, with the current practices and inputs the population densities exceed the carrying capacity of the land, that is only a part of the livelihood can be provided by means of crop or animal production.

As mentioned earlier, the growing demand for cash and the restrictions on farm activities forced a sizable part of the **labour**, usually men and possibly the more enterprising ones, into off-farm work. The returns tend to be limited, as most workers earn little and spent part of that in town or on transport. After buying the necessary staple food, in most households only little remains for investment in farming. The costs of off-farm work are rather high. The already heavy work load of the women who stayed behind was increased, in many cases without a proportional compensation in their resources or power to take decisions. Although women grow most of the food, the men who are often away and not even knowing what is going on in the field, still control the access to land and the cash for labour, tools, tractor ploughing or chemical inputs. Under such conditions one can hardly expect efficient and innovative farm management, as already sketched 70 years ago:

"Nowadays it is only in years of special plenty that there is no food shortage before harvest. And it is absurd to pretend that the absence, in the agricultural tribes [of Kenya], of more than half the able-bodied male population is not the chief cause of this chronic scarcity. In addition an excessive share of the work of cultivation is thrown on the women, with consequent injury to their young children. And the kinds of work always done by man, such as house-building, are neglected." (Leys 1924: 304)

A large part of the **capital** of the Mijikenda had been destroyed by Kwavi raids, rinderpest and the 1914 rising. It proved difficult to recover the former, modest degree of wealth,

because of the limitations of farm activities mentioned and the heavy taxes imposed by the government. The hut tax rose from Rs 1 in 1901 to Rs 8 in 1921 and could take as much as half of the income (Cooper 1981). The timing of taxes, which were collected in cash, and restrictions on maize marketing often forced farmers to sell maize when prices were low and to buy it back later when they were high. Until independence most buyers and retailers were Indians or Arabs (Gerlach 1963; Parkin 1974, 1979; Cooper 1981). These probably spent a larger part of their profits outside of the area than local entrepreneurs would have done, so much money was being siphoned off instead of circulating in the local economy. In brief, of the already modest incomes of the Mijikenda a large part had to be spent at first on taxes and later increasingly on staple foods. In both cases capital was taken away rather than invested in livestock, tree crops, houses, infrastructure, education or business. This affected not only the present productivity and income but also the potential for future development.

Kwale and Kilifi are sparsely provided with **infrastructure** and services. During the first decades of colonial rule the major activity of the government in rural areas was the collection of taxes; more sensitive officials found it hard to justify their work to the local population (Memon & Martin 1976). The recurrent famines of the 1920s and 1930s forced the government into action. Research on food crops was started (Humphrey 1938), the planting of cashew was promoted (Herlehy 1985), and a veterinary official was posted (Sargent 1951), which finally led to the so called Mariakani Milk Scheme (ALDEV 1962). Cash crops received some new stimuli with the plans of Swynnerton (1954) and Brown (1963). After independence many marketing cooperatives were established in Kilifi District. These merged into the Kilifi District Cooperative Union (KDCU), which became the sole legal buyer of crop produce such as copra -- not always to the liking of farmers. In Kwale for several reasons cooperatives were less numerous and successful. Protestant and Catholic missions, Local Native Councils (LNC) and later also *harambee* (cooperation) efforts contributed to the improvement of education and health facilities (Mambo 1981). Rural water supplies were also improved, partly as a spin-off effect of the pipelines from Mzima Springs and Sabaki River to Mombasa (TARDA 1983). During the last decades numerous rural roads were constructed and some main roads were paved with tarmac. In spite of the efforts Kwale and Kilifi continue to score low with regard to physical infrastructure and social services. For example, the numbers of doctors or extensionists per person are below-average, the length of tarmac road per head can aptly be expressed in millimetres, most people have to walk long distances to drinking water or health centres, and education facilities, enrolment and results leave much to be desired (MENR 1984, 1985).

5.5 Failure of technology

The restrictions on activities and the stress on resources went without adequate changes in technology, here defined as the whole bundle of knowledge, skills, tools, crops and livestock that make production possible (adapted after Dommen 1988). It will be clear from the pre-

vious sections that the past and present technology is not the cause of all problems. However, improved technology could have enriched farmers' ability to cope with restrictions, to exploit opportunities, and conserve resources. It would certainly not have solved all problems.

Backward farmers

For more than a century missionaries, officials, researchers and bureaucrats considered laziness and prejudice as major causes of the assumed or real poverty of the Mijikenda. Although their motives and intentions probably were quite diverse, their expressions were remarkably similar.

"Cassada [cassava] is a very valuable plant to the natives; it is most easily propagated, and if the natives were not the laziest people in the world, they need never know what famine means." (New 1873: 87)

"... to date very little progress has been made in persuading the coast natives to adopt better methods, principally due to prejudice and probably laziness." (KNA 1925)

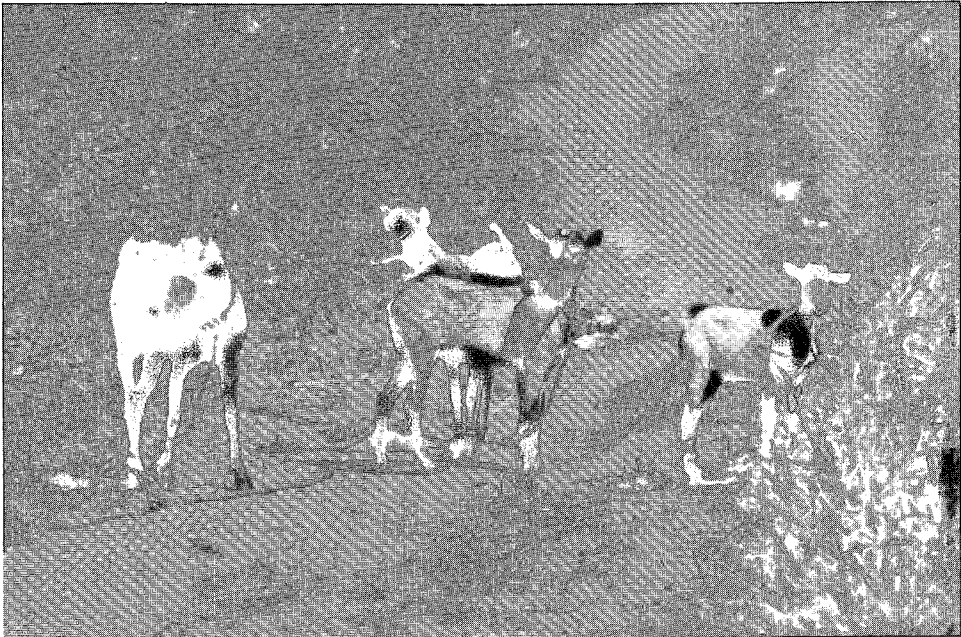
"... reluctance on the part of coastal tribes to change to modern methods was a major setback to the development of agriculture as a viable economic enterprise." (Standard 1982b)

These and numerous similar statements depart from the stubborn belief that the agricultural production of the Mijikenda is based on an age-old and outdated technology applied by farmers with an innate and irrational aversion to change. They assume that there is a large and unexploited agricultural potential that can be tapped easily by means of already amply available so called modern or improved seeds, inputs, tools and practices.

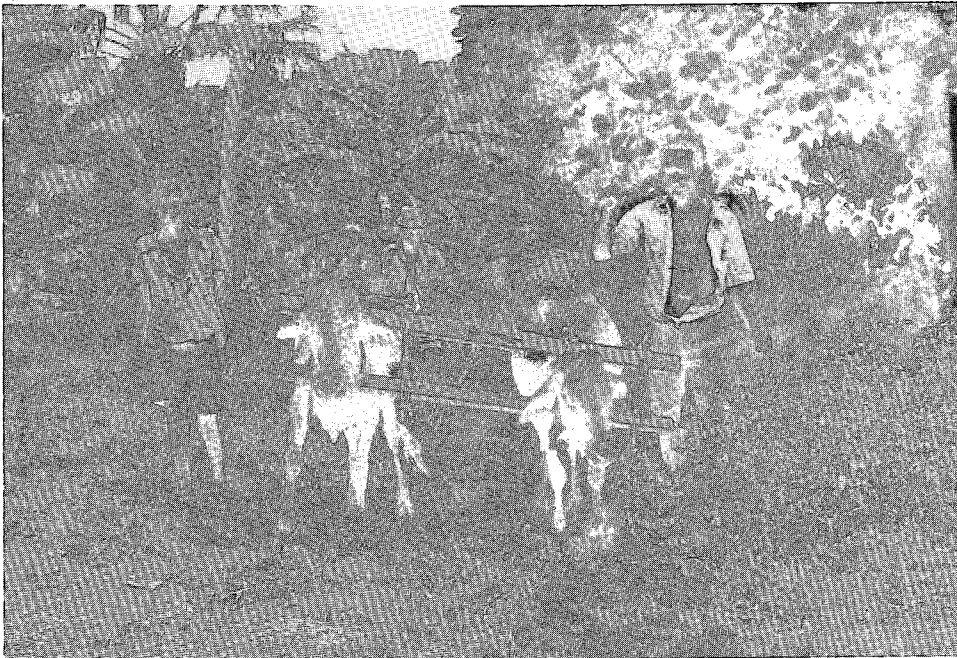
Inconspicuous change

"... [the Giriama] said they would most gladly cultivate any new products, provided a sale of the same was assured them." (Fitzgerald 1898: 97)

Far from being resistant to change, the Mijikenda showed much interest in the improvement of agriculture. All their major crops are relatively recent introductions: maize, rice, cassava, coconut and cashew. They learned by trial and error where and how to grow them. They adapted their tools and practices to the new crops and weeds. In coconut palms the rhino beetles are controlled by putting sand into their holes or killing them with a pointed stick or piece of wire. Many cashew plantations protect steep slopes against erosion; old trees are cut down and the fertility built up is used to grow a few crops of maize in what might be called a modified fallow cultivation system.



Photograph 3.9. Goats are muzzled so that they can be led safely through maize fields.



Photograph 3.10. Farmers and animals practising a new technology: ploughing with oxen.

Cattle have been moved from densely populated areas to places where land is less scarce; the introduction of zero grazing may bring milk production back to such areas. Instead of being herded by boys of school age goats are tethered beneath coconut palms. Where they have to cross maize fields to reach the browsing areas they are muzzled with tins or shells of coconuts or baobab fruits. On clay soils tractor ploughing has lightened the burden of land preparation and weeding. Now land is becoming very scarce people are beginning to appreciate the benefits of trash lines and various other formerly unpopular ways of combatting erosion.

Many changes have been slow and piecemeal, so that people staying for a short time only, like most officials, could not even have seen them happen. Today, for example, it is hard to imagine that the millions of coconut palms have not always been there or that so called traditional maize cultivars were introduced half a century ago. Nevertheless, hundreds of small improvements have changed the outlook of Mijikenda agriculture and enabled it to withstand better the heavy stress imposed by an ever growing population. Whereas in the past one square kilometre carried only a few tens of people, now it provides about half of the food and a sizable proportion of the cash income of up to four hundred persons.

Potential and technology

"... the potential of the [Kenya] coast is tremendous..." (Goldson 1970: 331)

From the mid-19th century onwards the agricultural potential of the southern Kenya coast has been described frequently in superlatives. Some writers were impressed by the exuberant vegetation (Krapf 1860; New 1873), while another found rich loam soils and fine crops everywhere (Fitzgerald 1898). More recently the large areas of unutilized arable land (Standard 1983b), and the possibility of raising yields were stressed (Goldson 1970; Warui 1982). The observers did not refer to one and the same reality: missionaries praised the beauty of creation, the explorer pictured the future potential, the administrator criticized the present abuse, and two directors of research highlighted the contributions of their institute.

Meanwhile, most of the vegetation and the related nutrients have disappeared and many soils were found to be -- or to have become -- less fertile than once thought. Most small farmers lack access to so called underutilized land, or have to leave part of their land under bush in order to restore soil fertility or because of lack of resources. There are indeed methods to raise livestock and crop yields to far above the present levels. However, these usually require high labour or money inputs, involve large risks, and in many cases give low margins. When all these obstacles have been overcome, for several products there is the old problem of marketing. Not surprisingly, most Mijikenda farmers are cautious when embarking on a new course, which attitude has often earned them the label of backwardness. Recently their views on the lack of suitable technology were confirmed, an important first step on the way towards improvement:

"Although Government efforts are being made to help small farmers through the Integrated Agricultural Development Programme (IADP), a major constraint for the programme is the lack of improved and suitably tested technologies." (Majisu 1980: 188)

"With the exception of small holder dairying in the coastal strip the preparation mission was unable to identify or recommend viable packages to improve the productivity of rangeland production ..." (BOOKER 1982: 5)

6 DISCUSSION

Appreciation of the past

In studies of precolonial or traditional African agriculture two kinds of viewpoints are encountered (Koponen 1988). One sketches a state of relative harmony and prosperity with people living in "comfort and plenty" (Kjekshus 1977: 181), while the other paints the past in terms of harsh struggles and misery in which "men measured out their lives in famines" (Iliffe 1979: 13). The Mijikenda would appear somewhere on the middle of this scale. Most had little material wealth, but their *makaya* offered them some protection against their enemies, whereas their food production, gathering, trade and social security systems helped them to survive adverse conditions. Only severe droughts and epidemics could threaten their existence (Herlehy 1984a).

The term "traditional" tends to be associated with a timeless or static culture, which was disrupted and accelerated at the advance of colonial rule and western technology. The present study has also described how things were during the so called *kaya* period, and how they changed afterwards. In that way, a false impression was given of the dynamics of Mijikenda society and agriculture. There were probably numerous developments between the 17th and 19th centuries, but apart from the knowledge that new crops were introduced, that the population increased, and that the extent and nature of trade did change, there was little information on which to build a detailed account.

An agricultural revolution

In the course of the last two centuries the society and agriculture of the Mijikenda changed irrecognizably. Apart from the abandonment of the *makaya* and of the way of life these implied, there were numerous other structural changes:

- from sorghum and millet to maize, cassava and rice;
- from annual crops to ever more palms and other trees;
- from gathering and trade to cash crops and off-farm work;

- from shifting cultivation to almost permanent land use;
- from inalienable communal rights to transferable private ownership;
- from herding and ranging to zero grazing;
- from hoe cultivation to tractor ploughing.

The differences between the past and present situation are impressive, also when compared to the pace of development elsewhere. The number, size and scope of the changes would justify the term "agricultural revolution" (Richards 1985). Objections against the use of such a term are that not all changes meant progress, and that the transformation of Mijikenda agriculture is the sum of many gradual and careful changes. Although today's agriculture at first sight is completely different from that of the past, it is firmly rooted in opinions and behaviour formed one to several centuries ago.

Pressure and opportunity

In 1965 two publications of consequence for the understanding of African agriculture appeared. The first -- while stressing the importance of the natural resource base in determining land use potential -- pointed out that carrying capacity is not an inherent characteristic of the land, but of the land use system employed (Allan 1965). The other argued that under population pressure farmers become even more inventive than normally and improve their technology or, to put it in the terms of the former publication, they adapt their land use systems (Boserup 1965).

In the changes of Mijikenda agriculture the pressure of population growth and land scarcity can be recognized. Among the examples are the spread from the *makaya*, the shortening of fallow periods, the changes in land tenure, the slowly growing interest in erosion control, and the adoption of zero grazing. However, Mijikenda farmers, far from being driven by pressure only, were also quite active in the pursuit of opportunities. They were resourceful traders, proved quick to grasp the potential of coconut palms and palm wine, preferred cashew and rejected cotton, set up small-time businesses and cooperative unions, and quickly saw there was a market for the milk of zero grazing cows. Whereas population pressure is likely to make farmers run behind the facts, the human potential will make them move ahead in time. In other words, rural development is more easily brought about by the carrot of benefits than by the stick of pressure as the different reception of soil conservation measures and crop or livestock productivity increases has shown (Ruthenberg 1985).

Traces of the past

Whereas in the coastal strip impressive ruins testify to a glorious past, in the coastal uplands the traces of history are much less conspicuous. The *makaya* are uninhabited, the wood and grass houses have returned to dust, and little of the sacred forests escaped from the axe.

Elsewhere small concentrations of baobab trees or silted waterholes are attributed to the people of the past. However, for an informed and attentive eye the landscape of the coastal uplands is a large mirror of the past and of the changes that happened. One sees the last patches of once lofty woods, a few sorghum or millet plants in a home garden, and the coloured seeds of so called traditional maize cultivars. The spatial pattern in the heights of coconut palms still reflects the spread of this tree of life, and the dense cashew forests on the hills behind Kilifi remind one of the factory established in the 1930s.

History has also left less material traces. The Shungwaya myth helped to unify the tribes into one people. Evidence that five hundred years ago there were already settlements north of Sabaki river reinforces claims to politically sensitive land. In the *makaya* the basis was laid for the present rules about land and labour. Trade influenced the patterns of population growth and increased the use of slave labour. Both are reflected by the sizes of the tribes and by their views on work or the roles of wives. The apparent tranquillity of the *kaya* period was followed by a series of drastic political, social, economic and ecological changes which led to the present state of poverty.

Speculation about what might have happened if the Mijikenda had not been struck by the adversities of the late 19th and early 20th century and had been left the choice to develop their own alternatives is of little use. History gives some knowledge of the past and helps to understand the present. It is impossible to translate these in clearcut answers for the future. The present situation looks gloomy, but the both cautious and open attitude of the Mijikenda with regard to new opportunities gives reason to be optimistic.

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4 Mijikenda farms in Coast Province of Kenya:
reality and model of peasant agriculture

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1 INTRODUCTION

The Mijikenda people

The Mijikenda (derived from *makaya chenda* or *miji chenda*: nine towns or villages) are a Bantu people numbering about one million persons and consisting of nine tribes: Digo, Duruma, Rabai, Ribe, Kambe, Jibana, Chonyi, Kauma and Giriama. They live in the hinterland of the southern Kenya Coast, from the Tanzania border to halfway between Sabaki and Tana rivers, in an area roughly coinciding with Kwale and Kilifi Districts of Coast Province of Kenya (figure 4.1).

On the east the area is bordered by a narrow coastal plain, where for more than one thousand years small ports maintained a lively trade with peoples from the other shores of the Indian Ocean. At present, with the exception of Mombasa which has good railway and road links with Nairobi, most of these ports have declined or depend on tourists who come for the coral beaches. In the west the area becomes a mostly flat, semi-arid and sparsely populated wilderness known as the Taru desert, in which the land use is wild parks and cattle ranches.

In between lie the coastal uplands and plateaus, an undulating landscape with a few prominent hills and ridges. Most soils are sandy, dry and poor, but there are numerous small valleys and depressions, and locally some larger pockets of fertile clay soils. The average annual rainfall ranges from more than 1,200 mm in the southeast to less than 600 mm in the west and north, with large differences between years and seasons. The original vegetation, little of which remains, consisted mostly of forests and woodlands.

According to oral traditions, the Mijikenda settled in the Mombasa hinterland about four hundred years ago. Until the 19th century they lived in nine *makaya* (singular *kaya*), i.e. fortified settlements on densely wooded hill tops (figure 4.1). They grew sorghum, millets and cowpea, kept some cattle and goats, and traded surpluses, forest products and some ivory with their neighbours in the coastal strip and the interior of the country.

In the course of the 19th century the Mijikenda left the protection of their *makaya* and spread over the surrounding countryside. Most of them still dwell in the uplands and plateaus, but large numbers have spilled into the coastal strip. Nowadays, the Mijikenda have scattered homesteads on small farms of a few hectares. They grow maize, rice, cassava and cowpea, and harvest the produce of their coconut, cashew, citrus or mango trees. A few households own cattle, most keep some goats or sheep, and nearly all have members working off-farm.

Kaloleni: go and see

The above gives a glimpse of the background of the Mijikenda. Their dynamic agricultural history was described in more detail in chapter 3 of this thesis. There the Mijikenda people

and their country were mostly dealt with as a whole, for lack of information or for the sake of clarity. However, there have always been between groups and areas. The people called Mijikenda today are an amalgam of old and new arrivals, hunters and herdsman, gatherers and cultivators, slaves and freemen. They have always lived under diverse natural and economic conditions, with flora and fauna determining the opportunities for gathering or hunting, soils and climate where coconut palms could be grown, and distances to coastal towns the access to markets or off-farm work. Historical processes, such as the diffusion of cassava and the participation in trade, did not act simultaneously or in the same way everywhere, but were modified by differences in the backgrounds and conditions of the people involved. As a result the Mijikenda area became a varied patchwork of different land uses and ways of farming.

For that reason the present study, which deals with Mijikenda agriculture as it is today, limits itself to one specific area that thanks to its moderate size is better surveyable than the total of Kwale and Kilifi Districts. The location selected for this case study is the Kaloleni area, defined as an approximately 40 km x 20 km east-west transect halfway between Mombasa and Kilifi (figure 4.1). The area displays a large variation in soils and climates, land uses and farms, population groups and densities, and infrastructure and services within relatively short distances. The name "Kaloleni" was borrowed from the largest village and the administrative unit in which most of the transect lies; it means, appropriately, "go and see" (Mwangudza 1983).

Views of agriculture

The diverse reality of Mijikenda agriculture can be observed and described in many ways. For example, it can be studied at various levels, from individual plants or animals, via fields or herds, to villages or agro-ecological zones. The focus may be on the productivity of crops or livestock, the utilization of land, the economics of enterprises, or on the people that coordinate them. The objects of study may be single units or aggregates of similar or different units. Each of the following sections on land and land use, farm organization, farm activities and classes of farms has its own levels of observation, focus or emphasis, sampling methods and sample sizes.

Agriculture is first depicted as a spatially differentiated land use which, like the natural vegetation it replaced, is determined by landform, soil type and climate. Then it is described in terms of farms, economic enterprises characterized by certain patterns of settlement, the composition and activities of households, and the organization of fields. Next, the economic activities and options of the farmers are presented and discussed. Finally, an exploratory classification of the farms studied is made and discussed. In other words, the themes of this paper are how the Mijikenda have adapted to their ecological conditions, how they have organized their economic activities, and to what extent they differ in the approaches they have adopted.

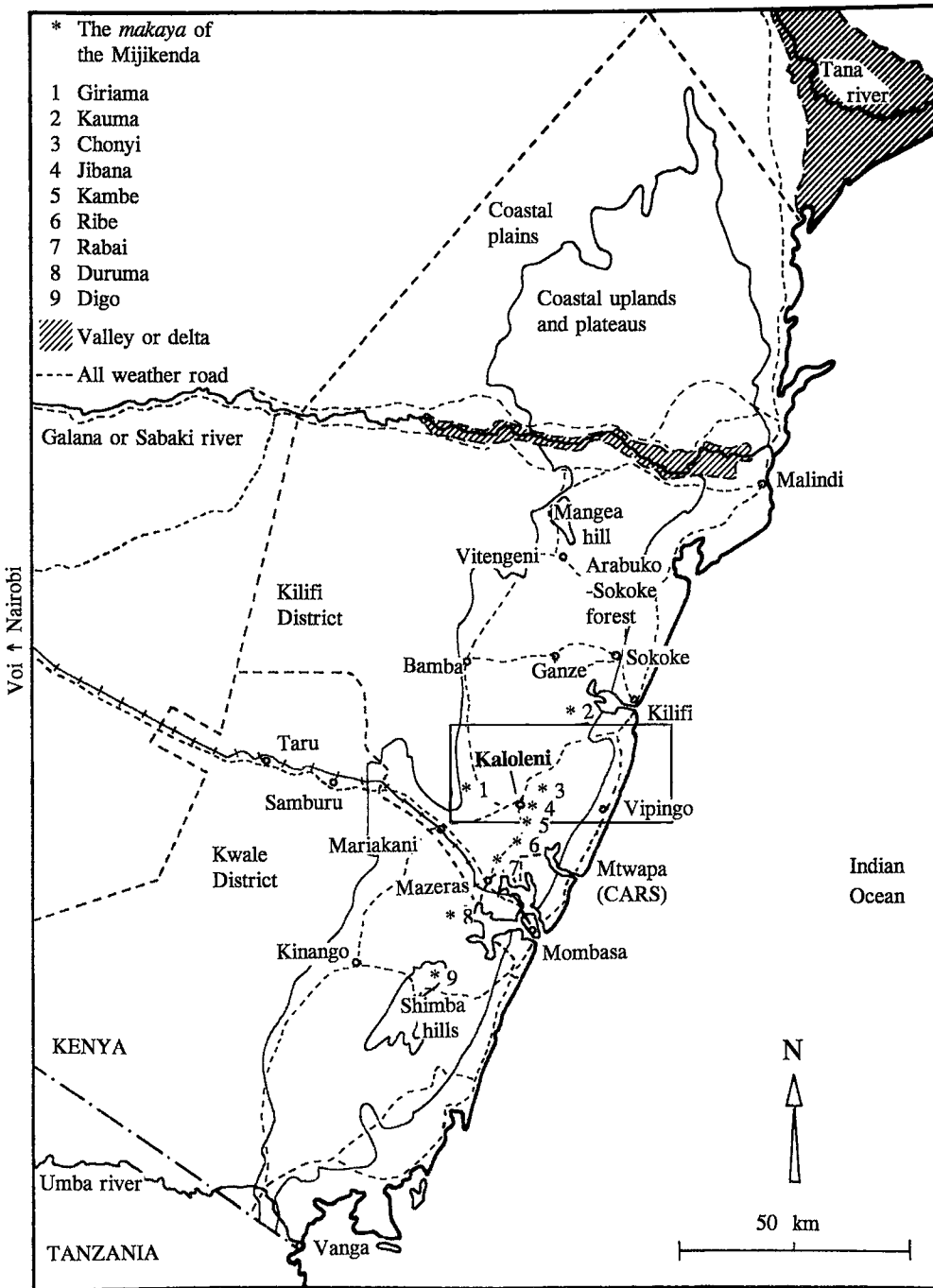


Figure 4.1. Geography of the southern Kenya coast.

2 METHODOLOGY

The field work for this study was carried out between 1981 and 1985. In this section the methods are outlined; details are given in the text and in the footnotes of figures and tables.

Land and land use

Whereas other sections limit themselves to the coastal uplands and plateaus, the description of land units and land use also includes the coastal strip in the east and the plains west of the coastal uplands, by way of context. Most information on soils, climate and vegetation was obtained from the literature, notably the report of the soil mapping and land evaluation project in which this study was carried out (Boxem *et al.*, 1987). The ratings of crop performance and the descriptions of land use zones are mainly based on the field observations and experiments described in chapters 5 and 6.

Farm organization

After a provisional delimitation of land use zones in mid-1981 four villages were selected that covered most of the variation in ecology and land use across the Kaloleni area: Pingilikani, Mbuyuni, Chilulu and Kinarani. In December 1981 two Giriama assistants using a questionnaire interviewed random samples of 31-37 farmers per village about household composition and economic activities, tenure and use of land, annual and perennial crops, and livestock. The information obtained forms the core of the section on farm organization.

Farm activities

The interviews of December 1981 also are the basis for the description of the productive activities of the farm household. They are complemented by the results of several later interviews, field surveys and experiments by the author or by students working under his supervision; references to interviews and students' reports are given in italics.

Classes of farms

The 31-37 farms studied in each of the four villages were used to study the differentiation in what at first view is a uniform small-farm area. The differences between farms were illustrated with Lorenz curves that visualized the skewed distribution of individual variables per village (Samuelson 1980). A multivariate approach was used to classify the farms. A first clustering was done with the help of SPSS-PC+ software (Norusis 1986). The output was refined by hand and presented graphically with the help of a tabulation method devised for the classification of vegetation relevés (Digby & Kempton 1987).

3 LAND AND LAND USE

3.1 Soil

The Kaloleni area consists of several rather distinct landscapes. The interaction of time, weather and vegetation on a wide range of landforms and parent materials has resulted in many different soils and land uses. Figure 4.2 and table 4.1 sketch the physiographical and geomorphological setting, and describe the most representative soil units. They do not show the variation within units; there are numerous valleys, depressions and micro-reliefs. These are too small to be presented in figure 4.2, but are nevertheless important, as they reduce climatic risks and enable production to be diversified.

Most of the soils in the area are sandy, permeable and low in organic matter. Water infiltrates easily and passes rapidly through the rooting zone, so crops grown on them tend to suffer from drought. During dry seasons the clay soils on shales (UT₂c₁p) form deep cracks; the first rain infiltrates rapidly, but then the cracks close and the soils become susceptible to waterlogging.

Most topsoils are easy to work with the small local hoe. Exceptions are those of USc₁, which become hard when dry, especially in truncated profiles, and UT₂c₁p, which are very sticky when wet. Although the latter is also hard when dry, because it is self-mulching the upper few centimetres become friable and are then easy to weed with the hoe. Under dry conditions tractors with disk ploughs may experience problems with the brick-like structure of USc₁, whereas under wet conditions they can better avoid the sticky and slippery UT₂c₁p and the sodic and soft P₁Ol.

Most of the soils in the area are susceptible to erosion, because they are on slopes, have a sandy texture or lack of organic matter. The principal forms of erosion are splash, sheet and gully (especially along paths) erosion. On soils developed on shales (UT₂c₁p) the heads of gullies and valleys "eat" into the land from below. Some farmers try to stop erosion by making trash lines and by dropping branches, weed residues and maize stalks into the gullies.

Except for the soils on shales (UT₂c₁p), the fertility of the soils is moderate to very low. In the past this was not a serious problem. The crops thrived on the accumulated fertility released by the burning of the fallow vegetation. Nowadays, with shortening fallow periods and very limited use of manure or fertilizer the low fertility of most soils is a major factor limiting growth and yield.

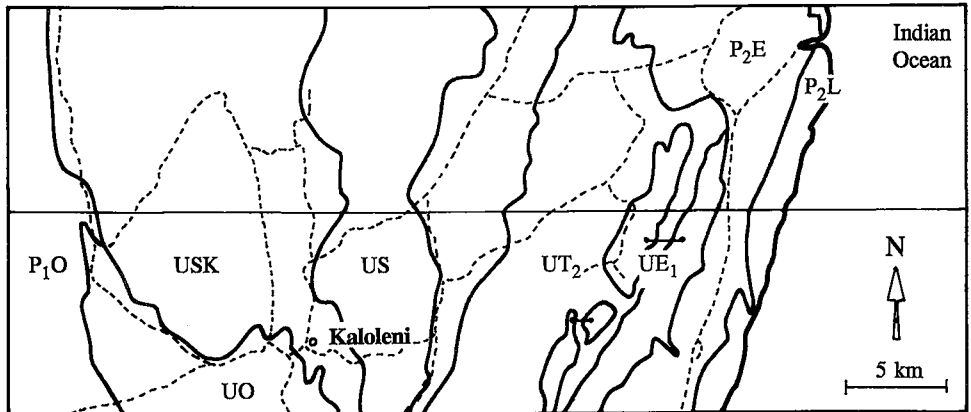
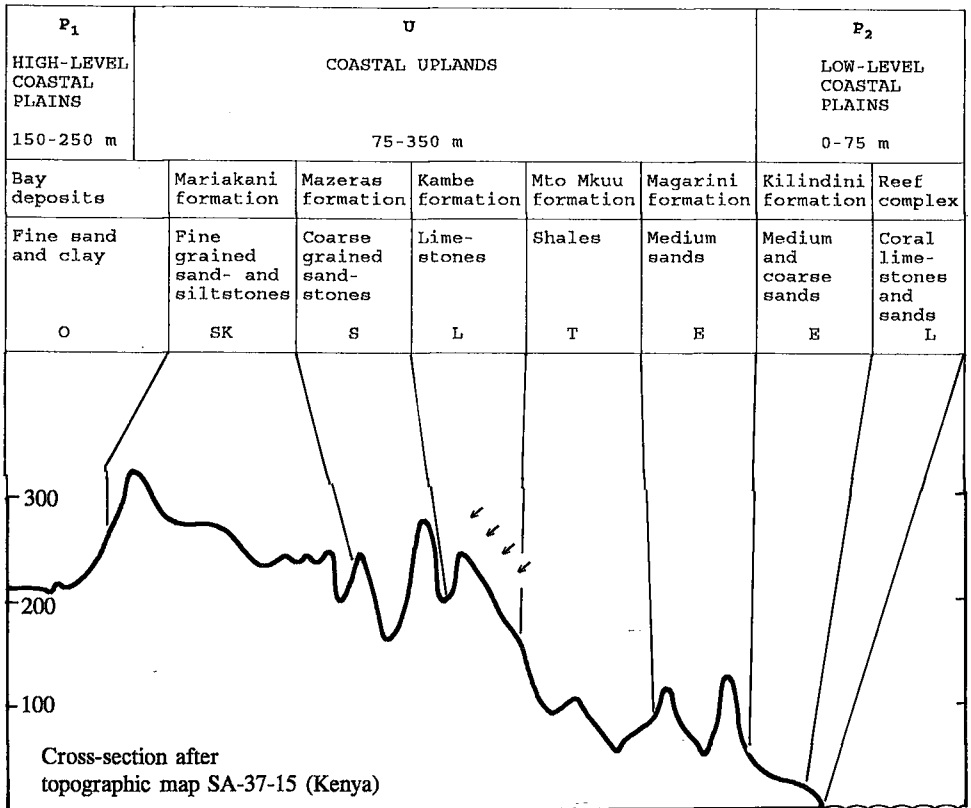


Figure 4.2. Physiography, geological formations and parent materials of the Kaloleni area, Coast Province of Kenya (adapted after BOXEM *et al.* 1987).

Table 4.1. Representative soil units of the Kaloleni area, Coast Province of Kenya; for details and codes see Boxem *et al.* (1987).

P₂Ll_{1p} - Lithosols, haplic Phaeozems, ferralic Cambisols

Well drained, shallow to moderately deep, red to dark reddish brown, extremely rocky, loam to sandy clay loam. ABC, AC and AR profiles, abrupt and irregular transition to the coral rock, low to moderate fertility, high permeability.

P₂El₁ - Ferric Luvisols and Acrisols

Well drained, very deep, dark red to yellowish red, sandy clay loam to sandy clay, underlying 30-60 cm medium sand to loamy medium sand. ABC profiles, mostly thick but weakly developed B horizon, low fertility, moderate to high permeability.

UE₁₁ - Rhodic Ferralsols, ferric and chromic Luvisols

Well drained, very deep, dusky red to reddish brown, sandy loam to sandy clay; in places underlying 20-40 cm loamy medium sand. ABC profiles, gradual to diffuse horizon boundaries, low nutrient status, high permeability.

UT₂C_{1p} - Gleyic and vertic Cambisols, chromic Vertisols

Well drained to moderately well drained, moderately deep to deep, yellowish red to yellowish brown, cracking clay; in places strongly mottled and/or calcareous. A(B)C profiles, clear horizon boundaries, high nutrient availability, variable permeability.

ULc₁ - Dystric Nitisols, chromic Acrisols and Luvisols; locally lithic

Well drained, deep to very deep, red to reddish brown, sandy clay to clay; in places rocky. ABC profiles, gradual horizon boundaries, mostly thick B horizon, showing shiny ped faces; moderate nutrient status, high permeability.

USc₁ - Ferric and chromic Luvisols; humic, ferric and orthic Acrisols

Well drained, deep to very deep, red to yellowish red, sandy clay loam to clay; in places underlying 20-80 cm medium sand to sandy loam. ABC profiles, BC profiles in case of topsoil erosion, clear horizon boundaries, low nutrient status and moderate to high permeability.

USKf - Albic and luvic Arenosols

Somewhat excessively drained, light brown to yellow, fine sand to sandy loam; in places with lamellae of clay accumulation. Profiles with little horizon development, a low nutrient status and a high to very high permeability.

P₁Ol - Gleyic and orthic Luvisols and Solonetz; solodic Planosols

Moderately well drained to imperfectly drained, deep to very deep, red-dish yellow to brown, mottled, sandy clay; in places underlying 20-80 cm fine sand to loamy fine sand. ABC profiles, abrupt to clear horizon boundaries, in places saline-sodic, in places with a petrocalcic horizon; variable nutrient status, low permeability.

Because of their elevation and relief several soils formed on bay deposits (O) because of their elevation and relief are grouped under those of the uplands (U); their codes start with UO. They are variable: some resemble USc₁ or even USKf whereas others are more like P₁Ol.

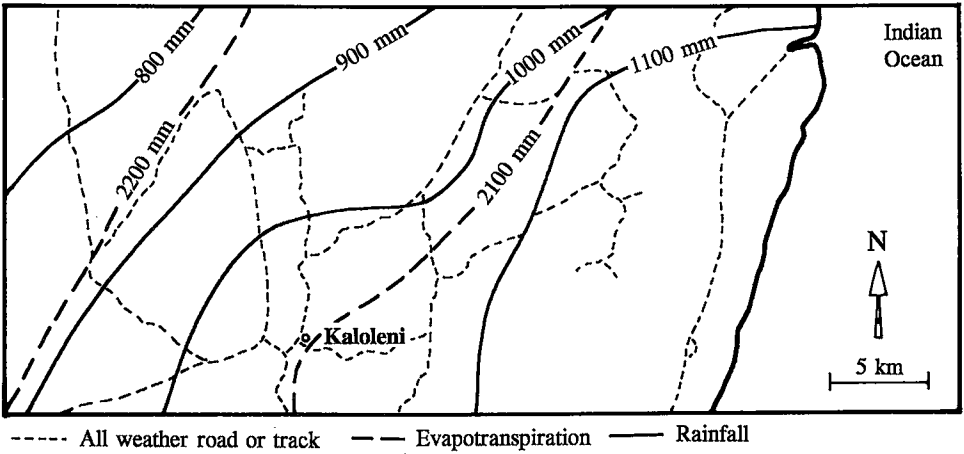
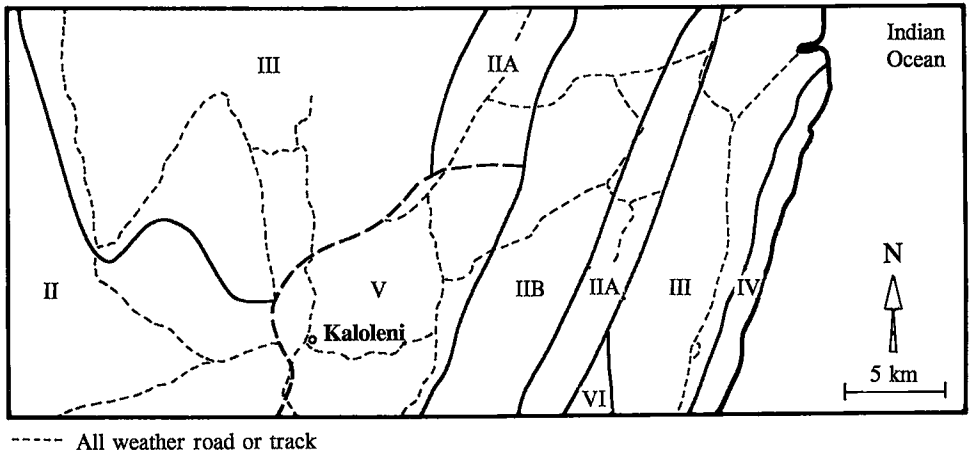


Figure 4.3. Approximate mean annual rainfall and evapotranspiration (mm) in the Kaloleni area, Coast Province of Kenya; after Boxem (1982, pers. comm.) and Jaetzold & Schmidt (1983).



II	<i>Manilkara-Diospyros</i>	Lowland dry forest
IIA	<i>Cynometra-Manilkara</i> (Sokoke)	Lowland dry forest
IIB	<i>Manilkara-Dalbergia/Hyparrhenia</i>	Lowland cultivation savanna
III	<i>Brachystegia-Azelia</i>	Lowland woodland
IV	<i>Combretum schumannii-Cassipourea</i>	Lowland dry forest on coral rag
V	<i>Sterculia-Chlorophora/Memecylon</i>	Lowland rain forest
VI	<i>Azelia-Albizia/Panicum</i>	Lowland moist savanna

Figure 4.4. Vegetation types of the Kaloleni area, Coast Province of Kenya; after Moomaw (1960).

3.2 Climate

The mean annual temperature in the Kaloleni area is about 24 °C and the potential evapotranspiration 2,100 mm per annum; the differences within and between years are relatively small. Rainfall is the most variable climatic factor. Inland the climate becomes drier, but locally the topography disturbs this pattern (figures 4.2 and 4.3). Behind the hills of the Magarini formation there is a rain shadow which becomes more pronounced towards the north, in the Ganze area. On the other hand, near Kaloleni the rainfall is higher than one would expect in view of the distance from the sea, and more reliable than elsewhere along the southern Kenya coast (Okoola 1978).

The rainfall is concentrated in the periods April-June (long rains) and September-November (short rains). Whereas near the coast most rain falls in the first season, inland the short rains are almost equally important. The amounts of rainfall received at any one site vary considerably. In the period 1981-1984, not an extreme example, the highest and lowest rainfall totals at five sites around Kaloleni differed a factor of 1.4-2.3 for years and 2.0-3.9 for seasons (chapter 5).

The effects of rainfall and evapotranspiration are modified by the topographical position, soil properties and the vegetation. Slopes, depending on their orientation, are exposed to varying intensities of wind, rain and sunshine. Soils vary in availability of water because of differences in infiltration, permeability, clay content, organic matter, fertility and root growth. Tall trees change the patterns of sun, rain and wind.

The high temperature and humidity of the Kaloleni area favour pests and diseases. For example, maize ears and cowpea pods are frequently lost due to rot during the ripening stage. Another case is sorghum: whereas the low rainfall makes the crop attractive, the humid air is a drawback, especially for compact heads that have been damaged by birds. The crop may simultaneously suffer both from drought (roots) and humidity (heads).

3.3 Vegetation

The natural vegetation of the Kaloleni area probably -- few people alive have seen more than scraps of it -- consisted of dense forests and woodlands. The classic study of Moomaw (1960) tried to reconstruct this situation, but not always with success, as shown by the unit "lowland cultivation savanna" (figure 4.4). A more recent study by Leeuwen (1982) depicts the present vegetation and land use; unfortunately his map is too detailed to be presented here.

Several soil unit and vegetation boundaries coincide. The effect of rainfall on the vegetation is less evident, as some isohyets run parallel with soil boundaries (figures 4.2, 4.3 and 4.4). However, it shows up in the transition from rain forest (V) to dry forest (IIA) or woodland

(III). The natural vegetation has also proved to be a good indicator of the suitability of climate and soil for specific land uses; the former natural and the present man-made vegetations are correlated. For example, coconut palms are concentrated in vegetation type V and the wetter parts of III. In most places with deep soils and adequate rainfall vegetation type IIB has been replaced with intensive annual cropping. Type II is mainly used for extensive grazing and browsing. The largest concentrations of old cashew trees occur in vegetation type IIA, but here the proximity of the processing plant established in the 1930s near Kilifi and fears that this land would be lost during the pre-independence period (before 1963) may also have played a role.

During the last two centuries the natural vegetation has gradually been replaced by annual and perennial crops, or has been affected by grazing, browsing, extraction and/or burning. A few isolated *mvule* (*Chlorophora excelsa*) or *mrihi* (*Brachystegia spiciiformis*) trees are the only survivors of the former forests or woodlands. These forests have given way to bushy grazing land and fallows of shrubs, grasses and herbs. In many places fallows have become so short, that the weeds growing between the crops are now the most "natural" element of the landscapes. Wild plants are still useful indicators of suitability; one cannot "see" soil fertility, but it can be assessed from the volume and composition of the natural, fallow or weed vegetation.

3.4 Crops

Nearly all land in the Kaloleni area has been cropped at some time in the past. Accordingly, farmers' knowledge of the suitability of their land is based on the performance of the crops themselves. The only drawback of this more direct indicator is that annual crops may be affected more by short-term weather variation than the composition of the weed population.

The standard practice in formal land evaluation is to determine the suitability of land units for specific uses by comparing selected soil and climate parameters with crop requirements derived from literature; only in the better cases is there calibration with actual crop yields. Table 4.2 starts from the opposite end: based on observations of growth and yield during 1981-1985 the actual crop performance on the main land units of the Kaloleni area was evaluated. The evaluation refers to crops without irrigation or fertilizer and is relative, as for most crops all soil-rainfall combinations are marginal, compared with conditions elsewhere in the world. Indications for fruit trees are very tentative, as farmers tend to plant them in above-average spots so that their performance says little about the land unit as a whole.

In table 4.2 the emphasis is on the performance of the crops in relation to soil fertility, water availability, weeds, pests and diseases. For farmers, factors that do not affect the crops themselves but interfere with operations such as cultivation and harvesting, may be just as important, if not more so. For example, weeding a field on sticky clay or infested by tall grasses, or harvesting cassava or groundnut on a dry and hard soil are unpleasant activities.

Table 4.2. Crop performance in the Kaloleni area, Coast Province of Kenya: tentative classification based on field experiments and observations of occurrence, growth and yield in farmers' fields.

Crop	Land unit (soil x climate)					Remarks
	Ping	Ngam	Mbuy	Chil	Kina	
Maize	-	++	++	+	+	Staple food, so must be grown everywhere
Sorghum*	+	++	++	+	+	Susceptible to bird attack; humidity may cause mouldy heads
Cassava	+	+	++	+	+	Harvest problems in Ngamani (wet and dry) and Chilulu (dry weather)
Cowpea	+	++	+	+	+	Yields variable because of insects
Green gram	+	++	+	+	+	Susceptible to mildew and aphids
Bambara nut	+	++	++	+	-	Wilt (<i>Fusarium?</i>) observed in Chilulu and Kinarani
Groundnut*	+	++	+	++	+	Harvest problems in Ngamani (wet and dry) and Chilulu (dry weather)
Sesame	+	++	+	+	++	Low yields and prices
Sunflower*	-	++	++	+	++	No bird damage observed; in Ngamani rats may eat seeds

Coconut	-	-	+	++	+	Distribution limited by low rainfall, poor drainage, cracking of clay soils
Cashewnut	+	-	+	+	+	High rainfall (>1,000 mm year ⁻¹ is harmful for yield (Eijnatten & Abubaker 1983)
Citrus spp.	-	-	++	++	+	Fruit trees are often grown near houses (refuse!) and other sites with above-average moisture availability and soil fertility
Mango	++	-	++	++	++	
Banana	+	-	++	++	+	

The land units are indicated by the abbreviated name of the village or area where most observations were made. Corresponding soil units are UE₁l₁, UT₂c₁p, ULC₁, USC₁ and USKf (table 4.1). For the approximate mean annual rainfall see figure 4.3. The evaluation applies to the central part of the area covered in the maps presented in this section. Key: - = poor, + = moderate, ++ = good performance; crops marked with * are rare, evaluation mostly based on experiments.

3.5 Zones

Differences in land suitability, geographical position and historical processes have led to distinct land use zones (figure 4.5). Many boundaries coincide with those of soil units; within the zones there are gradual changes from south to north, reflecting the decrease in the amount of rainfall. In the coastal strip (zone A) there is little relation between ecological conditions and land use, because of to historical factors (plantations, settlement schemes), and the effect of towns and beaches (vegetables, tourism).

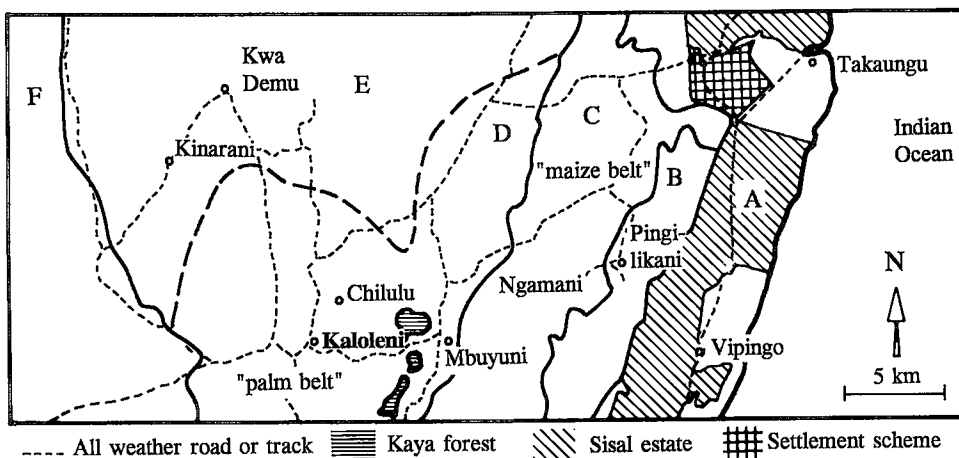


Figure 4.5. Land use zones of the Kaloleni area, Coast Province of Kenya.

Zone A is composed of the low-level coastal plains and some flatter parts of the Magarini formation. The population density varies from 50 to 300 persons km^{-2} because of the spatial distribution of the farming systems. There are small-scale farms, less than 10 ha (most 3 to 6 ha), with coconut, cashewnut, maize, cowpea and sesame production. Most lie in the settlement schemes established since 1962; before then, many farmers squatted on the same land. Medium-scale farms, 10 to 100 ha, devoted to vegetable, fruit, milk, poultry and coconut production are found mainly along the Mombasa-Kilifi road. Some large-scale farms, more than 1,000 ha, with sisal, milk, beef and mango production date from before independence (*Lieshout & Straver 1984*). This zone does not form part of the area studied.

Zone B consists of the remaining parts of the Magarini formation. The population density is about 50-150 persons km^{-2} . The homesteads, surrounded by coconut palms, are concentrated along the roads on the tops of the steep ridges. Most of the summits and upper slopes are covered by cashew trees. Some semi-permanent annual cropping takes place on the lower slopes. Rice is grown on valley bottoms between the hills rice. Most farmers grow maize and other annual crops in the adjacent zone C.

Zone C, known as Ngamani, is a thinly populated area with about 50 persons km⁻², despite the fertility of its clay soils. Most farmers live in the surrounding zones B and D where they have planted their tree crops. In zone C these are hardly grown because of rooting problems related to the drainage and the cracking of the soils. On the fertile soils, arable cropping is increasing in importance, especially since the introduction of tractor ploughing in the 1960s. This area might appropriately be called the "maize belt" of the Kaloleni area. In good years, which means moderate and well distributed rainfall, yields of 2,000 kg ha⁻¹ are obtained without fertilizer. Some maize is intercropped with rice; cassava, cowpea and some green gram, bambara, sesame and cotton are grown as relay crops. The part of Ngamani shown in figure 4.5 is the most productive. Southwards the soils become shallow and farther north rainfall becomes limiting.

Zone D, with diverse soils developed on limestone, sandstone and siltstone, forms a densely populated "palm belt" with 150-350 persons km⁻². Its western and northern boundaries roughly coincide with the 1,000 mm annual isohyet (Brom 1981). As well as coconut palms, mango, banana, *Citrus* spp., other fruit trees and cashew trees are also found; the cashew trees become more common towards the drier north. Maize is the main annual crop, followed by cassava and rice. The latter is grown wherever suitable valleys are found. In addition some cowpea, sesame and bambara nuts are planted. In this zone land is becoming very scarce, and many fields have been exhausted by too long periods of annual cropping. Some of the farmers in this zone have land in Ngamani, zone C.

Zone D gradually changes into the dry (700-900 mm rain year⁻¹) and relatively thinly populated (50-150 persons km⁻²) **Zone E**. Here, cashew is the dominant cash crop. Maize, cassava and a little sesame and even rice are grown, in a gamble against the climate. Where possible, timber, firewood, charcoal, honey and other products are extracted from the receding and degrading scrub and woodland. However, in most places, cropping, overgrazing, and the above forms of exploitation have reduced the vegetation cover to herbs and shrubs. This zone does not form part of the area studied.

In **Zone F**, with soils developed on saline sediments, the potential for crop growing is restricted by the rainfall of less than 800 mm year⁻¹ and the poor physical and chemical properties of the soils. This is reflected in a population density of about 50 persons km⁻². Most of the zone is covered by degraded or overgrazed *Acacia-Euphorbia* bushland. Extensive cattle farming, partly organized in cooperative ranches and locally some maize and cassava are the dominant land uses; towards the west there are large commercial ranches.



Photograph 4.1. Maize fields around Lutsangani, in the "maize belt" of the Kaloleni area.



Photograph 4.2. Coconut and cassava grow well in Mbuyuni, in the "palm belt" of the Kaloleni area.

4 FARM ORGANIZATION

4.1 Villages

The usual form of Mijikenda settlement is by village, a word used here for any concentration of rural homesteads. Some villages have clearly visible centres, usually clustered around shops, a school or a church; in other cases the homesteads are more dispersed through the landscape or clustered along roads or on the tops of hills.

On the one hand the village has a somewhat limited influence on land use and farming. It is often hard to see where the land of one village ends and that of another begins. The government representative in the village or sublocation, i.e. the subchief, has little to do with agriculture. He tries to prevent bush fires and encourages people to plant more trees, but his main task is to keep order and to prevent the tapping and drinking of palm wine. On the other hand the village is the place people feel they belong to, where the closest relatives and friends live. It is the unit for building schools or roads or digging trenches for piped water, and the first arena where local elders settle disputes about land, labour, crops and livestock.

The main village of the area is Kaloleni, with administrative headquarters (police station, agricultural office), secondary schools, churches and a mosque, a modern hospital, a post office with a public telephone, a buying centre of the Kilifi District Cooperative Union (KDCU), some bars, a restaurant, a shop selling tools and agrochemicals and a few local smiths making hoes. Kaloleni is a major junction for bus lines to and from Mombasa, Kilifi, Bamba and Mariakani; numerous small kiosks thrive on the flow of travellers. Other major villages outside the Kaloleni area but of economic interest are Mtwapa (with the Coast Agricultural Research Station -- CARS), Vipingo (headquarters of a sisal estate with the same name), and Mazeras, Mariakani and Bamba (livestock markets).

Most other villages have small centres, with no more than a primary school, one or two modest churches and a few kiosks or small shops. Usually by far the most people in a village belong to a single Mijikenda tribe. The following analysis refers to four such villages: Pingilikani, Mbuyuni, Chilulu and Kinarani, which are situated across the coastal uplands in different environments of the Kaloleni area (figure 4.5). Their populations were defined as all households which said they lived in the area denoted by the village names.

In **Pingilikani** most homesteads are clustered along the roads on the tops of the ridges of the Magarini formation (zone B). They are surrounded by fields of cashew. Some annual crops are grown on the slopes of the hills, but most farmers grow such crops on fertile land in Ngamani (zone C).

Mbuyuni is situated on the eastern border of the palm belt (zone D). About three-quarters of the farmers live in the palm belt itself, the others live in Ngamani (zone C). Most of the farmers grow coconut palms, *Citrus* and cashew trees and nearly all have land in Ngamani for annual crops.

Chilulu represents the heart of the palm belt (zone D), a varied landscape where areas densely planted with coconut palms alternate with fields of annual crops. Less than one-fifth of the farmers have land in Ngamani (zone C).

Kinarani lies on the dry western edge of the coastal uplands (zone E). The main farming activities are the growing of maize and cashew trees and grazing. The few coconut palms are mainly grown for home consumption; yields are low because of lack of rain. The opportunities for forest exploitation are limited, as most of the area has been deforested.

The differences between villages are not as large as one might expect, as villagers use land in different zones (Pingilikani, Mbuyuni) or different types of land within one zone (Chilulu, Kinarani). Moreover, all villages strongly depend on off-farm work in still another zone: the towns Mombasa, Kilifi, Malindi and Nairobi.

Table 4.3. Ecological and demographic data on four rural villages in Kaloleni Division, Coast Province of Kenya, 1981.

	Pingilikani	Mbuyuni	Chilulu	Kinarani	References
Principal soil units	UE ₁ l ₁ UT ₂ c ₁ P	ULc ₁ UT ₂ c ₁ P	USc ₁	USKf	Plus valleys (Boxem et al. 1987)
Mean annual rainfall (mm)	1000-1200	950-1200	1000-1200	800-1000	Jaetzold & Schmidt (1983)
Principal population groups	Chonyi	Chonyi	Giriama Jibana	Giriama	Main tribes in Kilifi District (Spear 1978)
Approximate population density (persons km ⁻²)	80	140	300	90	After CBS (1981) and own interviews

4.2 Households

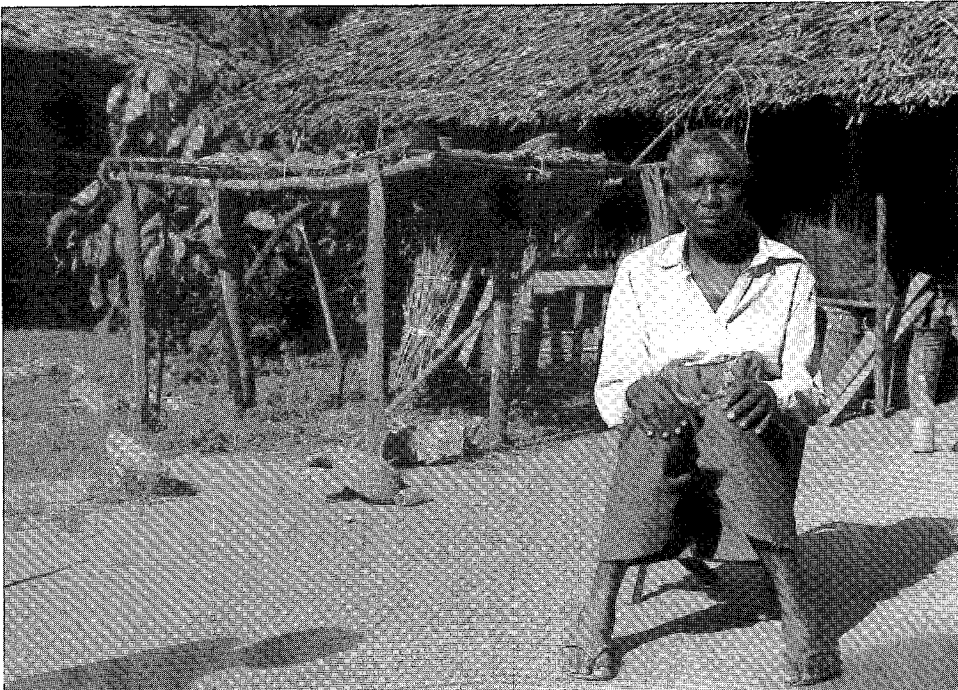
It is difficult to choose an appropriate unit for the analysis of Mijikenda farming. Some farming decisions are taken by individuals (e.g. use of plots), others by nuclear families (e.g. allocation of land) or by larger groups (e.g. sale of land). At all levels it may be a single person who takes or expresses the decision, on behalf of the group. Similar difficulties arise in the analysis of farm work or the use of the crops.

The largest unit within the village is the homestead, a cluster of houses inhabited by closely related people, often an extended family. The houses or huts tend to be grouped around that of the senior male and they share paths to fields and other homesteads. Each homestead

consists of one or more households, defined as people who work, eat and/or sleep together. These are usually linked by family ties. The farm is the household's joint agricultural enterprise and includes fields, crops and animals.

During the 1981 interviews the above criteria were outlined to the respondents, who were then left free to delimit their own households. In table 4.4 all persons sleeping and working off-farm and not contributing to the household income have been excluded, whereas people working off-farm but sleeping at home or contributing financially, and persons studying or looking for work have been included in the household. The freedom given to the respondents resulted in rather large "households", in some cases of two or more nuclear families. The CBS (1981) census apparently applied stricter criteria, resulting in much smaller households (table 4.4).

Although in some cases proud respondents probably exaggerated the size of their household, in many others the basic unit of decision, working and consumption was indeed large and consisted of two or more closely integrated nuclear families. The household size is determined by its stage of development (Chayanov 1925) and by economic or social factors such as having sufficient money to marry many wives or the ability to keep adult sons together (Mkangi 1975).



Photograph 4.3. The head of a Mijikenda household.

Head of the household

The head of the household -- usually the eldest married male member of the household -- coordinates the economic and social activities of the household and contributes in the work, especially that related to coconut palms and livestock. Nowadays one-quarter of the household heads cannot fulfil these duties adequately, because they work or even sleep off-farm (table 4.4). These men tend to be young, to have had some formal education and to be Christian. Of 34 household heads working off-farm 78 % were less than 50 years old, 74 % had received some formal education and 62 % were Christian. For 93 heads working on-farm the corresponding percentages are 48 %, 36 % and 32 %. The absence of household heads means more than the loss of labour. It also hampers decision-making, as these men retain often responsibility (for example for land allocation and tractor hire or purchase of fertilizer), whereas they no longer know the details of what happens on the farm.

Men: off-farm

Of all men of 15 years and over only about 47 % work full-time or nearly full-time on the farm. Some 37 % work off-farm, which here excludes the tapping of palms and occasional work on other farms. Off-farm work gives a more regular and reliable income than most farm activities, and this is more personal than the income obtained from working in a father's field or tending his tree crops. However, only a part of the salary is brought home, the rest being spent on travel or housing, food, drink and women in town. During interviews and field visits men often said they were looking for work; given the opportunity, the number of off-farm workers probably would increase. About 15 % of the men were attending primary or secondary school or, in a few cases, literacy classes for adults.

Women: on-farm

For the women the situation is completely different; about 92 % work on the farm, 5 % attend school and only 2 % work off-farm. The dependence of farm work on women is demonstrated by the fact that the areas planted with maize correlate positively with the number of women on the farm (maize = $-0.4 + 1.1 * \text{women}$; $R^2 = 0.56$, $n = 17$; 1982). The absence of women from schools and off-farm work is alarming. They grow the least attractive crop (maize) and lack the education to improve farming (they cannot calculate or read simple leaflets or labels) or to run away (unless into very poorly paid work or prostitution).

Table 4.4. Characterization of the households in four villages in the Kaloleni area, Coast Province of Kenya, December 1981.

	Pingilikani	Mbuyuni	Chilulu	Kinarani
Number of units				
Households listed	121	91	99	91
Households studied	31	37	32	31
Married men household ⁻¹	2.1	>2.5	>2.3	2.3
Married women household ⁻¹	3.3	>3.3	>3.3	3.7
Head of household				
Age (years)	50	54	47	54
Formal education (% of heads)	42	41	69	39
Working off-farm (% of heads)	19	19	38	29
Sleeping off-farm (% of heads)	13	11	>22	23
Religion of head				
Mijikenda (% of heads)	65	38	53	81
Muslim (% of heads)	0	0	6	6
Christian (% of heads)	35	62	41	13
Household composition				
Men (≥ 15 years)	3.7	3.6	3.9	3.4
Women (≥ 15 years)	3.6	3.9	3.5	4.1
Children (≤ 14 years)	5.8	5.6	7.7	7.5
Total: mean (median)	13.1 (10)	13.1 (11)	15.1 (14)	15.0 (11)
Total: mean CBS (1981)	5.7	6.5	5.9	8.8
Household activities				
Men on-farm (% of farms)	1.8 (87)	1.8 (97)	1.7 (87)	1.3 (90)
Men off-farm (% of farms)	1.1 (52)	1.4 (76)	1.2 (81)	1.4 (74)
Men studying (% of farms)	0.5 (35)	0.5 (27)	0.7 (56)	0.7 (35)
Women on-farm (% of farms)	3.5 (97)	3.4 (97)	3.2 (100)	3.8 (100)
Women off-farm (% of farms)	0.0 (0)	0.1 (5)	0.2 (9)	0.1 (13)
Women studying (% of farms)	0.1 (6)	0.4 (19)	0.1 (9)	0.1 (6)
Hired farm labour				
Employing (% of farms)	36	22	31	23
Costs 1981 (Ksh farm ⁻¹)*	870	790	520	200
Tractor ploughing				
Employment (% of farms)	42	19	3	0
Costs 1981 (Ksh farm ⁻¹)*	810	330	50	0

The data refer to December 1981 or to the whole of 1981 and with the exception of the asterisked variables apply to the whole sample. An > sign means that in one or few households the condition was not clear; the real figure may be slightly higher.

Hoes and tractors

The main farming tools are short-handled small hoes (clearing and weeding), machetes (slashing shrubs and tall weeds), knives (tapping palm wine) and mortars and pestles (processing grain). The own labour force is complemented by hiring tractors for ploughing or manual labour for clearing and weeding. Most ploughing takes place in Ngamani, during the long dry season, just

before the start of the rains. The payment is per acre and depends on guesstimates of the area ploughed; farmers are likely to overpay. Most labour is hired on a *vipande* (piecework) basis, paid per field or per 10 x 10 steps cleared or weeded.

There is an indication that off-farm work not only causes the need but also provides the cash for tractor hire or piecework. Of the 38 farms without off-farm workers only 21 % employed tractors or hired labour, whereas of the 93 farms with off-workers 38 % did. The number of cases is rather small for firm conclusions, but the pattern was consistent in all villages.

4.3 Fields

Fields are not much easier to define than households. The concept used in the interviews is that of a contiguous piece of land that the farmer considers a single unit. That means that the delimitation of fields depends on who is considered the farmer; the head of the household tends to think in larger fields (*munda*) than other members, for whom individual plots (*makoho*) are more interesting units. The definition also permits heterogeneous fields that, as long as the farmer does not object, may include different soil units, several crops, unused parts and parts worked by different persons.

However, instead of explaining these complications to the "farmer" (whoever he or she was), it was chosen to use the Swahili *shamba* (field; roughly equivalent to the Mijikenda *munda*) in the interview and to wait for the results. Nearly all respondents adopted the "head of the household's view" and distinguished fields based on spatial separation and including land under crops or short-term fallow. Part of the was often not considered to be a field or mentioned as such: small home gardens or rice plots, grazing land (group rights), long-term fallows (weaker claims), or land not yet divided between brothers.

Land tenure and use

Most farmers consider crop land (fields) their "own", not only where it is registered in the name of individuals (Pingilikani, Mbuyuni, Chilulu), but also where the land officially belongs to cooperative ranches (Kinarani). Although nearly all farmers own at least some land, some are partially or even totally dependent on land borrowed or rented from others (table 4.5).

Table 4.6 presents information on the access to different kinds of land, the intensity of its use, and the areas available. Farmers' estimates of the land use intensity "R" (Ruthenberg 1980) indicate scarcity of land, a preference for land in the Ngamani area, and a transition from one season to cropping two seasons from east to west. As fallowing is the only form of soil improvement, the intensive land use is alarming. It explains why farmers in Pingilikani and Mbuyuni are interested in the fertile soils of Ngamani, in spite of the distance

from their houses, along narrow and slippery paths, which increases walking time, transport cost and the incidence of theft. In the densely populated Chilulu most fields are near the houses. In Kinarani the distances vary; although many houses are on once fertile sites used for cropping, newly cleared fields tend to be far away and separated by degraded land nowadays used solely for grazing.

Table 4.5. Land tenure in four villages in the Kaloleni area, Coast Province of Kenya, 1981.

	Pingilikani	Mbuyuni	Chilulu	Kinarani
Farms studied	31	37	32	31
Land owned (% of farms)	100	89	94	97
Land on loan (% of farms)	0	14	19	19
Land loaned out (% of farms)	13	16	19	3
Usufruct pledged in (% of farms)	0	0	9	6
Usufruct pledged out (% of farms)	16	19	6	0
Land rented from others (% of farms)	0	3	3	3
Land rented to others (% of farms)	0	3	3	3

Table 4.6. Land use in four villages in the Kaloleni area, Coast Province of Kenya, 1981.

	Pingilikani	Mbuyuni	Chilulu	Kinarani
Farms studied	31	37	32	31
Ngamani (% of farms)	71	73	6	0
Other land (% of farms)	90	86	100	100
Land use intensity (R %)				
Ngamani, long rains	81	92	-	-
Ngamani, short rains	21	50	-	-
Other land, long rains	49	69	61	46
Other land, short rains	8	32	49	37
Maximum mean farm size (ha)	16	9	5	16

- Estimates of the land use intensity R (%) refer to fields only.
- The maximum mean farm size is based on mean population densities (table 4.3) and mean household sizes (table 4.4).

It proved difficult to estimate the areas of fields and farms by asking farmers. Many respondents could not express areas in acres or hectares. For those who could, the sum of the areas of the fields was, on average, 3-4 ha farm⁻¹. As said earlier, many farms have also land under long-term fallow, used only for grazing, or without clear claims. Table 4.6 gives estimates of the maximum mean areas available per farm, based on the average population

density and household size of the villages. These areas include roads, paths and home yards (especially of importance in Chilulu), steep slopes (Pingilikani), degraded land used for grazing (Kinarani), and fields belonging to people from elsewhere (farmers in Pingilikani and Mbuyuni are not the only ones with access to Ngamani). Therefore, they overestimate the farm sizes in all villages.

The situation is especially critical in Chilulu, where farmers have, on average, 2.0 ha of maize, 0.1 ha of rice, 184 coconut palms, 25 cashew, 26 citrus and 6 mango trees, 29 banana stands (of one to several plants), several minor crops, some goats and chickens, a homestead and an area of land under fallow on much less than 5 ha of sandy soils exhausted by many decades of almost continuous cropping.

Crops in space and time

The land use of the Mijikenda can be summed up as "**mixed cropping**". Table 4.7 shows that in 1981 there were far more crops than fields, not counting the many minor crops (vegetables) and the fact that for several crops, numerous cultivars with differences in growth habits and cultivation methods are grown -- sometimes simultaneously, sometimes during different periods of the year. In a rapid survey in 1982 up to 19 annual crops were recorded per field; moreover, nearly all fields had coconut palms and cashew or fruit trees (Waaijberg 1983).

Table 4.7. Numbers of fields and annual crops per farm in four villages in the Kaloleni area, Coast Province of Kenya, 1981.

	Pingilikani	Mbuyuni	Chilulu	Kinarani
Farms studied	31	37	32	31
Fields farm ⁻¹	2.7	2.5	2.0	2.2
Annual crops/farm				
Long rains 1981	7.1	7.5	6.9	6.1
Short rains 1981	1.8	7.5	3.8	3.1

The many crops found on any piece of land may be of various ages and have different owners. For example, a piece of land belongs to a farmer called Kazungu. In the lowest part his younger wife Esther grows rice and some sweet potato. The rest he has lent to his cousin Stanley to grow maize, cowpea and cassava. There are young cashew trees planted by Kazungu's father David, and old coconut palms which belong to his uncle Mweni. The latter mortgaged their production to Charo, who hired a young man called Masha to tap them. In a corner Kazungu's goats, tethered to some old orange trees, are grazing. This is a typical scenario.

Although crops are found in almost every site and every possible combination, they are not planted at random. There are relations with **topography and soil** which become stronger where ecological conditions are more extreme. For example, around Chilulu, where rainfall is relatively high and reliable, coconut palms are planted on hill tops and along valleys as well as on slopes (figure 4.6). In Kinarani, where precipitation is lower and less reliable, palms can only survive where most water is available, i.e. on flat tops and valley bottoms. In Pingilikani, coconut palms and fruit trees are found in similar positions; here the poor nutrient status of the eroded slopes may also play a role. In Ngamani, palms only thrive where there is good drainage and no cracking clay: a few sandy sites on hill tops and in valley bottoms.

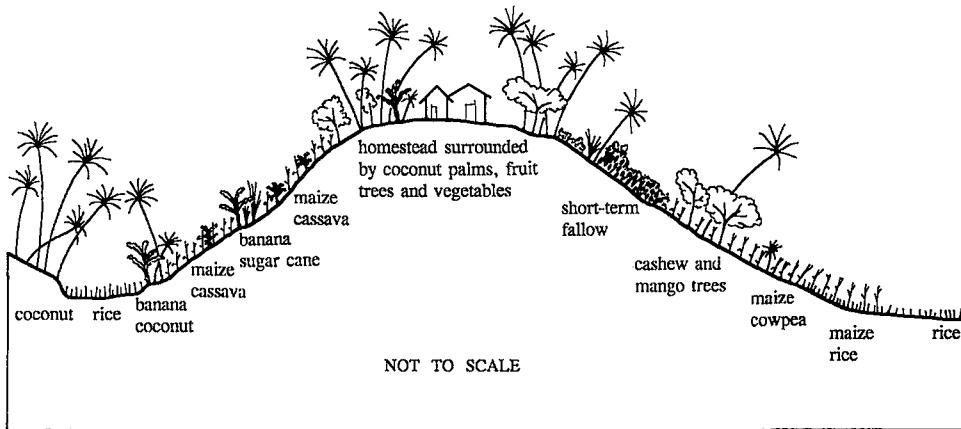


Figure 4.6. A typical toposequence in Chilulu, Kaloleni area, Coast Province of Kenya.

Rice also occupies specific niches in the landscape. Most is grown as sole crop on bottom lands and valley bottoms, but in Ngamani it is also intercropped with maize, on summits and slopes. Wetter than average years favour rice, drier years favour maize. The total yield of both crops appears to be enough to make the combination attractive, Moreover, the rice is probably less of a competitor for the maize than the gramineous weeds it replaces.

Maize is grown anywhere, although under dry conditions more care appears to be paid to the choice -- there may be little -- of land. Under coconut palms the yields of maize are lower than in the open, but often less labour is needed for weeding and the palms may benefit from the intercropping. There are indications that growing maize during the rainy season, followed by short-lived annual weeds in the dry season, competes less with the palms for water and nutrients than weeds, notably shrubs, all year round (Floor 1981).

Fields not only vary in their topography and soil, but also in their **rainfall distribution**. Two annual crop patterns can be distinguished, varying from year to year in response to climatic variation. Near the coast, where the long rains are more pronounced, most maize is planted at the start of the rains. About one month later during the first weeding, some widely spaced cassava is planted in part of the field. After silking a small part of the maize is weeded again and is interplanted with densely spaced relay crops: cowpea, sesame or bambara. During the short rains most land is left fallow. Further inland, where the rainfall is lower and more bimodal, the common practice is staggered planting of maize in both seasons. Relay crops are less important; cowpeas are often interplanted with the maize, spread in low density throughout the maize field.

The central features of Mijikenda agriculture -- the practice of mixed cropping, the growing of a crop in several fields and under different ecological conditions, and staggered planting - are often related to **risk management**. Some may indeed spread risks, for example, by reducing the incidence of pests or diseases, but there are more obvious motives. Interplanting between crops which have to be weeded anyway reduces labour inputs, and the lack of land and the planting of all crops in their optimal site result in mixed cropping where the niches overlap, e.g. maize, banana and rice on lower slopes.

From observations and interviews it appears that Mijikenda farmers aim to plant all crops at the best place and moment. Deviations are not a matter of accepting lower yields in return for lower risks, but can usually be traced to lack of better land or labour. This explains why rice is planted under less than optimal conditions but still on the best available land, and maize is grown on less fertile but easy to clear fields. Similarly, a farmer may grow maize in several topographical positions without intending to spread risks, but merely by planting all the land he can lay his hands on.

Near the coast, where the onset of the long rains is more reliable, most land is cleared in the dry season and planted just before or after the first rains; this may be seen as risk avoidance by planting all at the optimal time. In the interior, where the onset of the rains is less certain, it makes no sense to clear large areas in advance. Farmers prepare a small area, wait for rain, plant, weed, and repeat this process whenever rainfall and labour allow. The result may be risk spreading, but this is at best only partly intentional. Mijikenda farmers adapt to climatic risk by playing safe rather than by gambling.

Apart from the short-term changes in space and time, there is also a **long term trend** in the appearance of the fields. During recent decades, the planting of tree crops, the farmers' reluctance to cut down unproductive coconut palms, and the government prohibition to fell useless cashew trees have changed and fixed the landscape. In due course the cultivation of annual crops and the keeping of cattle will become restricted to areas that are unsuitable for tree crops.

5 FARM ACTIVITIES

5.1 Using wild plants

In the past, fishing, hunting and gathering were important complementary activities of Mijikenda farmers (Mwangudza 1983). In the Kaloleni area all streams are intermittent, and the fishes few and small. Whereas long ago animals as large as elephants or buffaloes were hunted, nowadays most game consists of small rodents, birds, and grasshoppers. The exploitation of wild plants is the only activity that has retained importance in spite of the reduction of the natural vegetation.

Table 4.8 presents a selection of the numerous wild plants used by the farmers of the Kaloleni area. There is a remarkable diversity in the species concerned and in their uses. One and the same plant can be a noxious weed, be eaten as a vegetable, and used as a medicine. Within some botanical species several users distinguish two or more types. In the case of *salakushe* one of these is preferred above the other, both are wild. In that of *mnavu* some plants are gathered where they happen to grow, while those of another type are sown and even transplanted; the division between wild and cultivated plants is indistinct.

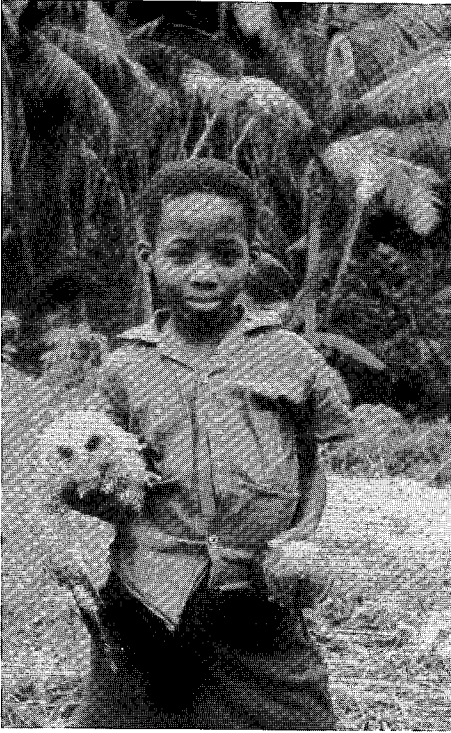
In table 4.8 an important group of plants is absent, i.e. the trees that provide fuel for cooking and materials for building. In the Kaloleni area they have become scarce; only in Kinarani is some timber, firewood or charcoal still sold occasionally. In the countryside the increasing scarcity of fuel is met by using e.g. husks or petioles of coconut palms. Towns like Kilifi or Mombasa are supplied with charcoal from the Ganze--Bamba--Vitengeni triangle in Kilifi District and the Kinango--Samburu--Taru area in Kwale District, but there too trees have become very scarce. Charcoal from overaged cashew trees may become an alternative, but people do not like its low energy/volume ratio (Eijnatten & Abubaker 1983).

The supply of timber is even more critical; in the near future the characteristic wattle-and-daub houses may disappear for lack of building materials. Twigs and fibres are being replaced by sisal poles or split petioles of palms and with strips of sisal leaves. It is hard to find a substitute for the strong, straight poles that give the structure its strength. In Kaloleni, between 1981 and 1984 they doubled in price and were obtained from up to 100 km or farther away. Demand for timber threatens the ecologically unique Arabuko-Sokoke, Mangea hill and Shimba hills forests, and the historically and floristically valuable remnants of the *kaya* forests. Rich people can afford to buy the equally scarce and quite expensive mangrove timber. Others substitute the poles with split coconut palm trunks, but in general sentiments against such a profane use of trees planted by parents and grandparents remain strong. The scarcity of timber, more than that of firewood, stimulated farmers' interest in the planting of trees like *Casuarina equisetifolia*. However, before the first of these are ready for cutting, thousands of coral-block-and-cement houses will probably have been built.

Table 4.8. Examples of the wild and semi-wild plants used by the Mijikenda of the Kaloleni area, Coast Province of Kenya, collected between 1983 and 1985.

Family	Scientific name	Vernacular	Remarks
Acanthaceae	<i>Asystasia gangetica</i>	<i>Salakushe</i>	Leaf vegetable; farmers distinguish two types
Caesalpinaceae	<i>Caesalpinia volkensii</i>	<i>Mburuga</i>	Large and hard seeds are used in rattles, and for the popular game of <i>bao</i>
Compositae	<i>Launaea cornuta</i>	<i>Mutsunga</i>	Popular leaf vegetable; common weed in Ngamani
Dioscoreaceae	<i>Dioscorea dumetorum</i>	<i>Mariga</i>	Tubers (poisonous) eaten during food shortages
Gramineae	<i>Coix lacryma jobi</i>	<i>Nderenya</i>	Beads for collars etc. to sell to tourists
	<i>Hyparrhenia rufa</i>	<i>Muchuchi</i>	Tall grass for thatching; is disappearing due to ploughing in Ngamani
	<i>Panicum maximum</i>	<i>Ondo</i>	Panicles used for making brooms
Labiatae	<i>Hoslundia opposita</i>	<i>Mutserere</i>	Edible fruits; extract of leaves stops bleeding
Loganiaceae	<i>Strychnos spinosa</i>	<i>Mujaje</i>	Pulp of fully ripe fruits is edible; unripe seeds cause abortion
Palmae	<i>Hyphaene coriacea</i>	<i>Mukoma</i>	Tapped for wine; edible mesocarp; hard endocarp for collars of tool handles; leaves of juvenile palms (<i>miyaah</i>) used for plaiting mats and baskets.
Salvadoraceae	<i>Dobera loranthifolia</i>	<i>Mukuha</i>	Twigs used as tooth brush
Solanaceae	<i>Solanum nigrum</i>	<i>Mnavu</i>	Wild and cultivated leaf vegetable; distinct types
Taccaceae	<i>Tacca leontopetaloides</i>	<i>Mukonzi</i>	Edible tubers
Tiliaceae	<i>Grewia plagiophylla</i>	<i>Mukone</i>	Edible fruits; wood for carving <i>vigango</i> ; bark with lubricant for sexual intercourse; near houses as shade tree for people and livestock

Specimens with detailed descriptions of sites, plants and uses were deposited in the East African Herbarium (Nairobi, Kenya), whose staff were most helpful with the identification, and in Herbarium Vadense (Wageningen). The collection comprises 80 specimens of common weeds, minor crops and useful wild plants. Most vernacular names are in Giriama, as spelt by local people; in some cases the first letter *u* is pronounced clearly, in others it is almost absent.



Photograph 4.4. Young owl and unripe papaya on their way to the cooking pot.



Photograph 4.5. Harvest of pumpkin, one of the minor crops in Mijikenda maize fields.

5.2 Growing annual crops

Maize, cassava, cowpea and rice are the dominant annual crops of the Mijikenda. They are grown by nearly all households, and their areas far exceed those of other annual crops. However, the other crops together contribute considerably to the diet and/or cash income of most households. Table 4.9 presents the percentages of farms growing specific crops, in decreasing order; the areas per farm decrease in roughly the same order. Differences between the villages are principally related to ecology and preferences, as most crops are for home consumption or are easily transported cash crops (dry and with a relatively high value/weight ratio). An exception is the budding commercial production of fresh vegetables, which is concentrated around Kaloleni.

Table 4.9. Principal annual crops in four villages in the Kaloleni area, Coast Province of Kenya, 1981: number of farms studied and % of farms growing specified crops.

	Pingilikani	Mbuyuni	Chilulu	Kinarani
Farms studied	31	37	32	31
Maize	97	100	100	100
Cassava	94	95	100	77
Cowpea	94	84	88	90
Rice	45	38	72	45
Sesame	45	51	28	29
Pumpkin	65	68	38	32
Calabash	39	38	9	32
Tobacco	13	16	28	58
Pineapple	26	30	34	26
Hot pepper	48	35	31	10
Amaranth	39	27	28	10

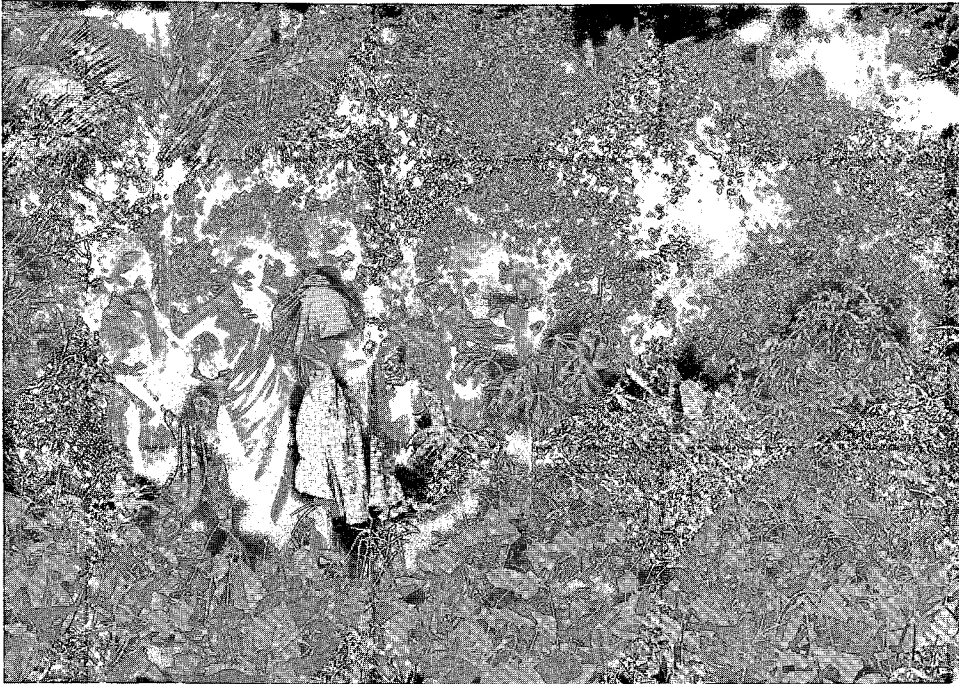
Species

About a century ago **maize** (mainly white grained) took over from sorghum as the main food crop. About 2 ha per household are grown, with local cultivars (maize is an introduced and cross pollinating crop so that the terms should not be taken too literally) like "*Mingawa*", "*Mdzihana*" and "*Mugao*". Only a few farmers grow recently introduced "Coast Composite" maize, an "improved" cultivar which in fact never proved superior. Yields are variable, but usually less than 1,000 kg ha⁻¹, and not enough to cover the households' own consumption.

The yields of **cassava** (5-15 ton ha⁻¹ for sole crops but much less at the usual low densities of cassava grown as relay crop) are more reliable than those of maize. This is why cassava was promoted during the colonial period. However, people prefer to eat maize, as *sima* or *ugali*, a thick porridge of maize meal boiled in water. Cassava, whose roots are consumed boiled in chunks, is seen as less nutritious; it does not "fill" as well as maize. Cassava areas, nearly all of the sweet cultivar "*Kabandameno*", vary from less than 0.1 to more than 0.5 ha farm⁻¹. They are largest in Mbuyuni, where the crop does very well on the soils developed on limestones and shales (only well-drained sites). There cassava is increasingly grown for cash, fresh roots being sold to markets in Mombasa or to the starch factory of Tapioca Ltd. in Mazeras (Khagram 1983).

Cowpea, whose leaves and seeds are popular in side dishes, is usually grown as intercrop or relay crop in maize. There are numerous cultivars; the most common ones are the semi-erect "*Karingongo*" (small seeds) and the creeping "*Mnyenze*" or "*Mbomu*" (large seeds). Nowadays, many people having eaten the last of their own stock buy new seeds, often from outside the area, in shops or at markets. In that way old cultivars are lost and the gene stock is "enriched" with new but possibly less well adapted material. Many farmers plant just enough cowpea for home consumption. Others especially in Ngamani plant up to one hectare as relay crop. In some years they sell considerable surpluses, most to private buyers; in other

years there is not even enough to cover the household needs for a few months. The difference between bad and good luck, 100 or 700 kg ha⁻¹ (Leeuwen 1984), is determined by the rainfall and the equally unpredictable incidence of pests.



Photograph 4.6. Children in a plot of cowpea and cassava in Pingilikani.

Rice has also many cultivars, both older and newer introductions, the most popular ones being "*Kathele*", "*Ambari*" and "*Sindano*". The crop is grown throughout the area, even in the dry Kinarani. The main growing season is during the long rains from April to August; after the harvest, which is done by collecting individual panicles, some farmers cut the crop back in order to stimulate a ratoon harvest. When rice is grown as sole crop the area varies between 0.05 and 0.25 ha farm⁻¹; if intercropped the area tends to be larger. In 1982 paddy yields of between 250 and 2,500 kg ha⁻¹ were measured; note that these were of carefully harvested sample plots in valleys and bottom lands and that rice yields were above-average, thanks to abundant rainfall (Hempenius & Wassink 1982). Rice is considered a luxury food; some farmers sell it to private buyers, whereas others keep it in store for special occasions. Some older people prefer to eat maize, and regard rice as "food for Arabs".

Sesame was once an important cash crop. However, the work involved in planting, weeding, harvesting, drying and threshing, the low and variable yields, and the low prices have discouraged farmers from growing it. In 1982 most of the few growers had less than 0.1 ha,

with an average yield of less than 140 kg ha⁻¹, or 250 kg ha⁻¹ when accounting for mixed cropping (*Wassink 1983a*). The black seeds of the crop are sold to the KDCU, the only legal buyer, or smuggled to buyers in the coastal towns (*Kortram 1984*).

Although grown in small quantities, usually as intercrop in maize, **cucurbits** contribute significantly to Mijikenda life. The leaves, flowers and fruits of pumpkins are eaten as vegetables. Calabashes in many sizes and shapes are used for widely different purposes: containers for tobacco or medicines, rattles for local dances, spoons for gruel or soup, cups for drinking palm wine, vessels for collecting palm wine or honey, or for carrying water. Gradually calabashes are being replaced by plastic equivalents, although it was reported that palm wine does not taste the same in plastic cups. Water melon plants are occasionally grown.

Most **tobacco** (*Nicotiana tabacum*, in few cases also *N. rustica*) is grown for home consumption, in small gardens near the homesteads. In Kinarani it is an important cash crop, with up to 0.1 ha per grower. Nearly all the leaves are processed on-farm into snuff, which is used locally by elder people, or bought by buyers from Kaloleni and Mombasa (*Hempenius 1982*). The advance of cigarette smoking may cause the disappearance of the industry in the long run.

In the Kaloleni area some **pineapples** are grown, mostly for local consumption. Prospects for marketing are limited, as pineapples from the Malindi hinterland already flood the markets in the coastal towns, and there is no processing industry. Local gossip blames a "Del Monte" monopoly for this situation.

Hot pepper and amaranth are popular **vegetables**, found around the homesteads and spotwise in maize fields. Peppers are usually planted; both cultivated and semiwild species of amaranth exist. Other common vegetables are tomato, eggplant, *mnavu* and *mutzunga*, the last two mostly found as weeds in maize fields. Most farmers grow just a few plants for home consumption, usually rustic crops or cultivars which need little care like African eggplant (*Solanum macrocarpum*) or *tindi*, creeping tomato plants with small fruits. In Chilulu and other villages near Kaloleni there is some production for the market, especially of modern tomato cultivars with larger fruits. Some growers also experiment with aubergines, sweet peppers and even cabbage.

Changes

There are no time series of the areas of annual crops available. According to old people, in the past yields were much higher and fields were correspondingly smaller; it is plausible that farmers would cultivate larger areas to compensate for lower yields. However, because of population growth and tree crop planting, the areas of annual crops per household will probably decrease in the near future. During the field work some fluctuations in the areas of individual crops were observed, but it is difficult to predict long-term trends. For the time

being most people doggedly attempt to grow enough maize for home consumption, but in the long run they may be forced to eat more cassava, or to concentrate on cash crops and buy food.

5.3 Growing perennial crops

The versatile coconut palm and the hardy cashew tree are the main tree crops of the Miji-kenda; the other tree crops are less widely grown and usually in smaller numbers (table 4.10). The differences between villages reflect the variation in ecology (soils and rainfall), economy (plant materials and markets) and timing. As most trees were planted years or even decades ago, their present distribution reflects historical conditions much more than is the case with annual crops.

Table 4.10. Tree crops in four villages in the Kaloleni area, Coast Province of Kenya, 1981: percentage of farms and number of bearing (B) and young (Y) plants.

	Pingilikani		Mbuyuni		Chilulu		Kinarani	
Farms in sample	31		37		32		31	
	B	Y	B	Y	B	Y	B	Y
Coconut								
Presence (% of farms)	77	45	89	59	91	69	77	74
Mean (palms farm ⁻¹)	48	21	113	31	184	25	38	19
Median (palms farm ⁻¹)	19	20	40	20	90	20	25	15
Total (palms sample ⁻¹)	1158	292	3719	676	5343	545	832	371
Cashew								
Presence (% of farms)	97	10	76	14	88	16	90	45
Mean (trees farm ⁻¹)	287	353	30	23	25	18	39	14
Median (trees farm ⁻¹)	60	50	8	15	12	20	30	9
Total (trees sample ⁻¹)	8597	1060	834	113	702	90	963	163
Citrus spp.								
Presence (% of farms)	42	6	68	19	72	31	19	6
Mean (trees farm ⁻¹)	13	7	25	41	29	17	4	13
Median (trees farm ⁻¹)	6	7	10	10	12	10	3	13
Total (trees sample ⁻¹)	172	13	613	290	662	172	23	26
Mango								
Presence (% of farms)	52	10	57	32	72	28	45	13
Mean (trees farm ⁻¹)	11	2	20	14	7	5	5	2
Median (trees farm ⁻¹)	6	2	5	7	4	5	4	3
Total (trees sample ⁻¹)	170	6	410	172	150	45	63	9
Banana								
Presence (% of farms)	87	29	81	30	91	47	29	13
Mean (stands farm ⁻¹)	22	27	16	12	25	14	13	3
Median (stands farm ⁻¹)	16	5	10	7	15	9	6	3
Total (stands sample ⁻¹)	589	246	465	129	733	198	121	10

The means and medians refer to the farms with that particular crop.

Species

The **coconut** palm has a central place in Mijikenda agriculture. It is hard to imagine the Mijikenda landscape, economy and social life without the palm and its products. Compared with other crops the palm gives a better and more reliable revenue, especially if in addition to nuts or copra the tapping of palm wine and the uses of the leaves and the value of the tree are taken into account. Another advantage is that the canopy of older palms is rather open, which enables intercropping (Nair 1979; *Wassink 1983c*; *Sprenkels 1985*).

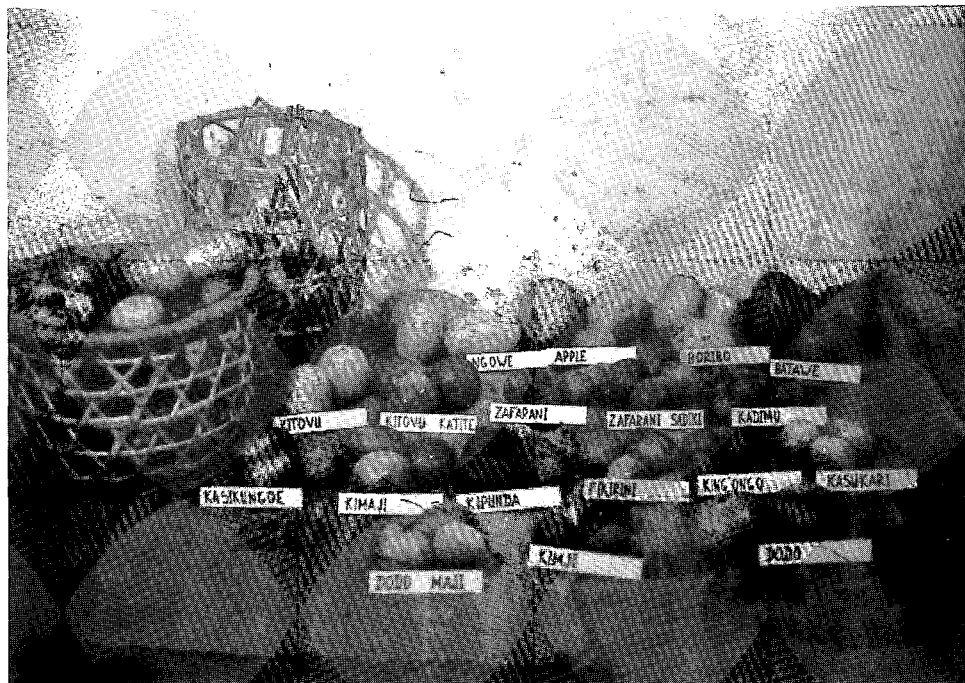
In Pingilikani and Kinarani, where there are few palms per farm, most products are for home consumption, but in Mbuyuni and Chilulu many farmers have surpluses for sale. Most coconuts are sold in Mombasa. The Kilifi District Cooperative Union (KDCU) oil mill in Kilifi has a monopoly for copra, although much is smuggled to private mills in Mombasa. Plaited leaves for thatch (*makuti*) are bought by traders and used for houses and hotels in the coastal strip. Before trade in palm wine was prohibited in 1981, much palm wine was sold in Mombasa, Kilifi and Voi, but since then most trade is between villagers. In spite of the restrictions on palm wine, most farmers would like to plant more palms and many actually do so, but suitable land is becoming scarce. In Pingilikani soil fertility is limiting; in Ngamani, rootability and drainage; in Mbuyuni and Chilulu, population density and tree density; and in Kinarani, rainfall.



Photograph 4.7. An uncommonly rich harvest of cashewnuts; in Coast Province of Kenya the juicy "apples" are usually small.

The **cashew** is the second tree crop of the Mijikenda, being adapted to poor soil, dry climate and little care (*Wassink 1983b; Rijpma 1987ab*). Some nuts are roasted and consumed on the farm, but most of the harvest is sold to the KDCU and processed and marketed by the Kilifi Cashewnut Factory. Between 1981 and 1985 the yields were disappointing, probably because of a combination of over-aged trees and excessive rainfall. The oldest cashew plantations, nowadays looking like forests, are found on the hills of the Magarini formation northwest (Sokoke) and southwest (Pingilikani) of Kilifi. In Ngamani the trees do not thrive. In the "palm belt" (Mbuyuni, Chilulu) cashew appears to occupy only the few spaces left over by the coconut palm. Only towards the drier north does it gradually replace the coconut as major cash crop.

Most **citrus** trees, mainly mandarin and orange, are found in Mbuyuni and Chilulu, which combine reasonable soils with relatively reliable rainfall and bus connections with the Mombasa markets (*Hempenius 1983*). In Pingilikani many soils are very poor (acid) and the transport of the fruits with their low value/weight ratio would be costly. In Kinarani the climate restricts the crop to a few spots with above-average soil moisture availability. For more information on citrus growing, see Eijnatten & Creighton (1980)



Photograph 4.8. Mango cultivars, showing the large variation in size and shape.

Most farms have only a few **mango** trees for home consumption. Their production is erratic and the marketing is difficult, especially of "old" cultivars with small, fibrous fruits like "*Mdodo*" and "*Kimudzi*" or "*Kimji*". It is remarkable that most trees of "new" cultivars with large and non-fibrous fruits like "*Boribo*", "*Ngowe*" and "*Apple*" are found in Pingilikani (near CARS, Mtwapa) and Chilulu (near extension office and bus station, Kaloleni). From a nutritional viewpoint the mango fruits may be quite important for the children, who like them ripe or unripe (*Hempenius 1983*).

Bananas, of the AA ("*Msukari*"), AAA ("*Mukimu*", "*Msukiche*"), AAB ("*Muhenzawenyi*") and ABB ("*Mboki*") groups, are common in Pingilikani, Mbuyuni and Chilulu, and are found even in the dry Kinarani, usually along valley bottoms (*Hempenius 1983*). Bananas are easy to grow and nearly always yield something, although under adverse conditions the process can take quite long. Most bananas are grown for home consumption, but a few farmers have successfully specialized in production for the market (Kilifi, Mombasa). Bananas could play a much larger role in Mijikenda agriculture, but many people do not like to eat them (*Kombe 1984*).

Distribution

The large differences between means and medians in table 4.10 indicate a skew distribution of tree crop ownership. At first sight the data gave the impression that farmers with little knowledge of numbers had translated "many" into "hundreds" or "one thousand", and that by discarding extreme values the data begin to make sense (Waaijenbergh 1987). However, on further analysis it appeared that the total numbers of trees per farm corresponded well with the sums of numbers given per field (for coconut $R^2 = 0.98$) and that the extreme numbers were compatible with the yields mentioned. Therefore, it must be concluded that the skewness was real.

The main way to obtain tree crops is by **planting**. In general, the ratios between young and bearing trees exceed those needed for the replacement of old trees although there are differences between crops and villages (table 4.10). Most young coconut palms are found in Mbuyuni and Chilulu, but relative increase is stronger in Pingilikani and Kinarani. Cashew is increasing most in Pingilikani (absolutely) and Kinarani (relatively), whereas numbers of fruit trees are rising in Mbuyuni and Chilulu. In Kinarani there are very few new banana stands; this may be an after-effect of the drought in 1980.

What factors can explain the **differences** in numbers of tree crops planted per farm? The differences between villages have ecological (land) and economic (market) backgrounds. Within villages, in some cases the lack of suitable land may play a role, but in areas with several soils or climates this is hard to prove. In Chilulu, where the variation is not too great, there were positive correlations between the farm size and the numbers of young (all farm sizes), and bearing palms (up to 4 ha). The largest farms had fewer palms than would

be expected. However, because of the small sample (only 14 farms had data on farm sizes) the correlations are no more than indicative.

In all villages positive correlations were also found between the numbers of palms and the availability of labour (men + women on-farm). Only the case of young palms in Chilulu was an exception; here other factors (land?) were more limiting. However, the fact that the present labour force also correlated with the number of palms planted long ago, should make one wary: what explains what?

In farms with up to 100 palms there were positive correlations between the numbers of bearing and the numbers of young palms. Farmers with still larger numbers of bearing palms showed a tendency to plant relatively fewer new palms. They may not feel the need to plant scarce land with even more of the same.

Table 4.11. The pledging of the usufruct of tree crops in four villages in the Kaloleni area, Coast Province of Kenya, 1981.

	Pingilikani	Mbuyuni	Chilulu	Kinarani
Farms in sample	31	37	32	31
pledged in (% farms)	19	14	19	6
pledged out (% farms)	26	32	31	6

Another mechanism for acquiring or losing the usufruct of trees is by **pledging**; outright sale of trees themselves is still less common. According to Parkin (1972) in the 1960s pledging led to palms being concentrated in the hands of a few richer farmers at the expense of many poorer ones. Also in 1981 there were more farmers pledging out than pledging in (table 4.11). However, in most cases only moderate numbers of trees were involved: respectively 10 % and 15 % of all coconut palms, the species involved most, in Mbuyuni and Chilulu. Instead of confirming an ongoing concentration of the ownership or use of trees, the data underline the importance of coconut palms in comparison with other tree crops.

The lack of indications of further concentration is not surprising. The distribution is already quite skew and farmers with few palms may not have the resources to pledge in, whereas those who have would do better to invest in e.g. building houses for letting rooms. Since the late 1960s copra has become less lucrative and recently palm wine was outlawed. This does not keep poorer farmers from planting palms for security, but richer ones can look elsewhere for profits.

5.4 Keeping livestock

Livestock are an important theme in Mijikenda life. In conversations cows feature most prominently, but goats are a more realistic goal, whereas chickens are the daily reality. Cattle and goats are a sign of wealth and status, and they have several advantages over tree crops. They do not require specific soils, they multiply and are easily transferable, even although people do not like to part with them. They can walk and be sold in an emergency, or used for paying bridewealth. Chickens and ducks serve as small change in economic and social life, being bartered or given as presents.

Table 4.12. Numbers of livestock in four villages in the Kaloleni area, Coast Province of Kenya, Kenya, December 1981.

	Pingilikani	Mbuyuni	Chilulu	Kinarani
Farms in sample	31	37	32	31
Cattle				
Presence (% of farms)	13	14	9	32
Mean (animals farm ⁻¹)	14	9	6	22
Median (animals farm ⁻¹)	9	6	5	25
Total (animals sample ⁻¹)	55	44	19	223
Goats				
Presence (% of farms)	39	57	72	68
Mean (animals farm ⁻¹)	5	14	8	14
Median (animals farm ⁻¹)	5	6	6	12
Total (animals farm ⁻¹)	56	284	182	301
Sheep				
Presence (% of farms)	0	3	0	29
Mean (animals farm ⁻¹)	0	10	0	4
Median (animals farm ⁻¹)	0	10	0	3
Total (animals sample ⁻¹)	0	10	0	38
Chicken				
Presence (% of farms)	94	92	91	87
Mean (animals farm ⁻¹)	21	15	10	13
Median (animals farm ⁻¹)	10	8	8	10
Total (animals sample ⁻¹)	615	462	230	268
Ducks				
Presence (% of farms)	32	59	28	35
Mean (animals farm ⁻¹)	7	6	7	7
Median (animals farm ⁻¹)	5	3	8	4
Total (animals sample ⁻¹)	70	125	64	75

In very few cases, with animals kept elsewhere, respondents did not know the exact numbers of animals; the real totals are somewhat larger.

Species

Few people have **cattle**, most of these are of the small East African Zebu breed. Long ago the people of Pingilikani took an oath not to keep cattle, in order to prevent Masai attacks;

some may still be sticking to this. In Mbuyuni there is too little grazing land left, in the centre of Ngamani, and to reach it the unruly cattle would have to pass through a wide belt of maize fields. Land is even scarcer in Chilulu; the few animals graze in unused corners of maize fields and bottom lands or under the coconut palms. Only in the less populated Kinarani are more cattle kept. Cows are kept mainly for the little milk they give; half of the owners sell milk, most locally and some to the Kenya Cooperative Creameries (KCC) factory in Mariakani. The animals are only eaten or sold in the case of funerals or other emergencies. The buyers are bereaved families, local butchers and auctions in Bamba or Mariakani.

Goats better than cows fit in densely populated areas; they need little forage and are tethered under tree crops, especially coconut palms, and along roads. In Mbuyuni the problem of crossing maize fields is solved by muzzling the goats with baobab or coconut shells or tins. Goats are the meat cows of the poorer, sold in cases of emergency, eaten at funerals or saved until there are enough to exchange for a cow. In Kinarani sheep are kept too.

Chickens are found on nearly every farm. It is almost a social duty to have some: how can you receive visitors if you cannot offer a young succulent rooster or an old and scrawny but no less delicious hen? Although eggs are sometimes sold or eaten, there are some cultural restrictions on their consumption, and probably most are left to hatch.

Distribution

The distribution of livestock is also rather skew, as shown by the differences between mean and median (table 4.12). Some people cannot afford livestock and others are reluctant to invest in the uncertain lives of animals or do not like the work involved. Nowadays the skewness extends to within homestead and household, as individuals buy livestock with money earned in off-farm work. However, in emergencies the heads of the groups may still make some claims.

The Mijikenda keep livestock not merely for status, but also for **consumption**, sooner if unavoidable or later if possible. However, many animals die beforehand from hunger, thirst, parasites and disease. Table 4.13 refers to one particular year, after the dry 1980, to few farmers and may contain inaccurate data. Although some details may be doubted, the message cannot be denied: keeping livestock is a risky undertaking with a narrow balance between births and deaths. This makes animals, in spite of their flexibility, a less secure investment than most tree crops.

Some farmers spread the risk by **pooling** animals (table 4.14). They leave them with other people, usually in exchange for some of the offspring or produce. In Mbuyuni nearly all cattle were kept this way and in Chilulu about one-third of the goats, while in Kinarani some farmers herded more cattle for others than for themselves. Sometimes even chickens or ducks are pooled. The practice results from a specific deal between owner and herdsman or comes about by leaving newly bought animals for an unspecified time with the previous owner. Pooling is not only, and maybe not even mainly, done to spread risk. Some farmers do not have the space or labour to keep their livestock at home. Herding a few animals and taking them daily to a distant watering hole is a time consuming chore.



Photograph 4.9. Most cattle are kept in dry areas with periodic shortages of forage and water.

Innovations

Recently some innovations have been introduced, which may change the livestock panorama in the long run, although so far they have had limited impact. Dipping and other **veterinary services** reduce the risk of diseases. However, only some of the animals are dipped, because of a lack of interest from the farmers and the malfunctioning of the services. For both sides transport is a major problem: how can the cattle go to and from the dip without damaging crops, or how can technicians operate the dips unless they have a car or motorcycle?

In the dry northwest, **ranches** may further shift farmers' interest from numbers to production parameters and ensure a better use of the deteriorating pasture and bush lands. So far, most of the ranches that have been set up are still dormant, and without substantial economic stimuli or strong pressure they are likely to remain so. In wetter areas, after long fence-sitting and watching, farmers are showing interest in **zero grazing** for dairy cattle. Bottlenecks are the investment in dairy cows and a zinc-roofed shed, and the provision of forage and water in the dry season. If many farmers adopt this system, so that the local market is saturated, marketing might become a problem: the Mariakani milk factory is distrusted because in the past it failed to pay farmers. Zero grazing is an important development option, but only few rural households can afford to buy the milk and still fewer to invest in dairy cows (Leegwater *et al.* 1991). For more information on livestock in Kilifi District see *Bartman (1984)*.

Table 4.13. Herd compositions, changes and uses in four villages in the Kaloleni area, Coast Province of Kenya, 1981.

	Pingilikani	Mbuyuni	Chilulu	Kinarani
Farms in sample	31	37	32	31
Cattle				
Total	55	44	19	223
Adult	41	36	13	163
Young	14	8	6	60
Born	14	8	6	80
Died	3	5	12	95
Bought	5	7	2	9
Sold	0	0	2	3
Eaten	0	1	1	6
Other	0	0	0	7
Goats and sheep				
Total	56	287	182	339
Adult	34	197	139	231
Young	22	90	43	94
Born	22	89	50	87
Died	53	85	57	79
Bought	3	4	5	6
Sold	7	17	2	9
Eaten	16	17	17	30
Other	4	20	16	10

As in table 4.12, the exact numbers were not known in some cases.

Table 4.14. Pooling of livestock in four villages in the Kaloleni area, Coast Province of Kenya, 1981.

	Pingilikani	Mbuyuni	Chilulu	Kinarani
Farms in sample	31	37	32	31
Cattle				
Herded for others (% of farms)	3	0	3	10
Herded by others (% of farms)	0	11	3	3
Goats or sheep				
Herded for others (% of farms)	0	5	13	10
Herded by others (% farms)	0	5	16	10

5.5 Making a living

Most farm households, striving for a secure living, combine a mix of crop, livestock and off-farm activities. Differences in ecological conditions, economic resources and personal capacities or preferences also contribute to diversity, but one characteristic is shared by

nearly all farmers: they put their eggs in more than one basket. Below the main options and their limitations are sketched.

Food crops

The first option is **self-sufficiency** in food production. For the Mijikenda, producing enough maize is still an important yardstick for measuring success. Their fellow Kenyans likewise interpret the fact that the Coast Province is a net importer of food, although it pays for it, not as a proof of being able to take care of itself, but as one more sign of backwardness.

Not all farmers opt for the same approach and with the same result. Most try to produce enough maize; few succeed regularly and many nearly always fail however hard they try. Others have become resigned to the fact that food comes from elsewhere, but continue to plant as much maize as their other activities permit. They have not forgotten the occasions when there was no food in the shops. Moreover, many people do not like the yellow maize meal that is sometimes sold.

One of the main and constant **bottlenecks** for producing enough maize is the availability of labour. During the first weeks of the cropping season work, is strenuous and workers are often in poor health because of a lack of healthy food and malaria. Late weeding coupled with unreliable weather, exhausted soils and noxious weeds or pests defeat the hopes and efforts of the farmers. Respondents in Pingilikani, Mbuyuni, Chilulu and Kinarani estimated that the 1981 maize harvest was enough for only 5.3, 4.7, 3.7 and 2.9 months or 44 %, 40 %, 31 % and 24 % of the year respectively. Such low percentages are normal; the year before was worse and the following years little better.

The degree of self-sufficiency varies between villages and seasons. In dry years the crops in Kinarani, with its sandy soils, tend to suffer most. Under wet conditions the acid sands of Pingilikani are leached and the fertile clays of Ngamani become waterlogged. Mbuyuni and Chilulu often occupy intermediate positions. In the long rains of 1984 the weather was excellent everywhere, but then a plague of armyworms hit hard in Pingilikani, Mbuyuni and Chilulu, but spared Kinarani.

A study carried out in 1982 of the maize **areas and yields** of 18 households (5 per village, 2 were dropped) illustrates the magnitude of the problems. On average, each household planted about 1.9 ha, with an average yield of 450 kg ha⁻¹ or 850 kg household⁻¹. Post harvest and processing losses will further reduce this meagre output. In order to cover their energy requirements the same people would need about 2,200 kg maize household⁻¹ year⁻¹. They themselves estimated that during shortages 2.6 packets of maize meal had to be bought daily, 1,900 kg household⁻¹ year⁻¹ (chapter 5).

Even when part of the energy requirements are satisfied with other foods, many households have to buy up to 1,000 kg of maize year⁻¹, for Ksh 2 (grain) to Ksh 4 (meal) kg⁻¹. Meal

is utilized fully, whereas during processing up to a quarter of grain is lost for human consumption, although it is picked up by chickens. As most neighbours are hardly better off, **maize has to be bought from shops**, where it is usually sold in the form of packets of meal. Therefore the question is, where to get a cash income of several thousands of shillings household⁻¹ year⁻¹? For, apart from food, there are also expenses for clothing, housing and schooling.



Photograph 4.10. Maize meal in a rural shop: evidence that the production of staple food is failing to meet demand.

Cash sales

The answer could be: by the sale of farm products. However, at present most of these do not offer bright prospects. The areas, yields and/or prices of **annual crops** like rice, cowpea, sesame and tobacco are in general too low and variable to make a substantial and reliable contribution to cash income. All need more labour than maize, have erratic yields, and some require rather specific ecological conditions. In the case of rice, water availability and weed control are major problems, and prices are only little higher than those of maize. Cowpeas are affected by insects (leaves, flowers, young pods) and rain (ripe pods), and part of the yield is needed for home consumption. Sesame is labour intensive, its yields unpredictable and its prices low. Tobacco, which can give high returns on land and labour, needs specific

combinations of sandy soils and moderate rainfall. Anyone able to assess soil quality exactly and to predict weather and pests accurately can make profit on any one of these crops. Other people, including most Mijikenda, can better plant small areas of several crops and pray for good luck.

Coconut palms are the farmers' favourites; they always yield something. However, they do not grow everywhere, and even where they do most households have too few palms for a substantial cash income, unless they resort to selling palm wine. The income from copra is about 30 nuts/palm * 1 kg copra/7 nuts * Ksh. 5/kg copra = Ksh. 21/palm/year (1984). Nuts fetch higher prices, Ksh. 1-2 each, but also more problems with marketing. Most are sold in Mombasa, where prices are highest during the fast of Ramadhan. Apart from nuts, a palm produces about 10 leaves per year, from which about 15 *makuti* can be made with a market value of Ksh. 8. The total income is Ksh. 25-35 palm⁻¹. As part of the products are used on-farm, there must be more than the average number of palms, to obtain the cash most households need for buying food. Tapping and selling palm wine yields ten times more, but this lucrative enterprise is now illegal. A few daring individuals can gain from it, but as soon as their business flourishes, the government is likely to crack down on it.

The yields of **cashew trees** are low (in Coast Province about 4 kg tree⁻¹ or 450 kg ha⁻¹), confined to a short period of the year and variable (Eijnatten & Abubaker 1983). Poor harvests in preceding years and a price drop to Ksh. 3.50 kg⁻¹ in January 1983 induced disappointed farmers in Pingilikani to fell some of their trees in order to make space for maize. Although the District Office prohibited the "wasteful" practice, the farmers were probably right. The aged trees yielded below average, whereas after a cashew "fallow", maize might yield 1,000 kg ha⁻¹. In other villages, with fewer and younger cashew trees, nearly all escaped the axe, but there anyway they are too few to make a substantial contribution to farm income.

In general, the same also applies to **fruit crops**. Most farmers have only small numbers of trees, their production is variable and the harvest is perishable and cannot be stored for long. Therefore only a few farmers, with considerable numbers of plants, cheap transport and access (family, friends) to markets in coastal towns, and some pluck and good luck, can make a good profit from fruit production.

Only a few farmers have **livestock** in significant numbers and the animals' productivity is low. Many animals destined for meat production die from natural causes before reaching the cooking pot. The few that do reach that destination usually end up in funeral parties, thereby fulfilling a good purpose, but not contributing directly to the sorely needed cash income of the bereaved family. The sale of milk is more profitable, but little is produced in densely populated areas like Chilulu, where demand is growing, and most in thinly populated places like Kinarani, which are far from markets.



Photograph 4.11. Every little bit helps: retail of fruit and vegetables in Kaloleni centre.

Off-farm work

Several of the farmers interviewed were successfully specialized in a few of the above options, while others managed quite well by combining little bits of everything. However, in general the income from agriculture and livestock was not high and not stable enough to provide for most households' needs. Therefore, these were obliged to include off-farm work in their mix of economic activities.

In 1981 about 52 %, 76 %, 81 % and 74 % of the households in Pingilikani, Mbuyuni, Chilulu and Kinarani, respectively, had one or more off-farm workers, corresponding with 30 %, 38 %, 31 % and 40 % of all men of 15 years and over. In the same households 14 %, 10 %, 19 % and 20 % of the men were in school, which may be seen as a preparation for an off-farm future. Women in school or off-farm work were still a rare, although increasingly common, phenomenon. Differences between villages appear to be related to population density, land quality, amount and reliability of the rainfall and access to education (mission schools).

Even if allowances are made for people too old to work and for the wish to leave one man on each farm, there is still some elasticity on the supply side of off-farm labour. Many households have young men waiting for paid work, some "hanging around" at home and others actively looking in Mombasa or elsewhere. When the 131 respondents, most of them

heads of households, were asked which future they wished for their sons, 67 % said they preferred off-farm work, 25 % claimed they would let their sons decide or did not know what to answer, and only 8 % opted for farm work. Even although the question did not stress that off-farm work in the long run will mean separation from homestead and family, the data indicate a strong interest in work in town. The many accompanying remarks about the increasing costs of life, lack of rain, help in dry years and support of the family, show that the choice was not determined by like or dislike of towns or interest or lack of interest in farming, but rather by necessity.

The future looks gloomy: there is little work in town and employers can afford to be increasingly more demanding. Several disillusioned job seekers have already had to return to the land. Some reluctantly gave up the anticipated pleasures of the town, but others embarked with enthusiasm on small rural business such as vegetable or tea stalls or started to exploit alternative forms of agriculture or horticulture.

6 CLASSES OF FARMS

6.1 Differences

Superficially all Mijikenda farms look similar. They are small and comprise only a few acres, trees or animals. The women grow maize for the household's needs and the men plant coconut palms or cashewnut trees and dream of herds of livestock; the reality is that many have to work off-farm to supplement the meagre farm income. The uniformity is also apparent from nearby and the farms: the Mijikenda tend to stress that the differences between farms are small, in most cases restricted to "a bit more of the same", with a few being referred to as "somewhat more progressive". According to this viewpoint all Mijikenda farms are variations on basically one single farming system or "class of similarly structured farms" (Fresco & Westphal 1988).

However, it can also be argued that there are several farming systems. In some areas cashew clearly dominates the land use, in others maize, coconut or livestock. Differences between farms in the same area are more difficult to spot, but the deviations between means and medians of numbers of tree crops and livestock per household show that they nevertheless do exist. An example is the Tsakani neighbourhood, near Chilulu. In this apparently uniform area Parkin (1972) observed a transition from a rather egalitarian situation towards increasing economic and social differentiation, or -- freely translated -- from one towards several farming systems. Although not all his observations can be extrapolated uncritically towards the future, his main point remains valid: are some Mijikenda farms becoming more equal than others?

Examples of the distributions of off-farm work, tree crops and livestock presented in figure 4.7 suggest that when separate activities or resources are considered, some farmers have a far larger share than others. None of the variables even approaches an equal distribution between households, represented by the diagonal line. If we account for the size of the households by expressing the variables in units per adult, the lines move only very slightly towards the straight line. Therefore, when evaluated per variable, the distribution of resources appears quite skew. A few rich farms own the upper half of all access to wealth and numerous poor ones share the lower half.

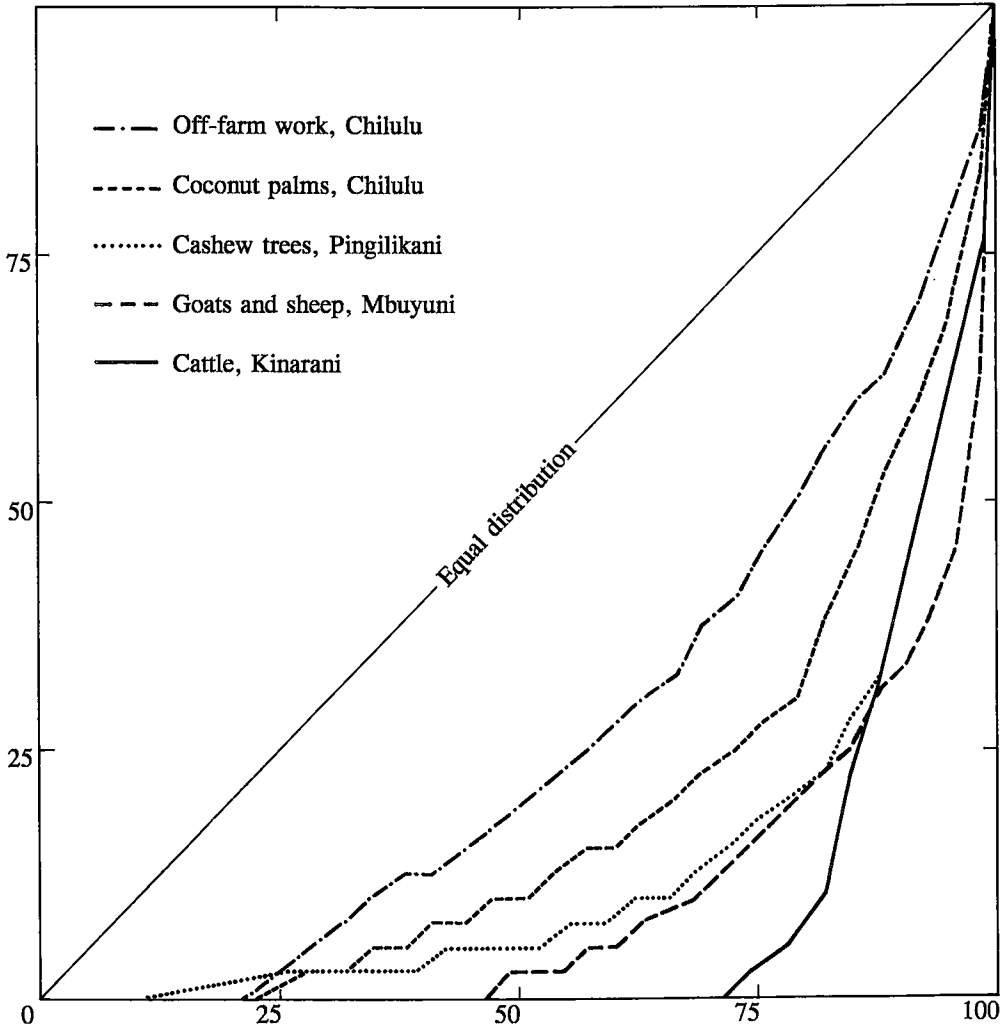


Figure 4.7. Examples of the distribution of off-farm work, tree crops and livestock between farm households in the Kaloleni area, Coast Province of Kenya, 1981.

6.2 Classification

Farms with, for example, few coconut palms can have much livestock, fertile soils for maize, or a high off-farm income. Therefore, a realistic classification of farms should consider several variables simultaneously. Table 4.15 presents those used for the following attempt to classify the 131 farms studied in the Kaloleni area. The choice of the variables and their subdivision in classes were based on the characteristics of the farms (many activities), the availability of data (December 1981 interview), and the type of variables (from nominal to numerical).

The variables chosen reflect many facets of Mijikenda farming. In the first place they represent the activities of the household: off-farm work, annual crops, tree crops and livestock. They refer also to resources: off-farm work means ready cash, much maize or annual cash crops access to fertile land, and much rice access to wet lands, whereas trees are an investment in future production, and animals can be seen as wealth in themselves. The variables moreover indicate the orientation of the household: having much of an activity means marketable surpluses. In the employment of labour and the sale of labour, palm wine, milk and other products the market orientation is explicit. The variables determine the household income: more activities and in larger amounts usually imply more produce for consumption and sale, and with less variation. Most variables refer to relatively permanent characteristics of the farm, such as the numbers of coconut palms and other crops, and others to more changeable features, such as the number of off-farm workers or the sale of milk.

Table 4.15. Summary of the variables used for the classification of the Mijikenda farms in the Kaloleni area, Coast Province of Kenya.

	Class 0 ()	Class 1 (⋮⋮⋮)	Class 2 (■)
hi hired labour (Ksh/year)	0	1-850	>850
of off-farm workers (#)	0	<2	≥2
mz maize harvest (months)	0-3	4-6	>6
ri rice grown (quantity)	-	+	++
an other annual crops (#)	1-3	4-6	>6
co coconut palms (#)	0	1-100	>100
ca cashew trees (#)	0	1-100	>100
ba banana stands (#)	0	1-20	>20
ci citrus trees (#)	0	1-20	>20
ma mango trees (#)	0	1-10	>10
go goats + sheep (#)	0	1-10	>10
ct cattle (#)	0	1-15	>15
ac annual crop products sold (#)	0	1	>1
tc tree crop products sold (#)	0	1	>1
wi palm wine sold	no		yes
mi milk products sold	no		yes

State variables refer to the moment of the interview (December 1981), flow variables to the year 1981. All data refer to the households as defined by the respondents.

The values of all variables were divided into two (no/yes) or three (none/some/much) **classes**. In most cases the rounded mean of all haves in the four villages was taken as the cut-off between "some" (class 1) and "much" or "many" (class 2). This allows villages to be compared on the same scales, per variable. The method does not take into account that not all variables have the same weight. For example, two wage earners, one hundred coconut palms, twenty stands of banana, and ten goats or fifteen cows certainly do not contribute equally to the household food and cash income. The scales could have been standardized, for example, by expressing all variables in shillings. However, that would require detailed information on salaries of off-farm workers, quantities and prices of products sold, ages and qualities of tree crops and animals, etc. Even so, the calculated weights would have only limited validity as the ratios between the values of crops, animals and products vary from place to place and change with time. Moreover, not all values and benefits can be expressed in terms of cash.

One of the reasons for working with classes is that they are easy to handle and to visualize with the **classification** method followed. This method was borrowed from vegetation science. In 1981 I saw a colleague bringing order in a large number of vegetation relevés by means of the so called "Braun-Blanquet" tabulation method (Leeuwen 1982). This consists of the reiterative ordering of the rows and columns of a species-by-sites matrix in such a way that sites with a similar species composition and species with a similar distribution over sites are brought together (Digby & Kempton 1987). By replacing "sites" with "farms" and "species" with "variables", the method can also be used for grouping similar farms and related variables into equivalents of "communities" and "associations", respectively. Its advantages are that it is conceptually simple, can if required be done by hand, and results in an illustrative two-dimensional picture of a multi-dimensional reality.

To reduce the amount of manual work a preliminary classification was made using the agglomerative hierarchical clustering method (average linkage, city-block distance) of the SPSS-PC+ programme (Norusis 1986). The resulting order, mainly a ranking of the farms along a scale from very little to very much, was refined by hand. This consisted of bringing together farms (rows) with a similar mix of activities, and of shuffling of the activities (columns) within the groups "off-farm work", "annual crops", "perennial crops", "livestock" and "sales". The results are presented in table 4.16. The classes of farms distinguished and their descriptions are not final. The number of classes, their boundaries and the positions of individual farms are open to discussion. Nevertheless, three important conclusions can be drawn:

- In all villages there are some farms that score low on most variables and others with high scores on a wide range of activities. In between there is a large group of farms, some having a moderate amount of many activities, and others with a tendency towards concentration in a few.

Table 4.16a. A tentative classification of farms in the Kaloleni area, Coast Province of Kenya, 1981: Pingilikani village.

Farm code	Age of head	# of adults	labour	annual crops	perennial crops	live-stock	sales of farm products	remarks
			hi of	mz ri an	co ca ba ci ma	go ct	ac pc wi ml	
65	35	5	■ ■ ■ ■		■ ■ ■ ■ ■ ■ ■ ■			"poor" farms
114	28	3	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■			
19	33	3	■ ■ ■ ■ ■ ■ ■ ■		■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
88	43	5	■ ■ ■ ■ ■ ■ ■ ■	??	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		
3	37	3	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		
32	52	3	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		
13	70	7	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
48	60	2		■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		■ ■ ■ ■ ■ ■ ■ ■	farms with annual and perennial crops; some with livestock
2	40	4	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		■ ■ ■ ■ ■ ■ ■ ■	
15	40	2		■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		■ ■ ■ ■ ■ ■ ■ ■	
40	36	3	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		■ ■ ■ ■ ■ ■ ■ ■	
117	45	5	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
45	58	7	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
74	50	7	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
12	50	5	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
5	47	4	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
21	70	4	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
17	45	4	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
105	70	10	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		■ ■ ■ ■ ■ ■ ■ ■	farms with off-farm work, annual and/or perennial crops
37	66	10	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		■ ■ ■ ■ ■ ■ ■ ■	
22	70	22	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		■ ■ ■ ■ ■ ■ ■ ■	
28	50	7	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■		■ ■ ■ ■ ■ ■ ■ ■	
20	45	7	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
57	60	8	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
55	40	9	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
47	50	10	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	"rich" farms
90	52	21	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
75	50	15	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
63	65	21	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
67	37	6	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	
101	50	3	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	■ ■ ■ ■ ■ ■ ■ ■	

Farm codes refer to a list of all farms of the village. For abbreviations or symbols see table 4.15. Remarks show how the classification can be interpreted.

Table 4.16c. A tentative classification of farms in the Kaloleni area, Coast Province of Kenya, 1981: Chilulu village.

Farm code	Age of head	# of adults	labour		annual crops			perennial crops					live-stock	sales of farm products			remarks		
			hi	of	mz	ri	an	co	ca	ba	ci	ma	go	ct	ac	pc		wi	mi
91	30	4		■	■	■	■					■							"poor" farms
92	23	3	■	■	■	■	■			■									
42	55	2	■	■		■	■	■	■	■	■				■				
93	45	7		■	■	■	■	■	■	■	■								
88	50	5		■	■	■	■	■	■	■	■	■							
30	60	10			■	■	■	■	■	■	■	■				■			
5	45	5		■	■	■	■	■	■	■	■	■			■	■			farms with intermediate numbers and amounts of activities
85	30	8		■	■	■	■	■	■	■	■	■			■	■			
99	60	8		■	■	■	■	■	■	■	■	■			■	■			
75	50	5		■	■	■	■	■	■	■	■	■			■	■			
83	32	10		■	■	■	■	■	■	■	■	■			■	■			
14	45	7	■	■	■	■	■	■	■	■	■	■			■	■			
33	50	6		■	■	■	■	■	■	■	■	■			■	■			
77	45	3		■	■	■	■	■	■	■	■	■			■	■			
71	37	7	■	■	■	■	■	■	■	■	■	■			■	■			
81	60	12		■	■	■	■	■	■	■	■	■			■	■			
55	45	8		■	■	■	■	■	■	■	■	■			■	■			
9	50	13		■	■	■	■	■	■	■	■	■			■	■			
39	59	12		■	■	■	■	■	■	■	■	■			■	■			
47	35	8	■	■	■	■	■	■	■	■	■	■	■		■	■			
48	91	6		■	■	??	■	■	■	■	■	■			■	■			
82	45	6		■	■	■	■	■	■	■	■	■			■	■			
27	45	6		■	■	■	■	■	■	■	■	■			■	■			
44	40	3		■	■	■	■	■	■	■	■	■			■	■			
22	50	15		■	■	■	■	■	■	■	■	■			■	■			
18	50	3		■	■	■	■	■	■	■	■	■			■	■			
57	45	17		■	■	■	■	■	■	■	■	■			■	■			"rich" farms
74	45	6	■	■	■	■	■	■	■	■	■	■	■		■	■			
49	40	3	■	■	■	■	■	■	■	■	■	■			■	■			
12	50	11		■	■	■	■	■	■	■	■	■			■	■			
50	61	9		■	■	??	■	■	■	■	■	■	■		■	■			
26	32	9	■	■	■	■	■	■	■	■	■	■	■		■	■	■		

Farm codes refer to a list of all farms of the village. For abbreviations or symbols see table 4.15. Remarks show how the classification can be interpreted.

Table 4.16d. A tentative classification of farms in the Kaloleni area, Coast Province of Kenya, 1981: Kinarani village.

Farm code	Age of head	# of adults	labour		annual crops	perennial crops				live-stock	sales of farm products			remarks					
			hi	of	mz	ri	an	co	ca	ba	ci	ma	go		ct	ac	pc	wi	mi
21	??	11		■															"poor" farms
11	40	7		■		■			■						■				
37	95	3		■					■						■				
66	60	2		■					■						■				
43	50	2		■		■			■	■									farms with off-farm work and/or crops
18	??	9		■		■			■	■					■		■		
56	60	2		■		■			■	■					■		■		
82	60	17	■	■		■			■	■	■	■	■		■		■		
36	45	5	■	■		■			■	■	■	■	■		■		■		
64	50	4		■		■			■	■									farms with off-farm work and/or crops and livestock
29	45	6		■		■			■	■					■		■		
74	60	5	■	■		■			■	■					■		■		
8	30	5	■	■		■			■	■					■		■		
71	35	7	■	■		■			■	■					■		■		
2	40	4		■		■			■	■					■		■		
41	70	9		■		■			■	■					■		■		
60	40	4		■		■			■	■					■		■		
76	55	7		■		■			■	■					■		■		
26	35	5	■	■		■			■	■					■		■		
89	65	16		■		■			■	■					■		■		
67	60	10	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	"rich" farms
68	60	8		■		■			■	■					■		■		
50	58	5		■		■			■	■					■		■		
16	??	3	■	■		■			■	■					■		■		
73	55	13		■		■			■	■					■		■		
33	??	11	■	■	??	■	■	■	■	■					■		■		
53	80	21		■		■			■	■					■		■		
14	35	6		■		■			■	■					■		■		
87	60	12		■		■			■	■					■		■		
38	50	6		■		■			■	■					■		■		
19	??	5		■		■			■	■					■		■		

Farm codes refer to a list of all farms of the village. For abbreviations or symbols see table 4.15. Remarks show how the classification can be interpreted.

- There are differences between villages, not only in the sense that in some there are more palms and in others more cattle, but also in their overall patterns. In Chilulu, for example, most of the farmers are "generalists" and differences between farms are small, whereas in Mbuyuni and Kinarani there appear to be more "specialists" and larger differences between farms.
- The variation within groups is large and boundaries are arbitrary. However, although it is hard to say where one group ends and another begins, there is no doubt that there are considerable differences between villages and farms.

Some of the differences between farms were related to household size. Depending on the village and the methods and parameters used for the estimation, between zero and half of the variance of the variance was explained by the number of adults (15 years and over) per household. In turn, the latter was related to the age of the head of the household. Farmers of middle age tended to have the largest households and the greatest numbers of crops and livestock. Of course, there were also middle-aged men with small families and few resources, young men who had inherited considerable resources, and old men who kept their grown-up sons and properties together. However, most of the variation between farms was not related to the life cycle of the household or its number of adult members. Therefore, it appears that indeed not all farms are equal.

One may argue that the differences are not very relevant and mainly a matter of less or more of the same things. So far, most farms use similar technologies and only differ in the scale of the activities or in the access to markets and capital. Although that may not be enough to recognize distinct farming systems, it does make a meaningful distinction between the rich and the poor (on a local scale). On the other hand, it cannot be denied that there are tendencies towards specialization. Some farms in due time may become little more than rural residences for town workers or may be given up altogether. Other farms may further explore the niches they ventured into and become specialists in a few products. How far farms must have diverged in order to speak of distinct farming systems depends not only on the farms themselves, but also on the purpose of the classification. For example, livestock husbandry and rural employment projects are likely to employ different criteria, and distinguish different farming systems.

6.3 Causes and examples

What factors have led to the differentiation between farms? Although the answer varies from one case to another, some generalizations can be made. These revolve around the conditions the farmer was born into, and what he has made out of these by own initiative.

First, there is ecological variation between villages and farms. The access to certain kinds of **land** has become static, but in the past there was more migration. People moved from the *makaya*, most in what is now the "palm belt", towards the northwest where virgin land could give good maize harvests. Later, when coconut palm growing expanded around Kaloleni and tractor ploughing was introduced in Ngamani, many came back to find most of the free space already taken up.

Another factor is **infrastructure**: access to roads, markets, water and schools. Roads facilitate the transport of bulky crop and livestock products. Until recently there were networks for the collection of milk (to Mariakani factory) and palm wine (to Mombasa and Kilifi). Cassava (to starch factory) and *makuti* (for thatching) are usually transported with pickups and lorries. Fruits are often sent to the distant markets by bus. Copra, cashew and sesame are sold to the nearest society of the KDCU. Easy access to piped water or health services may free labour for farm work, whereas schools prepare young people for work in town. These facilities are not "natural conditions", but the result of human activity. However, some households benefit from infrastructure they have got for free, whereas others have to make with very little in spite of much effort.

The availability of **labour** is crucial. It is not only a matter of being blessed with many babies, but also of deliberate family planning. Here that term refers to keeping adult sons together and investing the proceeds from farm, trade, wage labour and bridewealth in more wives, for more labour and further family expansion. Under conditions of abundant virgin and fertile land, labour gave high returns. Even where land was becoming scarce, large families long remained an advantage as a factor in the making of large and strong claims to land (Mkangi 1975).

In many Mijikenda farms a considerable amount of labour or money has been invested, by previous or present farmers. Many people are reaping the benefits from **investments** in land (claims can be expensive), labour (cropping large areas, planting trees), perennial crops (coconut palms have proved reliable), livestock (not without risk) and education (at first schooling guaranteed a job). Some farmers already saw the benefit of such investments long ago, whereas others discovered it too late.

The **management** factor binds the other factors together, for individual or group benefit. Management means taking the right decisions at the right moment and being able to mobilize the resources to implement them. Many people profit from decisions taken long ago or by others, but under Mijikenda conditions, everyone has to contribute too. Many studies of small farmers tend to stress these farmers' limitations, but to understand how they manage to survive it is important to focus on their capacities. The Mijikenda have a long history of being quick in grasping new opportunities for farming and trade. In the 19th century many ventured into the profitable long-distance trade in ivory and cattle or acted as middlemen between others involved in these activities (Spear 1978). Early in the 20th century Giriama farmers in the fertile Sabaki valley profited from the proximity of Malindi by growing maize

for export (Brantley 1981). By then palm growers in Rabai had already discovered their neighbours' thirst as a basis for a busy local and regional trade in palm wine, grain and livestock (Herlehy 1985).

More recently, in the 1950s enterprising Digo and Duruma traders on bicycles created their own markets by teaching the people to consume fresh fish and milk (Gerlach 1963). One decade later Parkin (1972) studied the business spirit of Giriama engaging in the production of copra and in the establishment of shops, cooperative societies and bus services. Since the introduction of schools many families have based part of their economy on education and wage labour. Several of the educated people moved via mission schools and teaching in primary schools to jobs in the government (Parkin 1974). Nowadays, on a few acres of exhausted or drought-prone land, with schools crowded, and well-paid and secure jobs hard to get, it is less easy to excel and advance. Even so, many farmers manage quite well, as some of the examples below show. These are representative in so far that many Mijikenda farmers follow similar, although not identical, paths of behaviour. However, they should not be seen as typical for the village they are taken from; they are all unique in their own right.

Forty-years-old **Munga** (P 067, table 4.16a), from Pingilikani, at first view would easily qualify for any poorest-of-the-poor project. His bare feet, ragged trousers and old shirt, and the humble huts where he lives with his three wives and numerous children, hardly suggest a bright and successful farmer. His father left him about thirty coconut palms, about forty nearly worthless cashew trees and a few cows. Munga tapped the palms, took the wine to the main road at Vipingo every day, and with the money he earned he married a second and later even a third wife. His wives cultivate fertile fields in Ngamani; as Munga can afford to hire a tractor for the ploughing, in good years they are self-sufficient in maize, rice, cowpea and cassava. Meanwhile his herd has grown to fifteen animals, herded by his sons and good for the sale of a few bottles of milk from time to time. In fact, Munga has done so well that he could lend some money to another farmer, who in return gave him the right to harvest a field of coconuts, bananas and cashew. As the field is some distance away, Munga hired somebody to tap the palms, in return for half the yield. He himself taps little nowadays; it is risky and he has discovered a new way of making money. Recently he planted more than 200 stands of banana and has already started to sell the fruits in Kilifi, where they fetch a good price. In spite of his own success, Munga is not building the future of his children on farming alone. He already has one son in Lutsangani secondary school and another in a mechanical engineering school in Mombasa.

For **Ngala** (M 027, table 4.16b), of the same age, from Mbuyuni, things have not gone so well. He lives on a three-acre plot in the centre of Mbuyuni. The soil is moderately fertile, but his maize crop has to share the available space with some eighty coconut palms, ten citrus trees and some cashew trees and bananas. Therefore the yields are far from sufficient for his family, which includes his aged parents, a wife and six small children. They often have to do with only some boiled cassava; a crop which fortunately does very well in his plot. Until some years ago life was much easier, when Ngala tapped fifteen palms and could

live comfortably from the sales of the wine. Nowadays the practice is forbidden and dangerous -- the plot borders the road -- and the demand is much less. The odd bottle of palm wine he sells hardly covers the household's needs. Ngala has been thinking about getting a plot in nearby Ngamani, but his wife can hardly handle their own field, being busy with the children and often tired since the birth of the last one. His parents are too old to work much and in spite of diminished demand he himself is too busy tapping, selling and drinking palm wine. Moreover, nowadays it is very hard to borrow land near the village. His cousin Mwamboga, who works a two-acre borrowed plot one hour's walk away is not allowed to plant any trees on it. As Mwamboga's son in Mombasa has not sent money for six months, the old people barely manage to stay alive. No, as long as it rains enough, Ngala does not complain.

Fifty-five years old Jonathan was born in Chilulu, went to primary school in Kaloleni, and that education long ago was enough to get him a job in Voi hospital, in Taita District. Once a month he comes to his Chilulu home to visit his wife Christine and their five small children. **Christine** (C 042, table 4.16c) is the farmer. She looks after the one hundred coconut palms, seventy of which are in production. The nuts are sold to nearby buyers, who come and pick them. She has two fields, one near the house and one some thirty-five minutes' walk away in Mikiriani. Part of the land is used for maize, cowpea and cassava and part is under fallow. The latter is necessary as the poor sandy soils have been in use for as long as Christine remembers. In the plot near her homestead there is a small valley, where in years with good rainfall Christine grows some rice. The yields of the annual crops are low, but most of the year there are at least some maize, rice, beans, cassava roots or vegetables from the farm. Together with the money earned by selling coconuts and what Jonathan brings home, that is enough for if not a rich at least a content life.

The farm owned by **Masha** (K 076, table 4.16d), a sixty-year-old grandfather from Kinarani, is a model of a traditional Giriama farm: a semi-circle of small huts, two dozen tethered goats and sheep, scattered plots of maize and some sixty coconut palms, two-thirds of which bearing age. Masha has three wives and one son, Katana, who with his two wives and four children lives on the same homestead. Masha's three daughters are married already; their bridewealth helped their father and brother to marry so many wives. These wives work together in the extensive family fields of maize, cowpea and cassava. Moreover, several members of the family have their own smaller plots, where they grow the same crops or some vegetables. Masha himself spends most of his time tapping and selling palm wine, for which there is much demand, as in his neighbourhood there are few fully grown palms. Part of the money earned he uses to pay a labourer to help in weeding maize. With so much labour available, and by clearing, planting, weeding and harvesting nearly continuously, the family manages to grow almost all food they need, in spite of the poor sandy soils. When the crop fails due to drought, they live from the sales of toddy, and in the worst case they sell a few goats. Since last year Katana has been working on a nearby road project. He does not earn much, but he can sleep and eat at home.

These cases illustrate the rich diversity of Mijikenda farms. These are not just combinations of land, labour, crops and animals, nor the result of ecological and socio-economic conditions. Apart from being a way of using land, a kind of business or a class of farms, they are also the outcome of the dreams, intuitive or rational decisions and struggles of people. Some of these people have had a better starting point, others more good luck, but all have had to make their farm with their own heads and hands.

7 DISCUSSION

Problems and approaches

A major problem in the study of peasant agriculture in Africa is how to define, delimit and describe the main units of analysis, usually indicated as households, farms and fields. As a result it is difficult to compare populations described at different points in time or by different researchers. Households are especially fluid entities. Their size, age distribution, eater/worker ratio, requirements and aspirations change over time (Chayanov 1925). Moreover, instead of being clearcut and neatly coinciding production and consumption units they are variable mixes of decision makers, workers and spenders; different units have to be chosen in accordance with the theme or problem studied. Even in a physical sense households are hard to grasp; the house remains in one place but the people come and go (Guyer 1981).

The choice of the household unit determines the land, fallow, crops and livestock to be included or excluded from the farm. A wide delimitation results in heterogeneous farms with several decision makers, and a narrow one in farms that are not managed independently. Scaling down the farmer to a single person does not solve all analytical problems. For example, a field which is a single unit for the farmer, may consist of parts with different cropping histories, soil types, crop mixtures or cropping practices (Poate 1988).

One approach to the study of peasant farms is to follow the divisions made by the farmers interviewed and hope that these will result in a coherent picture. Another is to push the researcher's own definitions -- which may or may not provide useful analytical units -- and expect the interviewees to translate their realities into these terms. A third and most thorough method is to unravel each case by detailed interviewing and observation (Maxwell 1986). The time required or fear of small numbers appear to work against the last approach; case studies of farms, such as the one by Hart (1982), are scarce compared with interviews of large samples of farmers (Doorman 1990).

The present study also initially leaned heavily on interviews of large numbers of farmers. The answers of people to questions that probably made little sense to them form the bulk of the data presented here. The interpretation would have been difficult without the experience obtained by later more detailed studies of maize production and coconut palm growing. No

specific case studies of farms were carried out, but much insight was obtained by numerous formal and informal conversations and observations on a few farms that participated in several surveys or in field experiments. Apart from the normal pretesting of the questionnaire, interviews on peasant farms can be improved by immersing the researcher *ex ante* in a few detailed case studies.

A visible classification

Classification forms the link between the individual cases and the aggregate groups that are the usual objects of analysis or intervention. So far, there is no single (usable at several scales), comprehensive (covering all kinds of farms) and widely accepted classification of farms in the tropics, that might serve as guideline to bring order in specific cases (Fresco & Westphal 1988). There may never be one, as the criteria to be employed vary with the scale or purpose of the classification or the characteristics of the population. For example, access to valley land or ownership of oxen may be useful criteria at the village scale, but not in all villages, whereas variation in rainfall or the distance to markets may be more relevant at the regional scale, although not to the same degree everywhere.

A common approach to classify farms is to divide them into groups according to certain criteria or variables. Everyone can see what is being done, provided the choice of criteria is explained. Another is to group farms by means of mathematical clustering methods. Today, computers and software can handle large numbers of variables and farms. A drawback is that their output is not always easily recognizable so that a certain amount of "translation" is needed to understand the meaning of the clusters obtained.

The tabulation method used in vegetation studies is a convenient intermediate approach, which serves to classify units by hand or to present the results obtained by clustering (Digby & Kempton 1987). It combines a summary of the entire classification with details on each and every group and case. The tables are clear and concrete, easy to understand, and handy materials to discuss alternative ways of grouping the farms. They might also be useful for analysing, classifying and visualizing populations of fields containing many crops.

A question that did not receive explicit attention in this study, or in most other ones, is whether to classify the farms or the farmer. Many studies of agriculture in the tropics tend to classify the farms rather than the farmer (see examples in Shaner *et al.* 1982). Even where nominally the farmers are grouped, this is often done on the basis of where they live, what they have, or at best of what they do, rather than according to their views or strategies. However, in classifications made with a view towards undertaking action, the farmer's ideas may be of equal or more importance than the material conditions.

The obvious environment

In the Kaloleni area the effect of ecological conditions on the use of land is very obvious. For example, in Mbuyuni the limit between Vertisols and Nitosols is shown by an abrupt transition from fields with maize to an almost continuous grove of coconut palms. The effect of rainfall is most evident north and west of Kaloleni, where within a few kilometres, coconut palms almost disappear from the landscape. Maybe because of this obviousness the ecological environment is often seen as a major determinant of tropical farming systems and much attention is being paid to soil mapping, land evaluation and land use planning.

However, knowledge of the relations between land characteristics and land use performance is only part of understanding the reality of agriculture. The ecological conditions determine the limits of what farmers can do -- and it is good to know what these are -- but not what they actually do. In the Kaloleni area there was also an enormous variation within villages and between farmers with approximately the same qualities and quantities of land. Variables other than the ecological ones also contribute to the choices and success of farmers; these variables include access to markets, availability of labour, the needs of the household, and the farmer's aspirations and capabilities.

Social agronomy

"It is often forgotten that agronomy is an applied subdiscipline of ecology." (Hart 1986: 40)

De Schlippe (1956) and Allan (1965) are sometimes presented as early practitioners of what today is called Farming Systems Research (FSR). Those acquainted with the history of the Dutch in the East Indies are tempted to point to the older work of De Vries (1931). Apart from long and strong involvement with the peoples and objects concerned all these studies have in common that they balance the ecological and sociological focus within one single analysis.

The introduction of the "system" (Bertalanffy 1968) and "ecosystem" (Odum 1971) concepts in the study of farms brought about an important change. Systems no longer referred only to ordered (systematic) ways of growing crops or running farms. The terms were increasingly applied to the objects of study themselves. Fields and even farms were described and modelled using words and methods derived from the study of ecosystems (Hart 1985). System theory is also supposed to cover the social sciences (Bertalanffy 1968) and ecology was presented as a link between the biological, physical and social sciences (Odum 1975). In practice, the use of the ecosystem concept, whether or not in combination with mathematical models, the use of computers, and the emphasis on the future of the land rather than the happiness of the farmer, has narrowed agronomy to its biophysical aspects. A place was left for the *homo economicus* by putting price labels on inputs and outputs. The softer, less physical and not easy to quantify features of farmer and household disappeared from the

"hard systems" view of agriculture. The application of systems theory increased the understanding of ecological and technical facets of the complex and varied reality of tropical agriculture. The price was often simplification of its human and social elements.

Another school of thought continued to see the household or the farmer as the central element of agriculture (Hofstee 1946; Ploeg 1993). They emphasize the role of the farmer in shaping a valid -- adequate for the people depending directly on it -- structure of relations between labour, objects of labour, and means. This structure is based on a coherent set of conceptions, experiences, opinions and rules related with farming. The term "style of farming" is used for both the cultural code and the related material structure. Although these styles are sometimes characterized in system-like terminology such as scale, intensity or diversity of production they are first and foremost social constructions (Ploeg 1990, 1991). Other recent works have also stressed the crucial role of the households and farmers themselves in the structuring and adapting of farms and fields (Chambers 1983; Richards 1985; Chambers *et al.* 1989).

"I've been walking between you symbolically, because he sees only the soil and the trees, and you see only villages and people. Someone had to see both sides." (Gluckman 1964: vi).

Both the ecological systems and the socio-economic styles views are required to understand the nature of agriculture in the tropics. The first helps us to understand the functioning of the field, the second to comprehend the reasoning of the farmer. The present study of agriculture in the Kaloleni area would be incomplete by focusing on either agro-ecosystems determined by soil and climate or on farms as the outcome of human dreams and struggles. There are works where both approaches are balanced, but what has been lacking up to now is a framework that integrates the languages of the divided ecological and social sciences: a social ecology or social agronomy (Timmer 1947).

Futures for peasants

There are four hypothetical pathways for the development of Mijikenda peasant farms. The first is disengagement from labour and commodity markets and a return to complete self-sufficiency. The second option is to develop into "family farms" with a strong market orientation, i.e. into capitalistic enterprises. The third way is to engage fully in the labour market and become landless proletarians. The last is to remain peasants combining farm activities and off-farm work.

The temptations of modern consumption society close the door to the first path. The second option is more attractive. Several Mijikenda farmers are trying to develop businesses, in some cases based on farming, but in many others on activities such as shop-keeping or other forms of commerce. Most of them maintain their farm as some kind of security. Other people, favoured by good education or pressed by poor land, opt for permanent employment.

For the time being most maintain a *pied-à-terre* in their home areas. The last option -- if that is the correct word -- is the most common. Many people, forced by lack of land, capital, education or employment, have no choice but to grasp a bit of everything they can lay their hands on, i.e. to remain peasants.

Given the harsh and deteriorating ecological conditions and the population growth of more than 3 % per year their future will not be easy. There are few prospects of substantial increases in the availability of alternative employment, marketing opportunities and agricultural technology. Therefore, much will depend on the inventiveness of the peasants themselves and on their ability to exploit their ecological, economic and social diversity.

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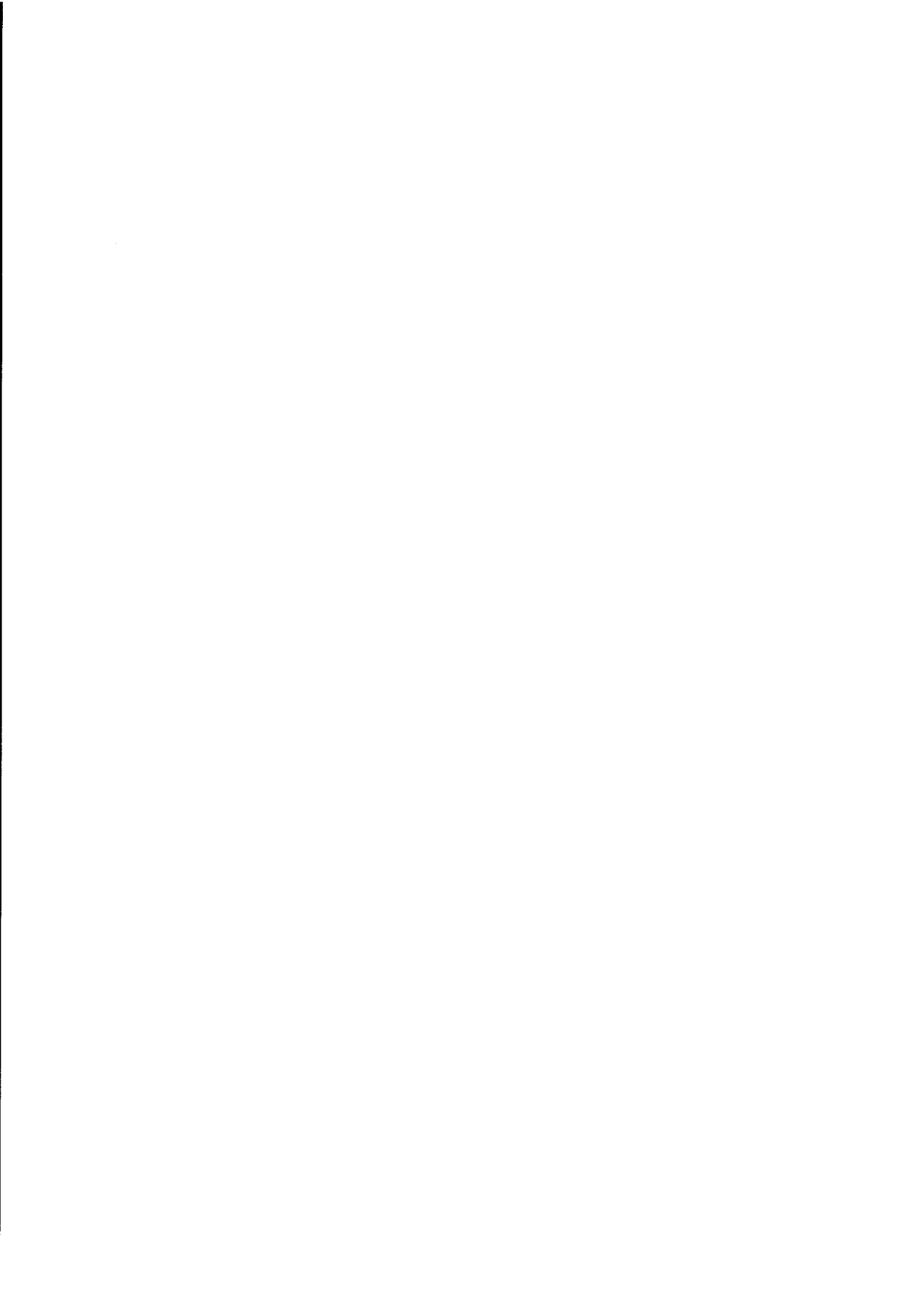
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5 Maize production in Coast Province of Kenya:
the agronomy of an "unsuitable" crop

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1 INTRODUCTION

The Mijikenda people

The Mijikenda (derived from *makaya* or *miji chenda*: nine towns or villages) are a Bantu people numbering about one million persons and consisting of nine tribes: proceeding northwards, Digo, Duruma, Rabai, Ribe, Kambe, Jibana, Chonyi, Giriama and Kauma. They live in the hinterland of the southern Kenya Coast, from the Tanzania border to halfway between Malindi and Tana river. The area they live in roughly coincides with Kilifi and Kwale Districts of the Coast Province of Kenya (figure 5.1).

According to oral histories, the Mijikenda settled there about four hundred years ago. Until the 19th century they lived in nine *makaya* (singular *kaya*), fortified villages on densely wooded hill tops of the coastal uplands and plateaus (figure 5.1). They planted sorghum, millets and cowpea, kept some cattle and goats, and traded agricultural surpluses, forest products and ivory with their neighbours in the coastal strip and the interior of the country.

In the course of the 19th century the Mijikenda left the protection of their *makaya* and spread over the surrounding countryside. Most of them still dwell in the uplands and plateaus, but large numbers have migrated towards the coast. Nowadays the Mijikenda live in scattered homesteads, on small farms of mostly less than 5 ha. They grow maize, rice, cassava and cowpea, and harvest the produce of their coconut palms or cashewnut trees. Some households own cattle, most keep goats or sheep, and nearly all have one or more members working off-farm.

A striking feature of the Mijikenda economy is the rapid and complete change from sorghum, pearl millet and finger millet towards maize, cassava and rice as staple foods. Within a century sorghum and millets disappeared from the Mijikenda fields and kitchens, and it is hard to imagine life today without maize, cassava and rice. Maize is by far the most important of the new food crops, in terms of the effort dedicated to its cultivation, of its contribution to the diet, and of its prominent role in the life world of most Mijikenda farmers and eaters. Therefore, the history, ecology, agronomy, productivity and sustainability of maize cultivation are central themes of this paper on Mijikenda food production.

Their daily bread

This paper is not intended as a neutral tale about the what, how, why or how much of maize production. It revolves around the harsh struggle of the Mijikenda for their daily bread. In rich western societies the latter term has lost much of its significance, being no more than a relic from an ancient prayer. For most Mijikenda food is still a matter of daily concern. Their cash incomes are low and uncertain, and the availability of food in the shops is far

from guaranteed. Therefore, they try to attain a high degree of self-sufficiency in maize, for most the favourite staple food (for the Digo cassava is a principal food crop).

Producing enough maize is not only a necessity, but is also a sign of accomplishment or status. It is a yardstick of success in carrying out one's duty, or of failure to do so. Mijikenda wives are proud if after working hard they are rewarded with enough maize in the store to feed their husbands and children for many months. On the other hand, many Kenyans see the low degree of self-sufficiency of Mijikenda agriculture as a sign of backwardness. And western public opinion tends to feel the local lack of food as some kind of basic failure, only excusable if due to drought or war.

An unsuitable crop?

The Mijikenda may have bet on the wrong horse by opting for maize to fulfil the demands of necessity and status. From early colonial days until the present, many have claimed that the Mijikenda area with its poor, sandy soils and low, unreliable rainfall is not suitable for maize growing. They considered the historical change from sorghum to maize an error which should be corrected, and would have been if not for the stubbornness of Mijikenda farmers.

This study will show that the objections against maize were not groundless, but also that the crop had definite advantages and that there was much in favour of the choice the Mijikenda made in the past. As for the present, the study would not be complete without at least touching on the alternatives and choices the Mijikenda now have with regard to maize production.

Choices in this paper

This paper cannot deal with all aspects of the daily bread or its modern equivalent food security: the physical availability of food and the economic means to acquire it (Eicher 1987). It focuses on the supply of staple foods, with the emphasis on the production of maize. The latter is not isolated, but has links with other farm and household activities. Any comprehensive study would have to deal with aspects varying from history to agronomy, from sociology to ecology, and from nutrition to economy.

The paper tries to strike a balance between width of coverage and depth of analysis. After summarizing the research methods employed, the ecological conditions and historical context are outlined. Then the actual cultivation practices and field characteristics are described, as well as their outcome in terms of self-sufficiency in maize. The paper concludes with an analysis of bottlenecks and an exploration of avenues for improvement of Mijikenda food production.

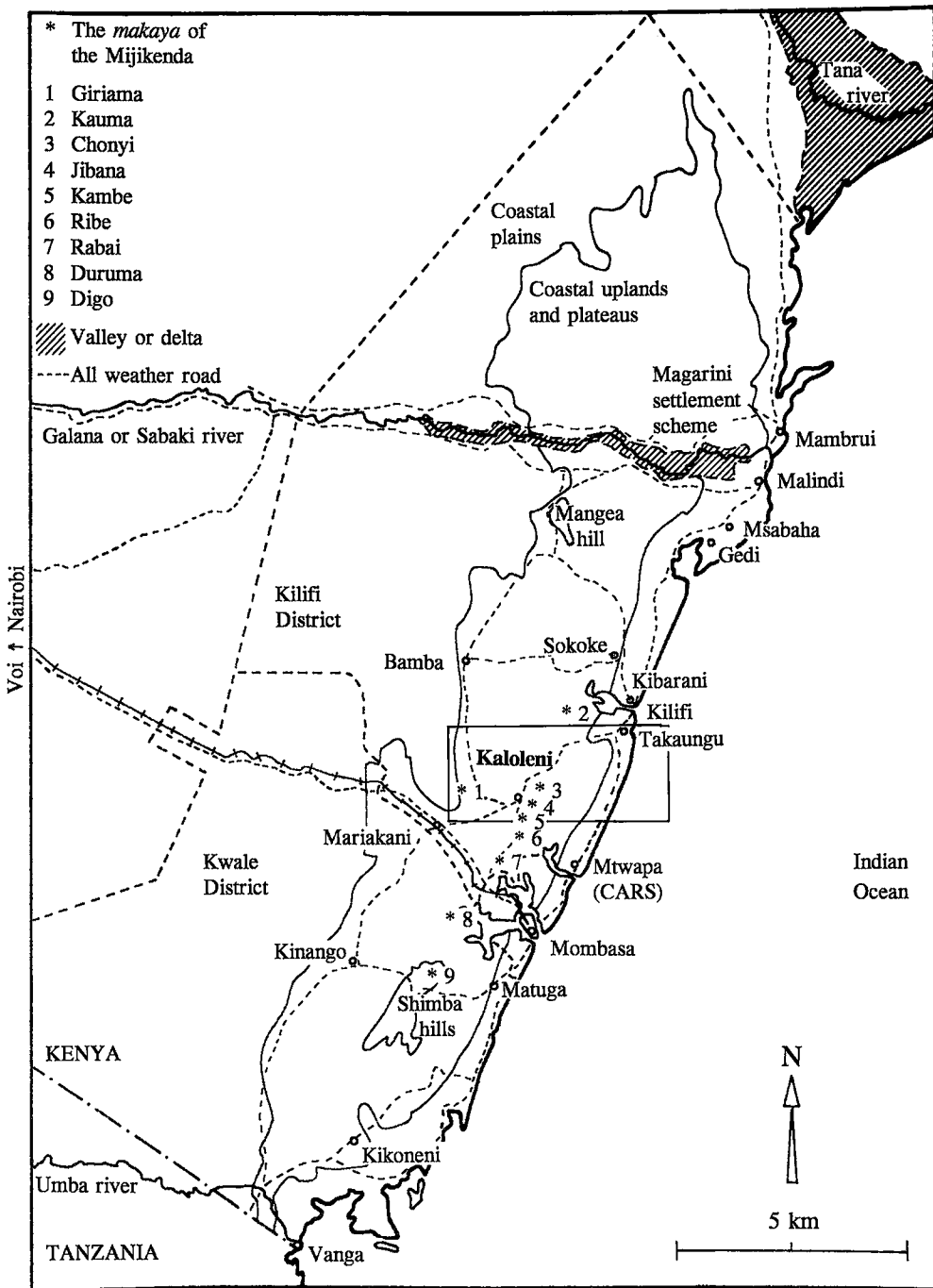


Figure 5.1. The geography of the southern Kenya coast.



Photograph 5.1. Maize, the daily bread of the Mijikenda, Coast Province of Kenya.

2 METHODOLOGY

This paper is based on studies carried out between 1981 and 1985 in Kaloleni division, the major maize growing area of Kilifi District and Coast Province. Field work was done in Pingilikani, Mbuyuni, Chilulu and Kinarani, and in an area referred to as Ngamani where farmers from the first two villages grow their annual crops. These places, along an east-west transect across the uplands, cover a large part of the variation in ecology and land use in the Mijikenda area. In this section per theme a short summary is given of the methods; details are given in the relevant sections. References to reports written by students working under the supervision of the author of this paper are given in italics (e.g. *Sprenkels 1985*).

Ecological conditions

The mean climatic data used in this study are from Jaetzold & Schmidt (1983) and Boxem *et al.* (1987). Moreover, rainfall was determined by means of 21 rain gauges, set up specially for this study, some monitored throughout 1981-1984 and others only during specific experiments. Most consisted of PVC tubes of 12.5 cm diameter and 75 cm deep, dug in with

their tops 30 cm above soil level. The rain water levels were measured weekly. Evaporation was prevented by keeping the water well below the soil surface and covered with oil.

The soil units mentioned in this paper are as delimited, described and classified by Boxem *et al.* (1987). Quantitative data refer to profiles studied and samples taken at the sites of experiments. Information on the natural vegetation was obtained from literature and by observation of the few remaining patches. Descriptions of the present land use were based on interviews and observations.

Historical context

The reconstruction of the disappearance of sorghum and millets and the introduction of maize presented in this paper are based mainly on archive sources, published reports, and a number of informal interviews which are referred to in italics (e.g. *Wakanyoe 1984*). Observations in farmers' fields and kitchens helped to understand the central place of maize in the cropping systems of the Mijikenda. Field experiments also contributed; it was, for example, illustrative to see sorghum trials devastated by birds or attacked by fungi.

Cultivation practices

The description of cultivation practices is based on interviews and observations. In 1981 30 farmers chosen at random from each of the four study villages were asked about the composition of household and farm, land tenure, livestock kept, tree crops owned, and annual crops grown (chapter 4). During 1982 and 1983 random subsamples of 10 farmers per village were interviewed in more detail about land preparation, weed control, crops grown and storage and use of produce. The interviews were complemented with observations in farmers' fields, and a botanical collection of weeds, minor crops and wild useful plants which was deposited at the East African Herbarium (Nairobi, Kenya) and Herbarium Vadense (Wageningen, The Netherlands).

Field characteristics

Quantitative data were collected about farmers' fields, after first testing sampling and measuring methods in 1981 (Waaijenbergh 1983). In 1982 random subsamples of 5 out of the 10 farms per village were studied, with entire fields as units and with emphasis on areas and yields (see below). During the long rains of 1984 a follow-up study was conducted on the same farms, with the aim of characterizing fields and explaining yields. In each of the 54 fields involved one 25 m² square was located, and in it the soil parameters, cropping practices, weed and pest incidence, and maize cultivars, densities and yields were determined by means of interviewing, estimating and measuring.

Needs, areas and yields

In 1982 on 5 farms per village the areas planted with maize and the quantities of grain harvested were estimated. The maize demands were estimated by combining the household compositions with energy requirements per age and sex class, and by asking the farmers how much maize (meal) they had to buy daily when they had none of their own. The results were compared with the number of months the households reportedly ate from their own harvest. This information was collected from January 1982 to June 1984, allowing differences to be observed within and between years.

Problems and options

Observations in farmers' fields raise many questions but, because of the large variability and the confounding of some factors or the absence of others, they are unlikely to provide all the answers. Therefore, some small diagnostic (discovery of bottlenecks) and exploratory (identification of alternatives) experiments were also conducted.

All trials were in farmers' fields and under representative soil, rainfall and land use conditions. Cooperating farmers received the harvest or were compensated with packets of maize meal. The field work was done by local casual labour. Most studies were done at several sites, one per land unit. They had randomized block, split-plot or factorial designs, with 1 to 6 replications. The smallest unit varied from 1.6 m² or 6 plants to 19.4 m² or 72 plants; all figures refer to nett sizes or numbers. The usual density was 37,000 plants ha⁻¹, corresponding to extension recommendations and the highest values in farmers' fields. Unless stated otherwise, effects were considered to be statistically significant at $p \leq 0.05$.

The section on problems and options also integrates some results of studies carried out by other researchers, mostly outside the Kaloleni area. Most dealt with fertilizer use, auxiliary species and stalk borer control.

3 ECOLOGICAL CONDITIONS

General statements about the potential of the Mijikenda area for maize growing overlook the variation in ecological conditions. The soils used for maize vary from sandy and poor Arenosols to clayey and fertile Vertisols. The climate ranges from sub-humid to semi-arid. Some land has recently been cleared from forest, whereas other sites have a cropping history of decades or even centuries.

On the southern Kenya coast several soil boundaries and rainfall isohyets, and consequently vegetation and land use transitions run parallel with the coastline. In other words, the ecological factors tend to be partly confounded. The following sections relate to land units, specific combinations of soil, rainfall, vegetation and land use. These are linked with the names of the villages or areas where the field work took place (figure 5.2, table 5.1).

Tables 5.2 and 5.3 describe the most representative soil units and summarize their physical and chemical characteristics. The quantitative data refer to the sites of the 1982 experiments; those in 1981 and 1983-1985 were on the same or similar sites. Most soils are sandy, well drained, easily worked, and poor in nutrients. The clay soils of Ngamani become very sticky when wet and hard when dry. The sandy clay loam soils in Chilulu are easy to work when wet, but some become hard like bricks when dry. The available water capacity of the soils is small in view of the high evapotranspiration and unreliable rainfall. This problem is sometimes aggravated by superficial rooting due to lack of nutrients in the subsoil (UE₁₁), poor drainage (UT_{2c1p}), or high bulk density of the B horizon (USc₁).

Mean annual temperatures in the Mijikenda area are 24-27 °C and the potential evapotranspiration 1,900-2,300 mm. Rainfall is the most variable climatic factor. Annual rainfall varies from more than 1,200 mm near the coast to less than 700 mm on the western edge of the uplands; in the same direction the distribution becomes more bimodal. Within the study area the differences between annual means are smaller, but in the period that it matters most, April to June, rainfall in Pingilikani tends to be at least one-third higher than in Kinarani (table 5.4). Differences between years and seasons are large: 1981 and 1984 were close to normal, the long rains of 1982 were extremely wet, and the short rains of 1983 very dry.

The original vegetation of the Mijikenda area consisted of forests, woodlands and savannas (Moomaw 1960; Leeuwen 1982). Early visitors burst out in superlatives like "noble trees", "fine forests" or "exuberant vegetation". The praise was extended to the soils below, which were classified in terms like "fine friable chocolate" or "excellent everywhere" (Krapf 1860; New 1873; Fitzgerald 1898). However, careful observers also commented that after cutting the forest, the soil and water turned "bitter" and the land became a "desert" (Fitzgerald 1898; Champion 1914).

The expansion from the *makaya*, rapid population growth, widespread deforestation and intensive land use with few conservation measures had a negative effect on the suitability of soils for crop growing. The generally low contents of organic matter and nutrients are significant (table 5.3). Nevertheless, there are large differences between land units -- the effect of soil units alone is sometimes hard to distinguish -- in the suitability for maize and other crops. The differences in land use, cultivation practices and productivity are discussed in the next sections. Two extreme cases are illustrated in photographs 5.2 - 5.5. Above Ngamani: heavy and fertile clay soils, tractor ploughed; one maize crop per year, planted almost simultaneously; under normal conditions high yields. Below Kinarani: fine sandy, rather poor soils, cultivated with the hoe; staggered planting whenever the weather looks favourable; crop failure due to lack of rain common.

Table 5.1. Land units studied in the Kaloleni area, Coast Province of Kenya, 1981-1985 (Boxem et al. 1987; Moomaw 1960; CBS 1981; own data).

Pingilikani

An undulating to hilly landscape with sandy and poor soils, formerly covered by *Cynometra-Manilkara* lowland dry forest. The present land use is dominated by semi-abandoned cashew fields. Most farmers grow annual crops in Ngamani. The population density is variable, about 80 persons km⁻² (Chonyi).

Ngamani

A flat to dissected area with heavy and fertile soils, under *Manilkara-Dalbergia/Hyparrhenia* lowland cultivation savanna. The present land use is intensive and consists of maize during the long rains followed by cassava, cowpea or sesame as relay crops. As most farmers live in the surrounding areas, population density is only 50 persons km⁻² (Chonyi).

Mbuyuni

An almost flat area with well drained clayey soils, originally under *Sterculia-Chlorophora/Memecylon* lowland rain forest and now planted with coconut, cashew, citrus and mango trees. Most farmers grow annual crops in Ngamani. The population density is approx. 200 persons km⁻² (Chonyi).

Chilulu

An undulating landscape with coarse sandy soils. As in Mbuyuni, the rain forest made place for a sea of coconut palms, with small islands of open land used for maize or rice. With about 300 persons km⁻², land is scarce and its use intensive (Jibana and Giriama).

Kinarani

On the dry western edge of the coastal uplands, with fine sandy soils in an undulating landscape. Small patches of the original *Brachystegia-Afzelia* woodland alternate with areas of degraded shrub and grazing land. On better spots coconut palms and maize fields are found. The density of 90 persons km⁻² is high for this marginal area (Giriama).

Population densities are for 1981; annual growth is over 3 %.

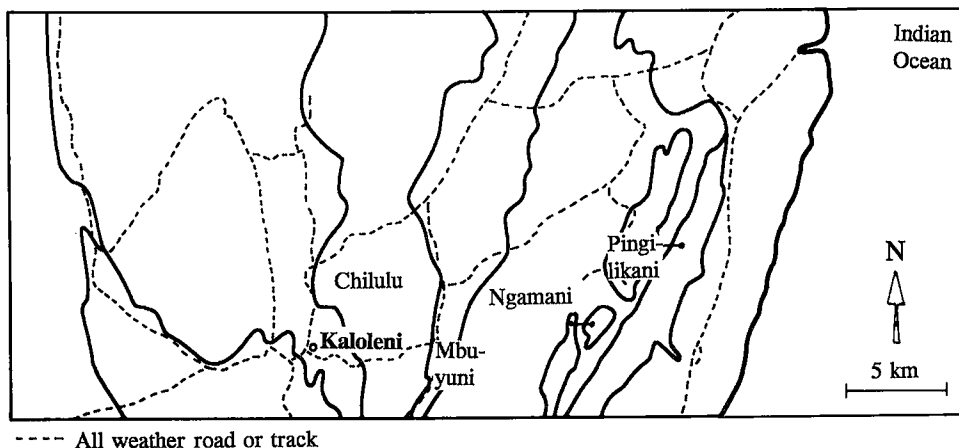


Figure 5.2. Land units studied in the Kaloleni area, Coast Province of Kenya, 1981-1985.

Table 5.2. Soils commonly used for maize growing in the Kaloleni area, Coast Province of Kenya; for details see Boxem *et al.* (1987).

UE₁l₁: rhodic Ferralsols, ferric and chromic Luvisols (Pingilikani)

Well drained, very deep, dusky red to reddish brown, sandy loam to sandy clay; in places underlying 20-40 cm loamy medium sand. ABC profiles, gradual to diffuse horizon boundaries, low nutrient status, high permeability.

UT₂C₁p: gleyic and vertic Cambisols, chromic Vertisols (Ngamani)

Well drained to moderately well drained, moderately deep to deep, yellowish red to yellowish brown, cracking clay; in places strongly mottled and/or calcareous. A(B)C profiles, clear horizon boundaries, high nutrient availability, variable permeability and depth.

ULc₁: dystric Nitosols, chromic Acrisols and Luvisols (Mbuyuni)

Well drained, deep to very deep, red to reddish brown, sandy clay to clay; in places rocky. ABC profiles, gradual horizon boundaries, mostly thick B horizon, showing shiny ped faces; moderate nutrient status, high permeability.

USc₁: ferric, chromic Luvisols; humic, ferric, orthic Acrisols (Chilulu)

Well drained, deep to very deep, red to yellowish red, sandy clay loam to clay; in places underlying 20-80 medium sand to sandy loam. ABC profiles, BC profiles in case of topsoil erosion, clear horizon boundaries, low nutrient status and moderate to high permeability.

USKf: albic and luvic Arenosols (Kinarani)

Somewhat excessively drained, light brown to yellow, fine sand to sandy loam; in places with lamellae of clay accumulation. Profiles with little horizon development, a low nutrient status and a high to very high permeability.

Table 5.3. Physical and chemical properties of the soils used in field experiments in the Kaloleni area, Coast Province of Kenya, 1982.

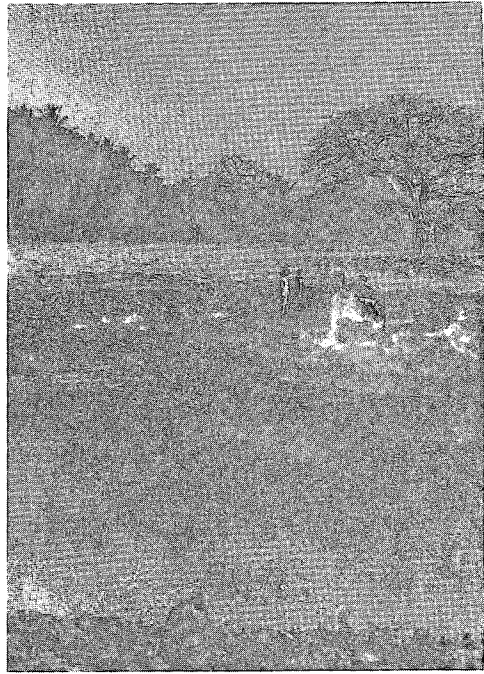
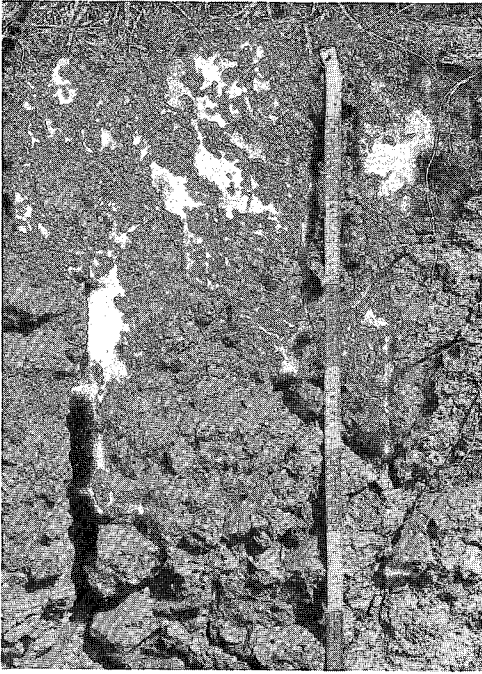
	UE ₁ l ₁	UT ₂ C ₁ p	ULc ₁	USc ₁	USKf
Available water (mm m ⁻¹)	63	143	101	74	89
Bulk density (kg m ⁻³)	1350	1160	1150	1440	1150
Sand (%)	74	4	42	66	79
Silt (%)	8	24	35	11	11
Clay (%)	17	72	23	23	10
pH-H ₂ O	6.6	6.2	6.6	6.4	6.2
C (%)	0.3	1.8	1.4	0.7	0.5
N (%)	0.06	0.20	0.20	0.11	0.06
P (ppm)	40	33	24	11	45
Ca (meq kg ⁻¹)	17	166	60	18	20
Mg (meq kg ⁻¹)	8	81	26	10	10
K (meq kg ⁻¹)	3	4	9	3	4
CEC (meq kg ⁻¹)	22	345	77	25	38

Available water (pF 2.3-4.2, 0-150 cm), bulk density (5-10 cm) and Cation Exchange Capacity (\pm 10 cm) were determined in one or two profile pits; the other figures on two composite samples per site (0-20 cm). Most analyses were done by the National Agricultural Laboratories (NAL), Nairobi, Kenya; for details on methods see Boxem *et al.* (1987). Clay content and bulk density tended to increase with depth, whereas C, N, P, Ca, Mg, K and CEC decreased in the same direction.

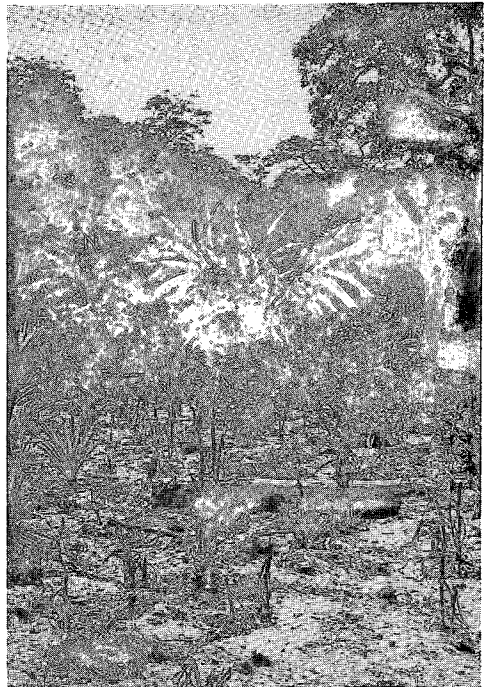
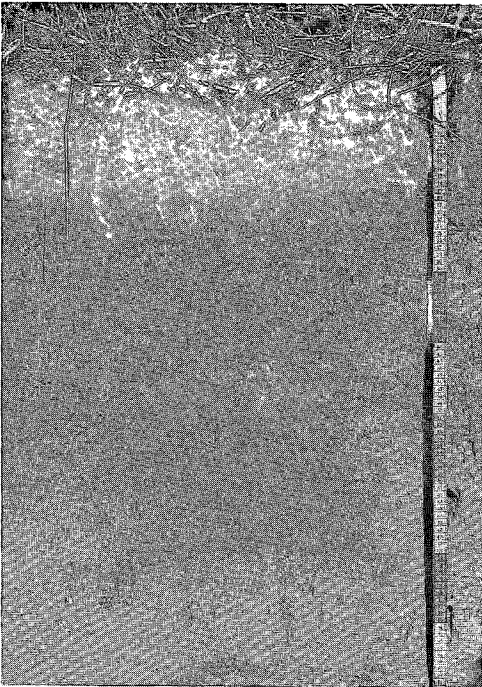
Table 5.4. Rainfall on five land units in the Kaloleni area, Coast Province of Kenya, 1981-1984 field observations and long-term averages from literature.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Pingilikani													
1981	20	0	140	100	140	80	50	80	64	115	83	67	939
1982	5	0	77	255	694	230	217	81	93	251	115	122	2138
1983	5	26	23	199	472	241	123	37	76	29	13	3	1247
1984	13	0	17	138	339	144	141	19	59	241	100	62	1260
Approx. long-term average	20	20	50	160	260	120	80	70	70	100	100	50	1100
Ngamani													
1981	30	0	100	100	130	70	50	90	76	86	59	53	844
1982	0	0	51	203	612	144	200	73	81	247	124	113	1848
1983	5	12	8	172	409	183	127	40	72	44	29	19	1120
1984	26	9	8	142	303	134	117	8	52	252	93	90	1234
Approx. long-term average	20	10	50	150	250	110	70	70	60	100	110	50	1050
Mbuyuni													
1981	40	0	60	100	120	60	40	110	100	127	72	130	959
1982	0	0	46	172	515	122	197	60	84	206	73	69	1544
1983	4	14	5	104	442	231	169	38	91	56	29	24	1202
1984	15	0	0	200	338	155	105	12	49	304	88	69	1335
Approx. long-term average	20	10	60	150	250	110	70	70	60	120	120	50	1090
Chilulu													
1981	40	0	190	130	120	40	30	80	85	114	52	98	979
1982	0	0	12	182	442	93	169	34	112	154	89	121	1408
1983	3	11	8	103	442	134	126	45	86	62	26	16	1062
1984	9	1	12	150	254	279	105	21	30	246	58	32	1197
Approx. long-term average	30	30	40	120	180	100	80	80	100	140	130	60	1090
Kinarani													
1981	30	0	230	110	90	40	20	80	67	85	17	78	847
1982	2	0	8	99	305	95	104	34	76	131	88	106	1052
1983	9	7	6	42	320	118	96	25	82	33	20	21	779
1984	44	3	7	112	189	167	76	14	23	97	78	45	855
Approx. long-term average	20	20	50	110	160	70	50	60	70	110	110	70	900

Figures for the first half of 1981 and the averages are based on interpolation or extrapolation from local sources, Jaetzold & Schmidt (1983), Boxem et al. (1987). Rainfall in Ngamani is the mean of observations near Lutsangani and Mto Mkuu (see figure 5.2). The peak of the long rains is between April and June, that of the short rains between October and December.



Photographs 5.2-5.3. Ploughing a Vertisol in Ngamani; the palms in the background are in Mbuyuni.



Photographs 5.4-5.5. Shifting cultivation of maize, pineapple and banana on an Arenosol near Kinarani.

4 HISTORICAL CONTEXT

4.1 Abandonment of sorghum

"A further adverse factor ... has been the abandonment of small cereals in favour of maize and the reliance [of the Mijikenda] on the latter crop for both food and cash." (Humphrey 1938: 106)

During most of the *kaya* period, from the 17th to the 19th century, sorghum, pearl millet and finger millet were the staple food crops. Sorghum was the most common and grown in large quantities, but finger millet was the most valued (*Kombe 1984*). The latter required more work and gave lower yields than sorghum, and it was used for brewing alcoholic drinks and for the paying of bridewealth.

Sorghum, once the staple food, by the 1920s had almost completely disappeared from Mijikenda life. At present, occasionally a few plants can still be encountered near homesteads. In many cases these are not grown for food but for the production of alcoholic drinks, the preservation of old cultivars for nostalgia's sake, or experimentation with new ones out of curiosity. Only in the Magarini Settlement Scheme, NW of Malindi, with a drier climate and stronger promotion efforts than elsewhere, does sorghum have a more than symbolic place in farmers' crop packages. Finger, pearl and foxtail millet are even rarer.

Cultivars

According to local informants there used to be at least two old sorghum cultivars: "*muhamambomu*", the most common, was very tall and had large loose panicles and white, sweet grain, whereas "*muhamamwiru*" was shorter and had small and compact panicles on goose necks and brown, bitter grain. No information was obtained on millet cultivars.

Government attempts to reintroduce the drought resistant small grain crops, notably sorghum, had little success. During the 1930s the early maturing "Dwarf Hegari" enjoyed "considerable popularity" (Humphrey 1938: 108). However, it has vanished without trace. Later "Serena" was introduced, an improved cultivar that yields well but has brown and somewhat bitter seeds (Acland 1971). In 1981-1985 during field work a small field of it was occasionally found. More recently the National Dryland Farming Research Station (NDFRS) in Katumani has developed cultivars with white and sweet seeds. Promising ones have been bulked and distributed, but very few farmers in Coast province have shown interest.

A factor that may have limited the reintroduction of sorghum was that most testing, bulking and distribution of seeds was done in the coastal strip, far from the dry hinterland where sorghum might have more advantage over maize. Most of the potential growers have never seen a good sorghum crop, let alone eaten one.

Cultivation

"The need for protecting other cereals [i.e. cereals other than maize] from attacks by birds has increased their [the Mijikenda] antipathy towards these crops, though in the past it was accepted as a part of the work on the farm." (Humphrey 1938: 106)

The reintroduction of sorghum was recommended by several research and development studies (Wang'ati 1982; TARDA 1983). Although its nutritive value, adaptation to poor soils and drought resistance in certain growth stages are superior, sorghum does not have as much advantage over maize as often is supposed. Therefore, a reversal of history in the form of a large-scale return of sorghum in Mijikenda crop packages seems unlikely, unless several problems related to its cultivation, pests and storage are overcome.

During its early growth sorghum suffers greatly from weed competition, and lack of labour for weeding is one of the major bottlenecks in Mijikenda agriculture. Moreover the crop is very susceptible to stalk borers, a major pest in Coast Province. Control by means of cultural methods is labour intensive and hard to enforce. Chemicals like carbofuran -- apart from having environmental drawbacks -- are only worthwhile if they are applied to a profitable cash crop.

Cultivars with white and sweet grain are not only attractive for farmers but also for birds, as evidenced by several devastated experiments in the study area in 1982. If sorghum were cultivated on a large scale the bird problem would be diluted, but any reintroduction would have to go through a difficult stage with small plots and many birds. Labour for scaring them is scarce as nowadays most children go to school. Wild birds can be discouraged by growing the sorghum near the houses, but little land is available here, and the crop may fall victim to hungry chickens.

Birds are not the only threat. When the ripening stage coincides with humid weather -- common in Coast Province -- moulds cause serious damage. Densely planted modern cultivars with short stalks and compact heads are likely to be more susceptible than the old local cultivars which were tall and had loose heads. The ripe and harvested grain of sorghum is vulnerable to maize weevils (*Sitophilus zeamais*). It needs to be protected by regular smoking or by applying insecticides.

Utilization

Traditionally, sorghum was consumed as a thick porridge (*sima*), a thin gruel (*uji*) or processed into beer (*pombe*). In the course of this century the habit of producing and consuming sorghum was lost. For example, in 1984 a farmer on a visit near Malindi had obtained seeds of sorghum and planted them near his house in Chilulu. After harvesting the grain he asked me where he could sell it; he quite clearly could not imagine himself eating such a strange food.

4.2 Adoption of maize

Maize was probably introduced by the Portuguese. In 1643 it was already grown on Pemba island, the granary of the Portuguese settlements in East Africa (Miracle 1965). It reached Mombasa -- at least as a food and maybe as a crop -- before the Portuguese were evicted from Fort Jesus in 1729 (Guillain 1856). By the mid-19th century the *Wanika*, as the Mijikenda were called then, were selling maize to Mombasa (Guillain 1856), and it had already become their favourite item of food (New 1873) (it is not certain whether these observations applied to all Mijikenda or only to those living near Ribe where New worked). Late in the 19th and early in the 20th century maize was an important cash crop for especially the Giriama, and large quantities were exported via the ports of Takaungu, Malindi and Mambrui (Brantley 1981; Cooper 1981).

Advantages

"... sufficiently good crops [of maize] have been obtained to give the native [Mijikenda farmer] such a preference for maize that he has allowed other cereals to fall into insignificance." (KNA 1935).

Both colonial records and oral history ascribe the switch from sorghum and millets to maize to a series of famines in the late 19th and early 20th centuries (Humphrey 1938; *Bennett 1985*; *Chome 1985*; *Mwaringa 1985*; Humphrey 1938). After eating the seeds of sorghum and millets, the people planted the maize they received to relieve the hunger. This process no doubt accelerated the change-over, but that does not explain why some decades earlier maize was already an important food and cash crop, nor why afterwards the Mijikenda did not return to growing sorghum and millets.

Aversion to bird scaring may have promoted maize, whose grain is well protected by the husks. However, as bird scaring is still an accepted practice in rice growing, maize must have had more advantages. The Mijikenda may have appreciated its short growing cycle, especially in the period they were spreading out from the *makaya* into new territory. In recently cleared forest or woodland, with high soil fertility and few weeds and pests, yields must have been high. The crop was easy to harvest, transport, store and process. Apparently the Mijikenda liked the taste of the new food, and any surplus could be sold easily in the coastal ports.

Niches

"Although it is clear that the [Kenya] Coast is not suitable for maize, it still remains the most popular food and it is planted on every possible and frequently impossible occasion." (DoA 1947: 59)

Colonial officials considered maize ill adapted to the dry climate of Coast Province, and strongly disliked and discouraged the strong dependence on maize. They blamed the farmers' lack of interest in sorghum, millets, cassava and other supposedly better adapted crops to blindness for the benefits of diversification or, in more general terms, to backwardness. They failed to see that the Mijikenda did and do grow a multitude of minor crops. If taken separately each is of little importance, but all together they make a substantial contribution to diet and cash income. There are also indications that rice, cassava and banana have become more important during this century. These did not replace maize, but complement it in their requirements with regard to land or labour and in their various uses. They fit into specific and unexploited niches.

Sorghum and millets competed -- unsuccessfully -- with maize for land and labour. In contrast, rice is cultivated on wet soils that are in general not suitable for maize. Both crops are sometimes found on transitions from dry land to valley bottoms, and in some parts of Ngamani. In wet years rice does better and in drier years maize, and in any case the other crop may be preferred above the weeds that otherwise would take its place. Cassava is grown as relay crop of maize; it requires little extra labour, withstands drought and can be kept (stored) in the soil. Most bananas and plantains are found in small clumps along the borders of fields or around homesteads. They require little space and receive little care. In all cases there is little competition for land or labour with maize, whereas the products diversify the diet and the sales opportunities.

Obstacles

"... once the duka [shop] has bought the maize, whether he exports it and later imports new maize or whether he stores it for sale back to the native, if food becomes short, he will sell maize at a considerably higher price than that at which he bought it. This is one of the chief reasons for the average native's lack of prosperity." (KNA 1939b)

The potential of maize as a cash crop was affected by a series of government measures, often not against coastal maize production per se but nevertheless quite effective. Maize grown up-country by white settlers was subsidized with cheap railway and shipping rates (Leys 1924). In order to obtain an export certificate, maize had to be graded in Mombasa. The best grade "K₂" should contain < 12.5 % moisture, < 8 % discoloured grains, and be free of weevils; conditioning had to be paid for (Maher 1932). The requirements worked against Mijikenda maize: much was exported via Malindi, the humidity of the coast hampered drying, and most cultivars had a high proportion of purple, yellow and red grains. Moreover, after 1921 the Rupee, currency of the coastal dhow trade, was no longer accepted in Kenya, which harmed the export to Somalia (Cooper 1981).

There were also changes in the organization of the trade. The Mijikenda used to carry the maize on their heads to the coastal strip. There they were often harassed, and so they became dependent on Indian middlemen. These also had a virtual monopoly in the distribution of

imported goods like the popular *merikani* (American) cloth (Martin 1973; Cooper 1981). Local (petty) trade was further discouraged when in the 1920s the buying and selling of produce was restricted to trading centres where only licensed businessmen could operate, few of them Mijikenda (Cooper 1981). From the 2nd World War onwards the trade in grain was regulated by the Maize and Produce Control and the Maize Marketing Board (Cone & Lipscomb 1972). After independence Indian traders lost their licences and the newly formed cooperative societies did not buy grain, so that the farmers stopped selling it (*Kombe 1984*).

Two factors had a particularly negative effect on the profitability of Mijikenda maize production: hut tax and export prohibitions (KNA 1939ab, 1940a; Cooper 1981). In order to pay taxes people often had to sell maize just after the harvest when prices were low, and later had to buy it back when they were high. The prohibition of maize exports during the threat of famines had the same effect: traders used it as an argument to pay less than the normal price, and once the stores were full applied for an export permit on the grounds that otherwise the grain would spoil. In this way farmers fell into debt, and artificial food shortages were created.

Shortages

"... the coastal area is frequently subjected to food shortages, which sometimes constitute famine (Humphrey 1938: 106)

During this century the capacity of Mijikenda agriculture to feed the own population and to produce surpluses has declined. After 1925 the grain exports of Malindi, based on maize production by Giriama in the Sabaki valley, diminished (Cooper 1981). In subsequent decades famines and food shortages were one of the main concerns of colonial officials throughout the Mijikenda area (Humphrey 1938). As the maize harvests often failed to feed the population, they had to turn to growing and eating cassava, whether they liked it or not (KNA 1943ab; Ngala 1949).

From the 1950s onwards it became normal to buy food in the shops. By the 1960s the Digo in the coastal strip south of Mombasa had to import food (Gerlach 1965). One decade later Digo households near Kikoneni spent 45 to 89 % of the total cash consumption expenditure on food (Gillette 1978). Elsewhere things were similar: in the 1960s most households near Kaloleni ran out of maize before the next harvest, although some still had surpluses for sale (Parkin 1972). By the early 1980s Kilifi District had to import 50,000 tons maize per year (MENR 1984). That corresponds with more than 100 kg per person or half of the energy requirement.

The regular surpluses and exports at the start of this century have turned into structural shortages and imports of maize. Part of that may be blamed on the obstacles which rendered maize production less profitable. That discouraged farmers from growing more than needed,

depleted their financial means and may also have dampened their interest in technical improvements.

A probably more decisive factor was the growth of the population, from less than 100,000 persons at the start of the century to about 900,000 in 1985. By then the overall density in Kilifi and Kwale Districts was only 40 persons km⁻², but the people were concentrated in the more favourable areas. In the Kaloleni area the average density was about 170 persons km⁻², with the extremes ranging from less than 50 to more than 400 persons km⁻² (extrapolated after Spear (1978) and CBS (1981)). With a large part of the land occupied by tree crops, livestock, homesteads, paths and roads, it is not easy to feed so many people by growing maize.

Policies

"Natives [Mijikenda] have now become so used to maize as their staple food crop, that its elimination from cultivation, even if desirable, could not be contemplated." (Humphrey 1938: 106)

On one point the often divergent policies of Mijikenda farmers and the past and present Kenya governments agree remarkably well: farm households should produce their own food. As for most people that means maize, successive governments have had little choice but to accept responsibility for the crop.

The Mijikenda are not blind for the problems of their staple crop. Nobody needs to explain to them that the sandy and poor soils and the erratic rainfall of their area are far from optimal for maize. However, it remains the favourite item of food, and opportunities to earn cash and buy it are limited. Therefore, most households have no alternative but to grow it themselves, in order to provide at least part of what they need. Moreover, the memories of empty shops are still vivid (Standard 1984).

Colonial agricultural officials soon realized that maize was set to stay -- as a food crop -- and that if they wanted to prevent famines they had to contribute to its development. Apart from some studies of cultivation practices, they concentrated their efforts on searching for drought-resistant maize cultivars, without giving up the hope of reintroducing sorghum and millets and of expanding the cultivation of cassava. With some deviations research and extension services have continued to work along these lines until today.

Government policy on food production, and particularly maize did not change after independence in 1963. Political leaders and civil servants still exhort farmers to exploit the potential of Coast Province and grow more maize and other food crops (Ndurya 1983; Mureithi 1983; Standard 1982b). As government policies and public opinion are well in line with each other, it is likely that support for research and extension with regard to maize, as a food crop, will continue (Majisu 1980; Muturi 1981).

4.3 Localized cultivars

A large part of the government support for maize consisted of the selection, breeding, bulking and introduction of better materials. Although maize is a relatively new crop, Mijikenda farmers already distinguish many types, differing mainly in the size and shape of the ear, the colours of the grain, the length of the growing season and the amount of rain they like. It may not be correct to call them cultivars, as maize is a cross pollinator. Farmers are aware that, for example, white seed of "*Mingawa*" may give birth to ears with the red grain of "*Kambiombio*", "*Mwangongo*" or "*Kanjerenjere*". For convenience, the word cultivar will be used for both breeders' and farmers' materials.

The main local cultivars are "*Mingawa (mbomu)*", "*Mdzihana*" and "*Mchonyi*". It is not clear if the latter exists; the Chonyi have maize, rice and cowpea with this name, and other tribes do not recognize these cultivars as such. Upon further questioning other names like "*Mugao*" were sometimes given for materials first called "*Chonyi*", which probably was used in the sense of "own" or "local". Although they may appear local, the maize cultivars of the Mijikenda are of quite diverse origins.

"Caribbean flint types of maize which still predominate in the East African coastal strip were introduced by Portuguese and Arab explorers and traders. This coastal and lowland type of maize has parallel-sided ears, usually with ten to twelve very regular rows of very hard shiny kernels, and may have a great mixture of kernel colors, though white now predominates and is preferred to yellow." (Harrison 1970: 23)

Famine relief with flat, white dent maize from upcountry -- where it was introduced from South Africa -- contributed to the dominance of the white colour. It was remarked that famine relief might lead to the replacement of already "acclimatised" materials and so to later crop losses (KNA 1935). During the 1930s and 1940s the Department of Agriculture imported, selected and distributed maize that was supposedly better adapted to the conditions of Kwale and Kilifi, with emphasis on early maturity and drought resistance. Mijikenda farmers participated actively in the process:

"The Kinango men [Duruma farmers] tell me that they did not want an issue of Java Maize, but want more of this Maize they call Duram, which they are prepared to buy, or exchange mixed Maize for." (KNA 1936)

They referred to the Australian yellow dent type "*Durum*", which had a growing season similar to that of local maize, did well under both favourable and dry conditions, and so became the standard for widespread issue (Humphrey 1938; KNA 1940b). "*Durum*" as such was not encountered during field work, but several farmers interviewed remembered the introduction of early ripening yellow maize. Names like "*Machame*" (from Chagga, Tanzania), "*Kameru*" (from Meru, Kenya) or "*Mzungu*" (white man) indicate the diverse origin of genetic materials that are now considered "traditional" or "local".

In 1951 a breeding programme was started to incorporate resistance against rust (*Puccinia polysora*) in coastal maize (Harrison 1970; Majisu 1980). Rust had caused much damage in West Africa but after its arrival in East Africa in 1952 it did less harm than expected (Harrison 1970). In 1966 the resistant but low yielding "Pp" maize was released which was later built into "Coast Composite", based on introductions from all over the world and released in 1975 (Harrison 1970; Mburathi 1978; Majisu 1980). After 1975 time was lost in selection to remove all yellow kernels in order to make the grain acceptable for the National Cereals and Produce Board (NCPB), although hardly any maize is sold (Majisu 1980). For local consumption a few coloured grains do not matter -- some people even prefer this -- although most dislike the hard yellow maize imported as famine relief.

The "improved" composite did not yield better than local maize and was susceptible to weevils; therefore initially the adoption rate was low. Farmers who could afford it preferred the expensive "Pioneer X105A" hybrid, which on good soils and with sufficient rainfall and adequate husbandry performed well (Reeves 1979; Majisu 1980; Muturi 1981). The shortcomings of "Coast Composite" were soon realized and selection was refocused on high yield and pest resistance. Also a programme for breeding a "Pwani Hybrid" was started (Rubui 1984). As in the past, most work is being done in the coastal strip, where rainfall conditions are relatively good.

"The famine was not entirely an "ill wind", as it was the cause of much good seed being introduced." (DoA 1929: 642)

Contrary to what many officials believed, the introduction of new crop cultivars among the Mijikenda was easy. Famines and lack of seeds played a role in the transition from sorghum to maize and the subsequent adoption of new cultivars. The mechanism still works: in March 1982, after a rather good year, only 15 out of 39 farmers had enough seeds left from their own harvest and did not have to borrow or buy. When many people are affected by the same calamity, such as the failure of the 1983 short rains, followed by an armyworm attack at the start of the 1984 long rains, local stocks are exhausted and farmers plant any seeds they can lay their hands on (Sauti 1984a).

Even without such pressure Mijikenda farmers have always been ready to try new seeds. Their receptiveness is illustrated by the adoption of maize itself, and by the active demand for "Durum" maize. Also during my field work farmers expressed interest in seeds or plants of almost any crop or cultivar. However, seeds of recommended cultivars are more expensive than those bought from neighbours, and it takes time and money to go to Kaloleni or Mombasa. Moreover, unless such seeds are kept in cold storage their germination and emergence tend to be poorer than those of local materials.

5 CULTIVATION PRACTICES

5.1 Cropping pattern

Given its importance as a staple food, it is not surprising that maize is a component of many cropping patterns, defined as arrangements of crops in space and time (Andrews & Kassam 1976). These vary from simple sole cropping to intricate mixtures of annual and perennial crops. As for maize, there is a gradient from planting nearly all at the start of the long rains to staggered planting during both rainy seasons. The first is common near the coast (Pingi-likani, Ngamani), where most rain falls in the long rains, whereas the latter occurs in the interior (Chilulu, Kinarani), where rainfall distribution is more bimodal.

Cassava is usually planted after the first weeding of the maize and is harvested just before next year's crop. Near the coast most cowpea is planted as a relay crop, after the silking of the maize, while inland it is grown as an intercrop, planted almost simultaneously with the maize. Cassava, cowpea and other annual crops may be found mixed in low densities throughout the maize field. More often each is concentrated in a certain area of the field, to avoid competition or to exploit soil variation. The sum of these areas is usually far less than the total area of the maize field.

Due to land scarcity maize is also planted between or under coconut palms. These are often widely spaced and their canopies tend to be rather open. Intercropping with other tree species is less common. Citrus and mango trees have dense crowns that allow little sunlight to penetrate. The same applies to cashew trees; furthermore, after the price for cashewnuts fell in 1983 the trees have been cut down, killed by fire, or at best coppiced, rather than intercropped. Useful forest trees or ones that are difficult to fell are left untouched or cut back to acceptable proportions.

The phenomena of simultaneous or staggered planting, and mixtures with annual and tree crops occur in numerous combinations. Typical and common ones, also found far outside the Kaloleni area are: maize and relay crops during the long rains (Ngamani), maize growing under coconut palms, mostly in the long rains (Chilulu), and staggered planting of maize and intercrops (Kinarani).

5.2 Site selection

"The Agiryama [Giriyama] will never cultivate grass land if there is any bush at hand. He says that the soil is hard and would have to be turned up and weeds would be plentiful, both involving much unnecessary labour." (Champion 1914: 8)

Less than a century ago the Mijikenda could still cultivate fresh bush land that thanks to its accumulated fertility, friable structure and absence of weeds gave heavy crops for a minimum

of labour. Since then, fixed settlement, population growth and tree crops have increasingly limited the choice of sites for maize. Nowadays fallow periods are short (often less than two years), and many farmers are glad to have some land at all. Those that still have a choice, have to weigh differences in soil fertility, weed presence, labour needs and expected yield. In that context, site selection is more than just deciding where to grow which crop. It also involves decisions on when and where to start clearing, planting or weeding, or on the types and areas of land and crops so as to reach an optimal balance between these activities. Moreover, the use of fertilizers is rare and farmers are fully dependent on the little fertility left in the soils.

5.3 Land preparation

Until some decades ago the Mijikenda prepared land by cutting trees and large shrubs and drying and burning the debris. Nowadays the vegetation often consists of crop residues, herbs, grasses and one season old shrubs, which are almost completely dead or dry at the end of the dry season in March. In most cases they are slashed (*panga*) or hoed (*jembe*) just above or below the soil surface. If there is little material, it is left where it fell, but otherwise it is collected into heaps or trashlines and burned or left to rot. In some cases branches and maize stalks are used to block erosion gullies, which are becoming a serious problem in Ngamani.

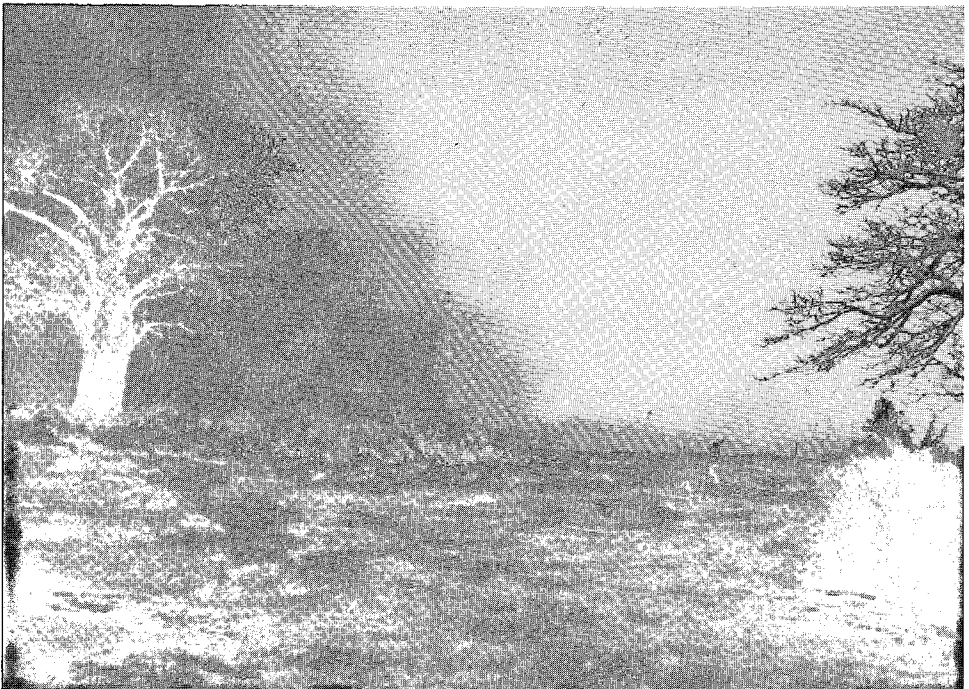
Two types of burning can be distinguished: veld fires and burning of heaps. The first are forbidden because they kill tree crops and so nowadays are less common. Farmers prefer to say that the fire that swept through their *shamba* (field) started "accidentally" elsewhere. The burning of crop or weed residues in heaps is more common, especially in some parts of Ngamani, where even fields that are ploughed later are sometimes burned as preparation. Burning makes clearing and weeding easier and rids the field of stalk borers, but it also destroys the dry organic materials that might help to maintain soil fertility.

Land preparation as described above leaves the soil almost untouched. Only in cases of dense living weed cover in loose sand are plants uprooted and soil is moved. An example is Kinarani, where only part of the area is cleared during the dry season and the rest gradually during the rainy season. The first showers of the long rains come in waves of heavy rainfall at the coast, decreasing inland: in 1982 the first wave gave more than 70 mm in Pingilikani, Ngamani and Mbuyuni, 40 mm in Chilulu, and only 20 mm in Kinarani. The first showers may peter out before they reach Kinarani or give too little rain for planting a crop, but enough to start weed growth. Under such conditions it makes little sense to prepare large areas in advance.

In some areas land is ploughed by tractors hired locally or from "Indians" in the coastal strip. The use of disc ploughs is most common on the heavy soils of Ngamani. These are

ploughed during the dry season, as after rain they become sticky and slippery. Payment is per acre and the rate depends on whether the land has been ploughed before or is rough and full of shrubs and stumps. These conditions and the skill or interest of the driver determine if the result is an excellent seedbed or more like a battlefield.

According to the farmers interviewed, the labour needed for land preparation varies from 6 (to clear maize stalks) to 13 (mainly grasses) weeks ha^{-1} , with the time required to clear shrub or bush vegetation in between. The type of soil appears less important; the farmers hardly touch it. Nowadays most land preparation is done by women who, because the men are absent doing off-farm work, constitute more than three-quarters of the labour force, and tend to work longer days than men. On 16 out of 40 farms studied in 1982 no men at all were involved in the preparation of land. Therefore, in this study the term "farmer" is used for any female or male person participating in farm work or interviewed about such work. As the activity can be spread out over the dry season, with 2-3 workers available per farm to prepare the 1-3 ha cropped, very few farmers employ hired labour for land preparation. Ploughing is more popular and cheaper, but often still too expensive. Even in Ngamani no more than half of the fields can be ploughed, for lack of cash or problems in finding a tractor. In an area north of Kaloleni some farmers are experimenting with ploughs and harrows drawn by oxen or donkeys (*Otieno 1983; Matano 1983*).



Photograph 5.6. In spite of the introduction of tractor ploughing fire is still an important tool in land preparation, especially in Ngamani.

5.4 Maize planting

Most farmers plant maize in moist soil, and unless the weather looks promising, only plant after a shower that can sustain the young crop for at least a week. In Ngamani planting in dry soil just before the expected start of the long rains is also practised, as planting in the wet and sticky clay is very laborious.

Planting is done with the *jembe* (hoe); where needed the soil is loosened, a small hole is made, some seeds are dropped in and covered with soil, which is pressed down lightly with a foot or hoe. Some farmers dig a hole just large enough to receive the seeds, whereas others cultivate around the plant hole or even make a small depression next to it. The seeds, from ears usually selected after the harvest, are removed from the cob at home or during planting. Many farmers plant more than one cultivar, for example, the early "*Kambiombio*" to provide green ears for roasting and the later "*Mchonyi*" for the bulk of the harvest which is stored dry. Sometimes the seeds of maize are mixed with a few seeds of cowpea, e.g. of the runner type "*Charika*", that are planted in the same hole.

The plant density is rather low, about 8,500 stands ha⁻¹ and 25,000 plants ha⁻¹. These numbers were counted at the harvest; farmers plant more seeds, but part of the seeds and plants are lost before that stage. Some are eaten by rats and birds or fail to germinate, others cannot penetrate the clay or die due to waterlogging (Ngamani), or fall victim to stalk borers (Kinarani). There is much variation in plant density, not only because of the whims of rainfall, rats or borers, but also because farmers adjust to soil conditions, expected losses and intercrops or relay crops.

According to the farmers interviewed, the labour input for planting is about 1 week ha⁻¹, so that with 2-3 workers farm⁻¹ all maize can be planted within a few days. Labour for planting is only limiting in case of sickness or other calamities.

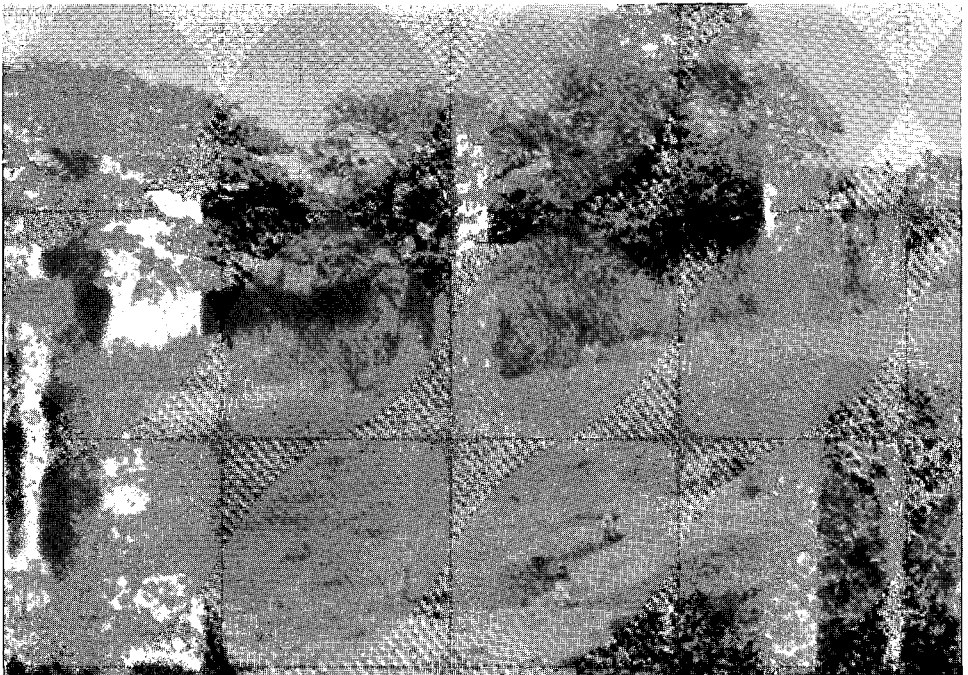
5.5 Weed and pest control

"... in the rainy seasons they [Duruma farmers] toil from early morning till late in the evening, cooking their food in the plantation. That they do not cultivate larger areas is not due to their laziness, as is sometimes asserted, but to their inability to cope with weeds; for as soon as they have planted the ground, they have to begin to weed the corn. And the state of the plantation is often so muddy that many days will sometimes pass without any weeding being possible. The result is that, before they can cover the ground, a part of the maize crop has been so choked by weeds that it has to be abandoned. It is useless for them to plant more than they can weed." (Griffiths 1935: 278-279)

Timely weeding, no later than 3 weeks after planting, is a crucial cultivation practice for maize. If it is late, yield suffers or the crop may even fail. After planting the farmers fight

a continuous battle against weeds and weariness; depending on the weather they lose or at best get even. They consider *mwamba nyama* (*Rottboellia exaltata* sp.; fast growing and tall annual grass with prickly hair), *ndago* (*Cyperus* spp., hard to eradicate perennials) and *dzadza* (*Commelina* spp., herbs that easily root at nodes) the most noxious weeds. In some areas or fields one or few species dominate, whereas elsewhere a mixture of many minor weeds is found.

Most farmers start weeding early, but they cannot mobilize enough labour to complete the whole field within a short period. Moreover, during weeding some labour is spent on planting cassava or sowing cowpea. Therefore, some parts of the fields are weeded in time and other parts too late; in 1982 the farmers interviewed considered that only half of the crop had been weeded in time.



Photograph 5.7. Immediately after the onset of the rains the fields are covered with a green haze of weeds and the farmers have to work hard to remove them before they smother the crop (here maize).

After the maize has silked, a part of the field is often weeded again. This is normally too late to benefit the maize, but intended for planting relay crops like cowpea, sesame, bambara or green gram. The areas devoted to these crops are often small, due to lack of seeds. In the case of maize, farmers see lack of labour or land as the main limitation, whereas for minor crops nearly all refer to lack of seeds. If in short supply, maize seeds have to be bought, but if the seed of other crops is scarce the area planted is reduced accordingly.

The farmers estimated that less labour was required for weeding than for land preparation: about 5 weeks ha⁻¹ in Ngamani and 3-4 elsewhere. From my own observations, I would have concluded the contrary. The difference may be in the fact that while weeding farmers -- forced by necessity -- work much longer days than during the more relaxed period of land preparation. The urgency of weeding is shown by the fact that a quarter of the farmers hire or sell labour for this. Most of the employed do not lack work but sacrifice their own future crop for the cash they need in order to buy today's food.

Most farmers do not practise pest control in the sense of directly interfering by using pesticides. However, there are several cultivation practices which reduce the levels of infestation of the main pest of maize, the stalk borer (*Chilo* spp.). The most widespread is the burning of crop residues during the preparation of the field for planting. Near the coast the concentration of maize in the long rains means that there is a closed season, during which it is hard for the borers to survive. In Ngamani the ploughing-in of crop residues further reduces the infestation level. On the other hand, in Kinarani maize is grown throughout the year, burning not very common, and land is not ploughed. Therefore already at the start of the rains the borer pressure is high enough to cause damage.

Stalk borers are somewhat predictable: crop residues and out of season planting almost guarantee damage. Attacks by locusts or armyworms are less easy to foresee, at least for the individual farmer. Locusts now are seen as something of the past, but they may return some day. Gregarious armyworms (*Spodoptera exempta*) attacked in force in the long rains of 1984. Small farmers do not use insecticides and government sprayers tend to arrive late. The shade of trees offers good protection, but is otherwise not recommendable. A positive characteristic of armyworms is that they prefer itch grass (*Rottboellia exaltata*) to maize. Incidentally rats, guinea fowl or monkeys eat germinating seeds or ripening ears but in most years and places the damage is small. Locally termites damage prop roots and stalks and cause the crop to lodge. The phenomenon appeared most serious on some sites in Chilulu, where after eating all dead crop and weed residues of the previous season the termites attacked the maize and cassava crops.

5.6 Harvesting and processing

The maize is ready for harvesting about 3-4 months after planting. When the crop is nearly ripe the leaves are sometimes stripped so that the intercrops (rice) or relay crops (cowpea) receive more light. Farmers usually wait for the ears to dry on the stalk, and once dry enough they are harvested as soon as possible in order to prevent them from being wetted by a sudden shower.

Harvesting is mostly done by small groups of women who help each other. When fields are far from the homesteads, as in the case of Ngamani, the transport between field and store

may take several days, unless a pick-up truck or tractor eases the burden. No quantitative data on labour inputs were collected. The harvesting itself is usually completed within one or two days. Transport takes longer, depending on the distance to the homestead.

Most maize is stored in the husk in a *lutsaga* (loft) in the hut; in the past usually a fire was kept below (KNA 1940c). The smoke deters weevils (*Sitophilus zeamais*), although these may hide within the husks. The warm, dry air stops fungal ear rot (probably *Diplodia maydis*), which in rainy weather causes damage. If the ears are dried quickly further deterioration is prevented. No information was collected on post-harvest losses, but these probably are small, because of the beneficial effects of the smoke. Moreover, most farmers are so far from self-sufficient that the interval between harvesting and consumption is quite short.

The maize is consumed as *sima* or *ugali*, a thick porridge made of maize meal (Gerlach 1961). Most Mijikenda consider this and to a lesser degree cassava to be the only real *chakuria* (food). Other foodstuffs are seen as *chitoweo* or *mboga* (relish or side dishes). People with money from cash crops or off-farm work often prefer to buy maize meal from the shop rather than to eat their own cassava.

"... complaints of "Njaa" [hunger] mean only that they [the Giriama] have no maize to eat; the people of Kayafungo while admitting that they had plenty of cassava objected to having to eat it twice a day ..." (KNA 1943a)

Before the maize is ground into meal the seed coat and germ are usually removed by pounding the moistened grains, drying in the sun and winnowing; they serve as chicken feed. Then the maize is ground on the farm in simple hand mills, or taken to commercial electrical or diesel mills. In the case of grinding by hand the grain is often slightly roasted in order to make it brittle. Ease of processing influences the choice of cultivars; women's dislike of its firmly attached seed coats has caused a decline in the growing of "*Mwangongo*" (Tuva 1983).

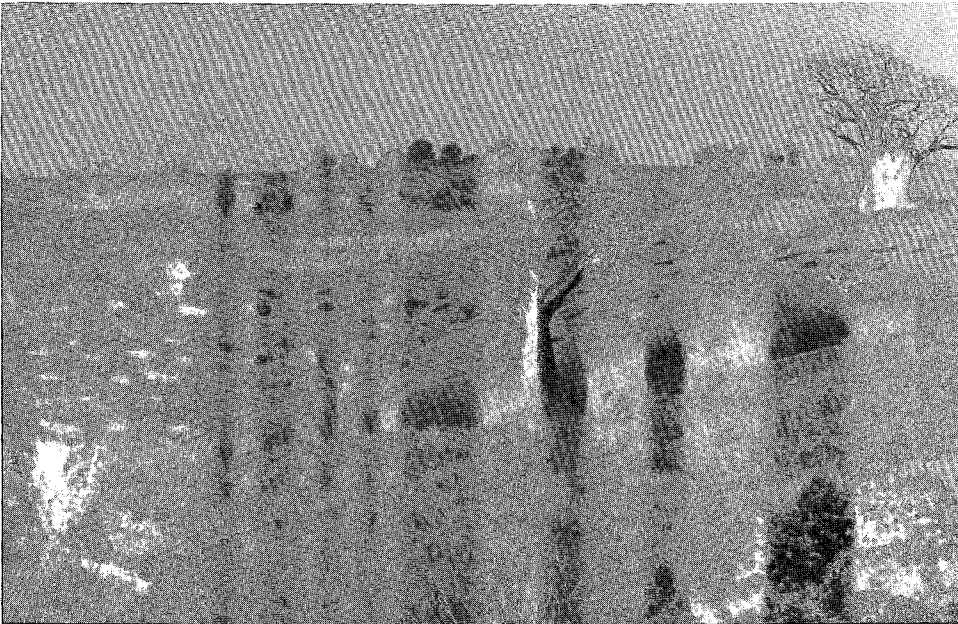
The removal of seed coat and germ means a weight loss of 15-25 %, and the resulting meal is also poorer in protein and oil than that from the whole grain (Platt 1962; Odero 1985). In the past the seed coat was removed for easier grinding with small hand mills. Maybe it was done also to get rid of the smoke flavour, although fresh maize was treated in the same way (Kalachu 1984). Today maize is stored for short periods only, often with little smoking, and ground in powerful electric or diesel mills. For that reason the practice appears unnecessary and in view of the shortage of maize it looks wasteful, unless the economic and social value of the chickens involved is taken into account. A Mijikenda homestead is hardly complete without chickens that can be prepared for visitors.

6 FIELD CHARACTERISTICS

6.1 Farmers' fields

Most information in this section is from a survey conducted during the long rains of 1984 in 54 fields belonging to 20 farmers living in Pingilikani, Mbuyuni, Chilulu and Kinarani. A field was defined as a contiguous piece of land which the farmer considered a unit. That does not mean that within each field the soil, management and land use conditions were uniform. All fields to some degree form a visible or invisible patchwork of overlapping soil types and fallow, crop and weed histories, with the boundaries of the cultivated parts in flux. Some causes of variation differ per area and field, e.g. slopes, soil moisture and erosion (Pingilikani, Ngamani, Chilulu), irregular ploughing or burning in heaps (Ngamani), tree crops (Mbuyuni, Chilulu) and tree stumps or termite hills (Kinarani).

To avoid the problem of heterogenous units, in each field one point was chosen at random, where observations were made per square of 25 m² (most data) or per circle with a radius of 15 m (tree crops). Most sampled sites did not appear to differ greatly from the surrounding areas, but nevertheless each should be considered representative of itself alone and not be expected to account for all variation within the field. Almost one-third of the squares were badly affected by an early armyworm attack and several were replanted. They were excluded from yield estimations but where relevant were included in other characterizations.



Photograph 5.8. A field in Ngamani: the burning of heaps of crop and weed residues increases soil heterogeneity; the trashlines are unable to stop gully erosion.

The number of fields (see also table 5.5) ranged from 1 to 5 farm⁻¹ (mean 2.7), the areas from 0.1 to 2.4 ha field⁻¹ (mean 0.6) and 0.4 to 4.5 ha farm⁻¹ (mean 1.7). Farmers in Kinarani had the smallest areas per field and farm (staggered planting), those from Pingilikani or Mbuyuni with land in Ngamani the largest (tractor ploughing). Whether a field is ploughed or hand cultivated depends on soil type, slope, accessibility, size and, most important, the farmer's financial situation. Burning of crop and weed residues is most common in Ngamani, where there is little risk of damage to tree crops. The "manured" fields are near homesteads (refuse) or livestock shelters (droppings). The deliberate application of manure or fertilizer is rare. The land use intensities during the long rains are high for the growing of annual crops without fertilizers or manure; several fields are used almost every year. During the short rains only a small part of the field is used, for relay crops (Pingilikani, Ngamani, Mbuyuni) or maize (Chilulu, Kinarani).

Most fields are around the homesteads or nearby, so that farmers have to walk less than ten minutes. The distances are greatest for fields in Ngamani, on average twenty minutes and in some cases up to more than one hour, often along slippery paths and up and down slopes. In Mbuyuni and Kinarani most fields are flat or on gentle slopes (mean 6 %), in Ngamani and Chilulu slopes are steeper (mean 10 %), and maize fields in Pingilikani are on the flanks of steep hills (mean 20 %). Not surprisingly most fields suffer from light to severe sheet and gully erosion. The latter is especially serious in Ngamani, where the heads of gullies or valleys eat into the land from below.

Table 5.5. Characteristics of maize fields on five land units in the Kaloleni area, Coast Province of Kenya; observations and interviews during the long rains of 1984.

	Pingilikani	Ngamani	Mbuyuni	Chilulu	Kinarani
Fields observed (#)	6	16	7	10	15
Fields ploughed (#)	0	6	0	0	0
Fields burned (#)	3	8	1	3	2
Fields "manured" (#)	0	1	0	1	3
Long rains "R" (%)	50	90	90	60	60

The term long rains refers to crops (maize) planted between March and May. R is a measure of land use intensity, defined as: 1/4 * number of crops during last 4 years * 100 % (see Ruthenberg 1980).

6.2 Maize population

The 1984 survey revealed a remarkable increase in the proportion of the maize cultivar "Coast Composite". It was grown in 13 of the 54 fields and by 8 of the 20 farmers, whereas in 1981 only 8 out of 131 farmers interviewed had planted it. One explanation might be that

farmers involved in the field studies were converted to planting "modern" cultivars. However, in most cases it appeared rather a matter of having to buy new seeds for lack of own stock and nearly all farmers also had fields with local cultivars. Although the increase in the proportion of "Coast Composite" was real, it was probably overestimated. After having bought it once, farmers will say for years that they grow this cultivar. Meanwhile the genetic composition will have changed completely by cross pollination with local maize.

The information collected on arrangements and densities of maize plants is summarized in table 5.6. Only very few farmers plant in rows, as in the 1981 Chilulu case. Most follow their instinct and try to attain a more or less homogeneous distribution, while adapting to conditions like intercrops or tree stumps. In general the density was less on clay soils like those in Ngamani (relay crops) than on sandy soils like in Kinarani. The difference was mainly in the number of stands per hectare, and less in the number of plants per stand.

Table 5.6. Density and arrangement of maize plants on five land units in the Kaloleni area, Coast Province of Kenya, during the long rains; observations in sample plots in farmers' fields.

	Pingilikani	Ngamani	Mbuyuni	Chilulu	Kinarani
1981 (strips)					
Fields (#)	1	7	1	1	6
Stands ha ⁻¹	8100	8200	7200	14600	10900
Plants stand ⁻¹	3.6	3.0	3.8	2.2	3.0
1982 (strips)					
Fields (#)	4	5	4	4	2
Stands ha ⁻¹	5900	7300	7200	8900	12400
Plants stand ⁻¹	3.0	3.1	3.1	3.2	2.9
1984 (squares)					
Fields (#)	5	6	7	5	13
Stands ha ⁻¹	8700	6500	7300	8100	11700
Plants stand ⁻¹	3.1	2.8	3.1	3.1	3.1

The 1981 measurements were made in 1 m wide strips (approx. 100 m² field⁻¹) laid out across a semi-random sample of fields (Waijienberg 1983); the 1982 observations were made in fields chosen for various reasons (section 7.3); 1984 measurements refer to one 25 m² square in each field of a random sample of 4 x 5 = 20 farmers.

As for maize yields, at first sight there is a bewildering confusion between land units and years (table 5.7). However, if we overlook the extreme cases based on only one observation, and anticipate information presented later on, some kind of picture emerges. Yields in Pingilikani were always at the low end of the range. The soils are acid and poor and somewhat excessively drained. However, where bush or cashew had recently been cut (and burned) yields could be as high as 1,000 kg ha⁻¹. Those in Mbuyuni and Chilulu were in the middle of the range. Both these locations have well drained soils, the first has slightly more fertile soils than the latter, but in both there is large variation due to the presence of tree

crops and a long history of cropping, and hence the soils are exhausted and the yields low. Yields in Ngamani and Kinarani tend to be unpredictable. The high fertility of the Ngamani soil stimulates not only crops but also weeds, and when rainfall is higher than normal the soils are easily waterlogged. In Kinarani yields are low in most years, because of lack of rainfall, but when there is enough moisture they can be higher than elsewhere, where leaching, waterlogging, armyworms or weeds wreak havoc.

As for the variation between years, in 1981 the rainfall was not high but well distributed, which showed up in the high yields in Ngamani. The long rains of 1982 were extremely wet, which depressed yields, but the short rains were favourable and yields were about the same as in the long rains. It appears that normally they are lower; in 1983 they failed altogether. This drought induced fallow and the well distributed long rains of 1984 might have resulted in a good crop, were it not for the armyworm attack mentioned. In table 5.7 the worst cases, the majority in Ngamani, have been omitted or put in brackets. However, it cannot be precluded that some farmers were discouraged by the events and paid less attention to their crop than they would have done normally.

Table 5.7. Average maize yields on five land units in the Kaloleni area, Coast Province of Kenya, during the long rains; observations in sample plots in farmers' fields.

	Pingilikani	Ngamani	Mbuyuni	Chilulu	Kinarani
1981 (strips)					
Fields (#)	1	7	1	1	6
Yield (kg ha ⁻¹)	1000	1800	500	1100	900
1982 (strips)					
Fields (#)	4	5	4	4	2
Yield (kg ha ⁻¹)	200	600	600	500	500
1984 (squares)					
Fields (#)	6	6 (7)	7	6	12
Yield (kg ha ⁻¹)	600	1000 (300)	600	800	1400

For a detailed explanation on sampling and measuring methods, see table 5.16. In 1981 the field in Pingilikani had been cleared recently, that in Mbuyuni was under coconut palms, and that in Chilulu had been ploughed, densely planted, arranged in rows and fertilized. Figures in brackets refer to squares affected heavily by armyworm and consequently abandoned or replanted (1984).

6.3 Annual crops

Maize shares the field with a wide range of other annual crops, the main ones being cassava, cowpea and rice. Some crops in table 5.8 are not strictly annuals, but in most cases their growing period does not surpass one year.

Cassava is planted in only part of the maize field and plant densities are usually low. In the Kaloleni area the most popular cultivar is "*Kabandameno*". Yields in trial plots in 1983 were only 0.6-1.5 kg plant⁻¹, probably due to infection with African Cassava Mosaic Virus (ACMV) and failure of the short rains (*Vervoorn 1986a*). The yields in table 5.8 were measured in March 1985, after a rather good year. Most Mijikenda are not very fond of cassava although it helps them through the lean months before the new maize harvest. Several farmers in Mbuyuni grow it as a cash crop.

Part of the cowpea is grown as an intercrop, in most cases planted separately but sometimes by mixing its seeds with those of maize; both leaves and grain are eaten. It is also grown as a relay crop, especially in Ngamani, in which case production is mainly for the seeds. The main cultivars are "*Karingongo*" (bunch type with small seeds), "*Mnyenze*" or "*Mbomu*" (runner type with large seeds), and "*Charika*" (runner type with small seeds). The yields are low and variable, probably mainly due to bud thrips and pod borers. Estimations for the relay crop in six fields in Ngamani in 1982 showed grain yields of 100-700 kg ha⁻¹, average 300 kg ha⁻¹ (*Leeuwen 1984*). The yields of the squares harvested in 1984 were even lower (table 5.8). The apparent absence of cowpea in Kinarani was probably due to lack of seeds after the failure of the 1983 short rains.

Most rice is grown as sole crop in small valleys and bottomlands throughout the Kaloleni area, but some is intercropped between maize in Ngamani. Farmers recognize more than 20 cultivars, common ones being "*Kathele*", "*Ambari*", "*Sindano*" and "*Mchonyi*". In 1982 paddy yields of sole-cropped rice in 11 fields in Pingilikani, Chilulu, Kaloleni and Vishakani were 250-2,500 kg ha⁻¹, average 1,200 kg ha⁻¹; in drier years they are probably lower (*Hempenius & Wassink 1982*). The 1984 intercrop yielded 400 kg ha⁻¹; the average maize yield in the same three squares, two of which were razed by armyworms, was 700 kg ha⁻¹.

Vegetables make up a very diverse group in terms of crops, cultivars, cultivation and produce. For example, both the African eggplant and the introduced aubergine are grown, and tomato cultivars include the traditional "*tindi*" as well as the modern "*Roma*". Some types of black nightshade are weeds and others are sown and even transplanted by farmers. Crops like amaranth and aubergine produce fruits or leaves only, whereas pumpkins are grown for their leaves, flowers and fruits. Calabashes are used as rattles, cups or spoons and especially as containers for storage or transport of palm wine, water, crop seeds, snuff tobacco and local medicines.

The other "annuals" in table 5.8 include virtual weeds like castor (formerly a crop) and a wide range of more useful crops (for the time being). Some are of considerable local importance, like tobacco around Kinarani or pineapple in the Malindi hinterland. Others are found in very small quantities, in fields or around homesteads.

Table 5.8. Annual crops in maize fields on five land units in the Kaloleni area, Coast Province of Kenya, long rains of 1984: presence in 25 m² squares, units per ha, and approximate yield of fresh tubers and dry seeds or paddy.

	Pingilikani	Ngamani	Mbuyuni	Chilulu	Kinarani
Squares (#)	6	16	7	10	15
Cassava of 1983					
Squares (#)	2	2	5	1	1
Plants ha ⁻¹	600	1200	1800	1600	400
Cassava of 1984					
Squares (#)	5	12	5	7	8
Plants ha ⁻¹	2000	2000	1900	1500	3400
Tubers (kg plant ⁻¹)	1.7	1.9	1.3	1.5	1.3
Cowpea intercrop					
Squares (#)	0	2	0	3	0
Stands ha ⁻¹	0	1400	0	3900	0
Cowpea relay crop					
Squares (#)	3	4	0	1	0
Stands ha ⁻¹	35000	20000	0	8000	0
Seeds (kg ha ⁻¹)	-	160	-	-	-
Rice intercrop					
Squares (#)	0	5	0	0	0
Stands ha ⁻¹	0	83000	0	0	0
Paddy (kg ha ⁻¹)	-	400	-	-	-
Fruit vegetables					
Squares (#)	0	4	1	1	6
Plants ha ⁻¹	0	2300	400	1200	900
Leaf vegetables					
Squares (#)	1	3	0	1	4
Plants ha ⁻¹	400	4500	0	2800	6200
Cucurbitaceae					
Squares (#)	1	1	0	1	2
Stands ha ⁻¹	400	800	0	400	800
Other "annuals"					
Squares (#)	0	1	1	1	5
Plants ha ⁻¹	0	1600	400	2000	8100
Relative density	0.15	0.35	0.17	0.08	0.09

Yields of cassava, cowpea and rice were measured in 2-4 squares per land unit. Fruit vegetables: tomato, African eggplant, aubergine, hot peppers and okra. Leaf vegetables: black nightshade, amaranth, jute and kale. Cucurbitaceae: pumpkin, calabash and loofah. The other "annuals" are mainly castor and sweet potato, pineapple, lemon grass, beans and tobacco.

The relative densities in table 5.8 are based on standard pure crop densities and adjustment factors relating to the development stage of each crop (Mutsaers *et al.* 1981). The densities

are based on literature and local pure stands, and the adjustment factors reflect the relative sizes of the plants during the maize growing season: cassava (10,000 x 1.00 or 0.25), cowpea (50,000 x 1.00 or 0.25), rice (10,000 x 1.00), fruit vegetables (20,000 x 0.25), leaf vegetables (20,000 x 0.25), cucurbits (10,000 x 0.25), other crops (5,000 x 0.10). The adjusted relative densities were summed per square and mean values per land unit were calculated. The densities were highest in Ngamani, due to the cowpea relay crop (near Pingilikani) or the rice intercrop (near Mbuyuni). Elsewhere they were lower but this does not imply, of course, that the crops involved are unimportant. In most land units and fields competition with annual crops probably had little influence on maize yields.

6.4 Perennial crops

Because of their permanence and large size, wild and cultivated trees can have a significant effect on maize yields. On most land units trees are a common feature in maize fields; only on the heavy, cracking clays of Ngamani they are scarce (table 5.9). Some trees are remnants of the natural vegetation (baobab, most have been planted by farmers (coconut, cashew, citrus, mango, banana) and others have multiplied almost accidentally via seeds thrown away by children (papaya, guava). For land use planning, most trees can be considered as given, they are too valuable for farmers or too large to be cut down. However, the lesser fruit and forest species run the risk of being coppiced or cut down to make room for maize.

The coconut palm is the most common and valued perennial crop. Typical coconut fields have 80-100 palms ha⁻¹ with an average yield of about 30 nuts palm⁻¹ year⁻¹. Nuts are used as refreshing drinks, made into cooking oil, sold in town, or processed into copra. The leaflets are used for thatch, the petioles as building material or firewood, and the nut shells as spoons. Last but not least, the palms can be tapped for wine production (chapter 6).

In areas less suitable for coconut, cashew is the main tree crop. The average yields are low, about 4 kg tree⁻¹ year⁻¹ or 450 kg ha⁻¹ year⁻¹. They depend on the age and size of the trees, their spacing and the weather, high rainfall having a negative effect. For a summary of information on cashew production in Coast Province of Kenya and interesting suggestions for its improvement see Eijnatten & Abubaker (1983).

For most farmers fruit trees are of minor importance: from time to time they give a little extra, for consumption or sale, and they keep the children happy and healthy. However, some farmers derive a considerable part of their income from fruit crops, e.g. citrus in Mbuyuni and banana or mango in Pingilikani (*Hempenius 1983b*).

Baobab (*Adansonia digitata*) trees, apart from being cumbersome to cut down and yielding nutritious fruits with useful shells, are associated with the spiritual world. Other species like *mvule* (*Chlorophora exelsa*) are left because of their timber or tolerated (only pollarded) because of their fruits or numerous other uses.

Table 5.9. Tree crops in maize fields on five land units in the Kalo-leni area, Coast Province of Kenya, long rains 1984: presence in circles with a radius of 15 m (area 707 m²) and number of units per ha.

	Pingilikani	Ngamani	Mbuyuni	Chilulu	Kinarani
Circles (#)	6	16	7	10	15
Coconut palms					
Circles (#)	2	1	7	7	7
Palms ha ⁻¹	120	14	75	53	44
Cashew trees					
Circles (#)	2	1	3	3	6
Trees ha ⁻¹	71	28	42	19	33
Citrus trees					
Circles (#)	1	0	4	2	2
Trees ha ⁻¹	28	0	64	28	14
Mango trees					
Circles (#)	2	1	1	1	1
Trees ha ⁻¹	35	14	14	14	28
Banana stands					
Circles (#)	2	1	4	3	2
Stands ha ⁻¹	35	99	28	80	21
Papaya plants					
Circles (#)	1	1	1	1	3
Plants ha ⁻¹	14	14	14	28	28
Baobab trees					
Circles (#)	2	0	1	0	0
Trees ha ⁻¹	14	0	14	0	0
Mvule trees					
Circles (#)	0	0	0	2	0
Trees ha ⁻¹	0	0	0	21	0
Other trees					
Circles (#)	2	6	2	4	8
Trees ha ⁻¹	28	30	21	21	28
Crown area (ha ha ⁻¹)	0.38	0.01	0.71	0.39	0.11

The other trees include guava, custard apple, kapok, *Casuarina equisetifolia* and several semi-wild fruit trees, which receive varying degrees of protection or care. For the methods used for the estimation of the "crown area" see the text.

Because of the variation in age and size within the same species, the relative densities of perennial crops were not determined in the same way as those of annual crops. Instead, for each tree whose trunk was within 15 m from the centre of the square the area of the crown was estimated by means of the formula $\pi \times r^2$. In the case of adult coconut palms a standard radius of 5 m (healthy) or 4 m (tapering) was used, for young palms and other species the actual radius was measured. The crown areas per square were summed and divided by $\pi \times 15^2 = 707 \text{ m}^2$. Then averages per land unit were calculated. The results show that on most land units "maize" fields also contain a considerable quantity of tree crops. The resulting shading and competition for water and nutrients probably influence maize yields.

6.5 Weed occurrence

The weed competition during the first weeks after planting was scored on a five-point scale, from clean or well weeded to almost completely overgrown. Scores are approximate, as they are based on a single visit 2-4 weeks after planting, at which height and cover or weed residues were observed, and in some cases the farmer was asked about the date of weeding. Proper weeding appeared to be the exception rather than the rule. Of the 54 squares only 15 were well weeded or free from weeds. The maize in the other squares suffered moderate to heavy weed competition. Even excluding the 16 squares with heavy armyworm damage, 17 remained where the maize had to struggle to keep above the weeds and showed symptoms of nitrogen deficiency.

In each square the three dominant -- in cover and height -- weeds were identified (table 5.10). In Mbuyuni and Chilulu there was much variation, whereas in Ngamani and Kinarani few families and species dominated. In Ngamani during 1981 to 1983 itch grass (*Rottboellia exaltata*) appeared the most troublesome weed followed, in time and harmfulness, by goat weed (*Ageratum conyzoides*). In 1984 the rains started late and were followed by armyworms, which preferred *Rottboellia* even above maize. These factors may explain the dominance of *Ageratum* in 1984.

In many fields woody plants, mainly shrubs, belonging to several families and numerous species formed an important part of the weed vegetation. In one-fifth of the fields they had almost disappeared, due to tractor ploughing and/or many years of growing annual crops. In the other fields up to 16 species, on average 5, were observed in or around the square (roughly the area of the 707 m^2 circle).

Table 5.11 gives a qualitative assessment of the occurrence of some individual weed species. Each land unit has a characteristic weed spectrum, although the proportions and quantities vary according to soil fertility and water availability. Hence, weeds can be used as indicators. The tall and very aggressive, annual grass *mwamba nyama* (*Rottboellia exaltata*) is an indicator of fertile, moist soils, suitable for maize growing, provided weed control is

adequate. The herb *Ini ra ng'ombe* (*Emilia javanica*) is mostly found on poor soils and under dry conditions. Farmers have a detailed knowledge of these and other weeds and use them to determine the suitability of land for crops.

Another aspect of several "weeds" is their contribution to the menu as leaf vegetables or potherbs and to local health care as ingredients in traditional medicines for disorders varying from headaches to venereal diseases. More information is given in the botanical collection deposited at the East African Herbarium (Nairobi, Kenya) and in Herbarium Vadense (Wageningen, The Netherlands).

Table 5.10. Dominant weeds in 54 squares of 25 m² maize on five land units in the Kaloleni area, Coast Province of Kenya, May 1984: the number of squares where each group was 1st, 2nd and 3rd in dominance (based on cover and height).

Order of dominance →	Pingili.			Ngamani			Mbuyuni			Chilulu			Kinarani		
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Shrubs	3	1	2	0	1	0	1	0	1	0	1	1	1	0	4
Gramineae	2	2	1	5	4	3	1	2	2	3	1	0	0	0	2
Compositae	0	1	0	9	8	6	2	2	1	0	4	4	0	0	2
Commelinaceae	0	2	1	1	2	1	2	2	1	5	2	3	8	8	3
Cyperaceae	1	0	1	1	0	0	0	1	0	2	1	0	5	5	3
Other herbs	0	0	1	0	1	6	1	0	2	0	1	2	1	2	1
Squares per land unit (#)	6			16			7			10			15		

Totals of columns equal the number of squares per land unit; those of rows can be larger when more species of the same family are involved, e.g. *Ageratum conyzoides* as the most dominant species, followed by *Bidens pilosa* in second place, and *Launaea cornuta* in third position.

6.6 Incidence of stalk borers

In the long rains of 1984 the armyworm was the major pest of maize and rice. Fortunately, the kind of massive outbreak observed does not occur often; the devastation that can be caused by armyworms has been compared with that of grazing cattle (Rose *et al.* 1988).

Normally the stalk borer is the most serious pest. In 1982 and 1983 only the incidence on maize ears from farmers' fields was recorded: it was lowest in Ngamani or Mbuyuni and highest in Kinarani (table 5.12). There were no differences in weight between ears without and with borers. The borers found in the ears usually arrive late, when the grain has already

Table 5.11. Weed occurrence in relation to land units in the Kaloleni area, Coast Province of Kenya: typical weeds roughly ranked in order of decreasing importance, based on interviews and field observations, 1981-1984.

	Land unit (abbreviation)					Remarks
	Ping	Ngam	Mbuy	Chil	Kina	
Ndago (<i>Cyperus</i> spp.)	+	+	+	++	+	Can be suppressed by growing cowpea; farmers distinguish several species
Mwamba nyama (<i>Rottboellia exaltata</i>)	-	++	+	+	-	Early, fast growing, tall; fertile, moist soils; prickly hairs irritate human skin; medicine
Dzadza (<i>Commelina</i> spp.)	+	+	+	+	++	Only problematic under rainy conditions; farmers distinguish several species
Mkakazi (<i>Ageratum conyzoides</i>)	-	++	+	+	-	Starts late: from May onwards
Karatuba, Kamaumau (<i>Acanthospermum hispidum</i>)	-	-	-	++	++	Recent introduction; prickly fruits stick to hairs and clothes
Kidungadunga (<i>Bidens pilosa</i>)	-	-	+	+	-	Leaf vegetable, medicine; fruits stick to hairs and clothes
Mutsunga (<i>Launaea cornuta</i>)	-	++	+	+	-	Popular leaf vegetable, most on fertile soils
Ini ra ng'ombe (<i>Emilia javanica</i>)	-	-	-	+	+	Common on exhausted land and in dry areas
Karamata katsi (<i>Tridax procumbens</i>)	-	-	+	++	-	Typical, but because of its creeping habit not a problem; edible and used as medicine
Kilimbi (<i>Rhynchelytrum repens</i>)	-	-	+	++	-	Appears more commonly on exhausted land

- = unimportant; + = common or problematic; ++ = very common or problematic.

formed. Each attacks a few or at worst half a row of grains, which remains undetected in the large variation in ear weights between and within fields. The borers may even show a preference for large plants and ears. Only in years with heavy rain during ripening may borers cause visible damage via water entering their tunnels and moulds attacking the wounds the borers have made.

In 1984 observations were also made at about one month after planting. On most land units the estimates of incidence (% of plants, larvae plant⁻¹) and severity (damage scores) were low (table 5.12). In a field experiment in west Kenya, using artificial infestation, ≥ 3 larvae

plant⁻¹ were needed to cause a significant yield reduction; the crop was most susceptible at 20 days after emergence, somewhat less 20 days later, and almost immune at 60 days after emergence (Seshu Reddy & Sum 1991). Compared with that experimental critical level, the borer incidences and expected losses in the Kaloleni area are quite moderate: in only 6 squares ≥ 3 larvae per dissected plant were found. Incidence and severity were highest in Kinarani but the variation was large: in some squares hardly any plants were affected and in others nearly all.

Table 5.12. Stalk borer incidence in farmers' fields on five land units in the Kaloleni area, Coast Province of Kenya, long rains of 1982-1984.

	Pingilikani	Ngamani	Mbuyuni	Chilulu	Kinarani
1982: at harvesting					
Fields sampled (#)	1	3	2	3	2
Ears observed (#)	13	49	30	21	42
Symptoms (% of ears)	54	43	26	68	67
1983: at harvesting					
Fields sampled (#)	2	7	2	5	5
Ears observed (#)	41	115	41	100	105
Symptoms (% of ears)	47	29	39	41	79
1984: at 1 month					
Squares studied (#)	5	6	7	6	13
Symptoms (% of plants)	3	10	3	11	29
Mean score (0-3 scale)	0.03	0.12	0.03	0.14	0.48
Larvae plant ⁻¹ (#)	0.12	0.00	0.06	0.13	0.71
1984: at harvesting					
Squares studied (#)	6	6	5	4	12
Symptoms (% of ears)	15	14	20	20	33

The 1982 sample is from the study reported in sections 7.2-7.3; the 1983 sample consisted of 20 recently harvested ears from 20 fields, of 20 farmers; the 1984 data are from the study that forms the core of this section. The scores refer to the external appearance of the plants, and vary from 0 (no visible attack) to 3 (growing point killed: "dead heart"); for a similar, more detailed 0 to 9 scale see Ampofo (1988). The numbers of larvae were determined by dissecting 10 randomly chosen plants per square. Mean scores and numbers of larvae refer to all plants sampled, not only those with symptoms.

At the harvest all ears were checked for symptoms of borers (table 5.12) and 20 plants per square were dissected to identify the species involved (table 5.13). Compared with previous years only few ears had symptoms of borer damage, with Kinarani again leading. Part of the lower incidence may be due to the effect of the armyworm attack on the first generation of borers and hence on population build up. However, only one-third of the squares were badly affected, and these were excluded from the analysis reported here. Therefore, the lower incidence may be part of the normal and probably weather-related variation between years,

which was found to be quite large at the Coast Agricultural Research Station (CARS) in Mtwapa (Croix 1967; Mathez 1972; Warui & Kuria 1983).

Nearly all larvae collected in farmers' fields were of coastal (*Chilo orichalcociliella*) and spotted (*C. partellus*) stalk borers, with an occasional one of the pink stalk borer (*Sesamia calamistis*). Some *Chilo* larvae had lost their pigmentation and become white, a phenomenon usually associated with diapause or dormancy. The data in table 5.13 suggest that land units differ in the composition of the stalk borer population. However, research at CARS indicated that the proportions of coastal and spotted borers at the same site may fluctuate greatly (Warui & Kuria 1983).

Table 5.13. Composition of the stalk borer population in mature maize plants (4 MAP) in farmers' fields on five land units in the Kaloleni area, Coast Province of Kenya, long rains of 1984.

	Pingilikani	Ngamani	Mbuyuni	Chilulu	Kinarani
Squares studied (#)	6	6	5	4	13
Symptoms (% of ears)	14	17	17	24	31
Coastal (# plant ⁻¹)	0.03	0.21	0.17	0.26	0.26
Spotted (# plant ⁻¹)	0.13	0.03	0.06	0.05	0.58
Pink (# plant ⁻¹)	0.00	0.01	0.03	0.01	0.00
White (# plant ⁻¹)	0.05	0.13	0.06	0.00	0.13
Pupae (# plant ⁻¹)	0.01	0.04	0.11	0.08	0.24
Total (# plant ⁻¹)	0.21	0.41	0.43	0.40	1.21

Per square 20 randomly chosen plants were dissected. Identification was according to Mathez (1972): larvae of coastal (*Chilo orichalcociliella*), spotted (*C. partellus*) and pink (*Sesamia calamistis*) stalk borers were distinguished. White larvae belong to the genus *Chilo*; pupae were not identified.

6.8 Correlation

Not surprisingly, it proved difficult to perform multiple regression or other mathematical modelling of Mijikenda maize fields and yields. In the first place there was much variation between squares, fields and land units; each square was a case in itself rather than one more unit in a sample. In only few of them did the variables studied have similar values; there were not even approximate replicates.

To complicate matters, several "independent" factors were confounded so that their effects on the yields of maize could not be distinguished. Some cases were expected and understandable, like the relation between land unit and rice intercrops (Ngamani), presence of palms (Mbuyuni, Chilulu), or density of maize (Kinarani). Others came as a surprise, like the correlation between tree crops and borer incidence in Kinarani (table 5.14).

Some cases of confounding were probably accidental and caused by the small sample size. Others indicate causal relations as in the chain: high tree density → low maize density → low maize yield. In still other cases correlated variables are probably less related to one another than to a common third one, e.g. fertile spot → high density of maize **and** of other annuals → high maize yield.

Table 5.14 illustrates the variability and confounding for the case of Kinarani. On other land units there were indications of also a strong effect of manure and a weaker one of burning. However, the armyworms had reduced the already few squares to very few, without reducing the variability or confounding of the variables. For that reason it was decided not to attempt to "explain" the maize yields by means of multiple regression or analysis of variance.

Table 5.14. Correlation coefficients between variables observed in 11 maize fields in Kinarani, Coast Province of Kenya, long rains of 1984.

Variables	Mean	CV %	W	T	A	M	B ¹	B ⁴	Y
Intensity (R, %)	2.2	79	+0.38	-0.31	+0.26	+0.54	-0.65	-0.69	+0.12
Weeding (scale 1-5)	3.2	46	.	+0.34	-0.25	+0.15	-0.26	-0.01	-0.05
Tree crops (m ² m ⁻²)	0.1	116	.	.	-0.61	-0.40	+0.30	+0.80	-0.40
Annual crops (-/-)	0.1	95	.	.	.	+0.79	-0.33	-0.66	+0.64
Maize (plants m ⁻²)	3.6	22	.	.	.	.	-0.21	-0.56	+0.63
Borer ¹ MAP (% plants)	29	125	.	.	.	.	.	+0.73	-0.05
Borer ⁴ MAP (% ears)	31	86	.	.	.	.	.	.	-0.50
Yield (kg ha ⁻¹)	1500	42	.	.	.	.	.	.	.

With 11-1 d.f. R is statistically significant if $|R| \geq 0.58$ ($p = 0.05$).

7 NEEDS, AREAS AND YIELDS

7.1 Maize needed

After the description of cultivation practices and an excursion to farmers' fields, we return to one of the central questions of this study: how much of their daily bread do the Mijikenda produce themselves? The answers given here are based on a case study of only a few farms during one particular year. They are not meant as statistical proof -- the quantities of maize meal imported in the area and the contents of the shelves in local shops are convincing enough -- but as illustration of the food situation at farm or household level. The amounts of maize produced on the farms are compared with those needed to feed the households.

Table 5.15 presents two estimates of the quantity of maize needed. The first is based on the household compositions (interviews), the energy requirements per age and sex class (King *et al.* 1972), and the energy value of maize (Platt 1962). Household compositions were corrected for persons working elsewhere but sleeping on the farm (0.50), being in boarding school (0.25), working and sleeping elsewhere but with a wife on the farm (0.10) and working and sleeping elsewhere without wife on the farm (0.05). Maize was valued at 15 MJ kg⁻¹, and it was assumed that small children need 0.38, women or children of primary school age 0.71, and men or boys in secondary school 0.83 kg maize person⁻¹ day⁻¹. The resulting rough estimates disregard the fact that people do not derive all their energy from maize, but on the other hand up to a quarter of the maize is lost during its processing.

Probably, both factors balance each other as the results agree well with the number of 2 kg packets of *unga* (maize meal, ready for use) farmers bought on days they had no maize of their own. Multiplying this quantity by 365 yielded a second estimate of the amount of food required. Comparison of the estimates per household indicated that the number of packets bought tended to exaggerate the demand of small households: you cannot buy half packets. In the case of large households it was the other way round: nice to have such a numerous family, but cheaper to eat cassava or to let some members fend for themselves. Both estimates are probably somewhat on the high side: people do not eat maize only, nor do they buy *unga* every day.

7.2 Areas planted

Of the 18 households surveyed all areas of maize planted throughout 1982 were estimated, by measuring the perimeter of the fields with tape and compass, drawing maps to scale, and determining the areas with a planimeter or by counting squares. The results are presented in figure 5.3.

The areas of maize planted per farm correlated with the number of women involved in maize production (table 5.16). Analysis of individual cases indicated that factors such as soil type, tractor ploughing, hired labour, or non-farm income also played a role, but the numbers of cases were too small for statistical analysis. From the viewpoint of statistics, even the relation with the number of women may be doubted as that is related to the number of persons in the household and thus with demand. However, in most cases harvests lag very far behind demand. One can want more food, plough more land or plant more maize, but most of the weeding has to be done by family labour, by one's wives. Therefore, it appears justifiable to assume a causal relation between the number of women and the area of maize.

It should not be concluded from figure 5.3 that in some villages the women worked harder than in others. The cases were too few and the differences in age, health and motivation were large. For example, one woman in Chilulu was very industrious, whereas a farmer in

Kinarani had severe land tenure problems in the first half of the year. In other cases, being married to shopkeepers -- stable income and cheap maize meal -- apparently dampened interest in maize growing.

The monthly areas planted with maize show a relation with the rainfall distribution, which becomes more bimodal inland (figure 5.3). In Pingilikani and Mbuyuni nearly all maize was planted at the onset of the long rains in April, while in Chilulu and Kinarani a large part was planted in the short rains, between September and December. In 1981 and 1984 similar patterns were observed; in the second half of 1983 little maize was planted and hardly any harvested, because the short rains failed.

Table 5.15. Average household composition and annual maize requirements in four villages in the Kaloleni area, Coast Province of Kenya, 1982.

	House-holds	Eaters					Workers		Food needed	
		0-6 years	7-12 years	13-18 years	Men	Women	Men "off"	Women "on"	Maize (kg)	Unga (kg)
Pingilikani	4	2.8	3.3	0.1	0.9	2.5	0.8	2.3	2200	1700
Mbuyuni	5	3.6	2.2	0.4	1.4	2.4	1.4	2.2	2200	2000
Chilulu	4	2.5	4.5	0.0	0.4	2.3	1.3	1.5	2200	1800
Kinarani	5	3.6	1.2	0.0	1.7	3.6	2.8	3.6	2300	2200

Men and women are persons ≥ 13 years old and not going to (secondary) school. Workers: "off" refers to all men with some income from non-farm work or sale of palm wine, "on" to women participating in maize growing.

7.3 Yields obtained

After measuring the perimeters of the fields, the grain yields were estimated by scoring or sampling. The performance of the crop was scored on a five-point scale: 0 for normal, -1 and +1 for worse or better, and -2 and +2 for much worse or much better, respectively. For calibration, after scoring, one or two 1 m wide strips were laid out across part of the fields. These were positioned at random (little variation) or along gradients (visible differences). The total area varied from 40-190 m², depending on the size and heterogeneity of the field. In the strips all stands, plants and ears were counted, and the circumference and length of one-fifth of the ears were measured. A sample of these ears was taken to determinate the regression between external measures and grain yields (table 5.16).

The correlation between external dimensions and grain weight of maize ears has been widely used in Kenya; it has been found that the calibration differed per region (Hesselmark 1978). A sample of ears from Kisii did indeed gave a different regression line ($W = -15 + 0.6 * C*L$), but on the eastern slopes of Mount Kenya an almost identical equation was observed:

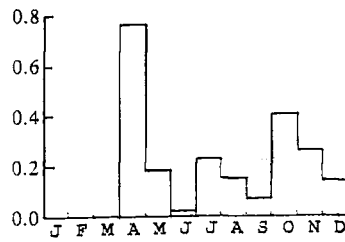
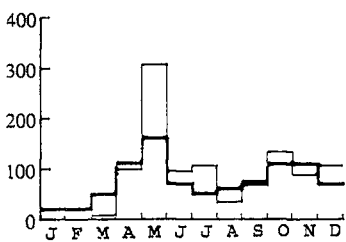
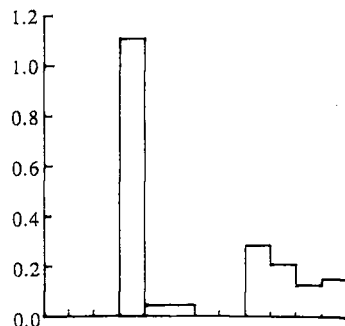
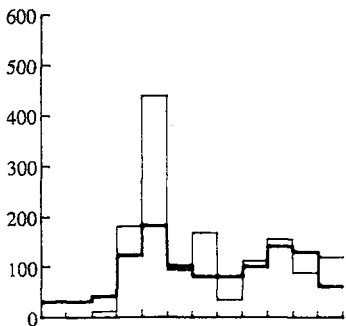
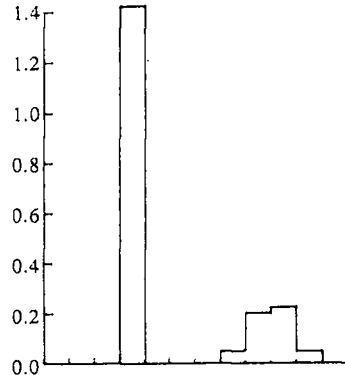
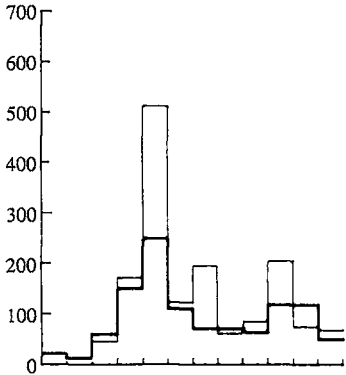
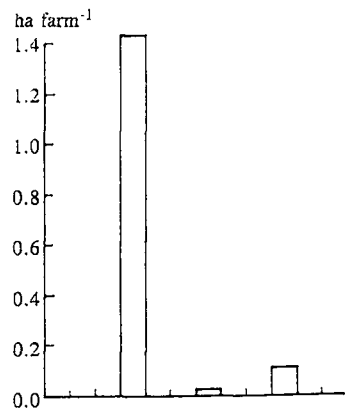
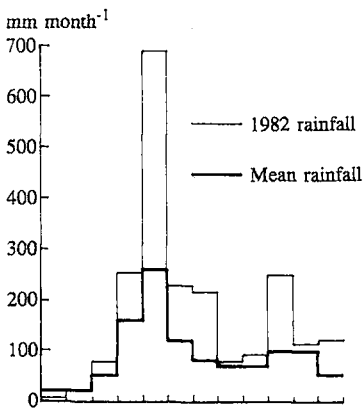


Figure 5.3. Distribution of average rainfall and areas planted with maize in four villages in the Kalolenti area, Coast Province of Kenya, 1982.

Table 5.16. Formulas to describe the relation between labour available and areas planted, and to calculate the yield of maize per ear and per area.

$$A = -0.4 + 1.1 * W \quad (R^2 = 0.56, n = 17 \text{ farms})$$

A = area planted with maize in 1982 (ha farm⁻¹);
W = labour involved in maize growing (women farm⁻¹).

One farm in Kinarani with land tenure problems was excluded from the analysis.

$$W = -10 + 0.4 * C * L \quad (R^2 = 0.85, n = 232 \text{ ears})$$

W = grain yield (g ear⁻¹), oven dry (4 hours at 113 °C);
C = circumference (cm) of the ear, including husks;
L = length (cm) over which grain could be felt.

The ears were from 33 fields, sampled in 1981 and 1982; the differences in regression between fields and years were small.

$$Y = 630 + 230 * S \quad (R^2 = 0.86; n = 19 \text{ fields})$$

Y = grain yield (kg ha⁻¹), oven dry (4 hours at 113 °C);
S = score on scale from -2 (very low) to +2 (very high).

The regression is based on 9 fields included in this study and 10 others that were studied for different reasons.

($W = -7 + 0.4 * C * L$; Ooms 1986). The estimation of ear weights by means of regression is relatively rapid, non-destructive, and the harvest can be left for the farmer.

The R^2 of 0.86 in table 5.16 gives a somewhat flattering impression of the accuracy of yield scores. Some fields were scored well before or after the harvest, or long after the fields on which the equation was based. Some estimates could be verified with information on the quantities reported harvested. The advantage of scoring is that it takes little time: a short period in the area to get a feel for the yields, and a quick walk around each field to assess it. However, the regression is personal and needs constant rechecking.

In 1981 maize yields of 300-2,500 kg ha⁻¹ were recorded (Waaijenberg 1983). Those in 1982 were much lower, in several cases practically zero and even in the best plot only a modest 1,200 kg ha⁻¹. The averages varied between 300 and 600 kg ha⁻¹ or 700 and 900 kg household⁻¹ (table 5.17). The main factor behind the disappointing yields was the excessive rainfall which, depending on the characteristics of the field, caused waterlogging, leaching of nutrients, and luxuriant weed growth while hampering adequate weeding. Maize yields were highest on the fertile soils of Ngamani. They were lowest in Chilulu and Kinarani. Chilulu is densely populated, and its fields are exhausted by long use. In Kinarani lack of rain may have played a role; a large part of the maize was planted during the short rains.

Table 5.17. Areas planted and grain yields of maize in four villages in the Kaloleni area, Coast Province of Kenya, during the long and short rains of 1982.

	farms	ha farm ⁻¹	kg farm ⁻¹	kg ha ⁻¹	Causes of low yields
Pingilikani	4	1.6	900	600	Low soil fertility, water logging (fields in Ngamani)
Mbuyuni	5	1.9	900	500	Water logging (fields in Ngamani), shade of coconut palms.
Chilulu	4	2.0	800	400	Exhausted fields, some under shade of coconut palms.
Kinarani	5	2.2	700	300	Low rainfall, variable soil fertility, land tenure problems, stalk borers.

Yields refer to shelled grain with a moisture content of 13 % of the weight. Weeds were a problem everywhere, but on the sticky clay of Ngamani heavy rains for several weeks made weeding almost impossible (Standard 1982a).

Table 5.18. Estimates of the self-sufficiency in maize production in four villages in the Kaloleni area, Coast Province of Kenya, 1 July 1982 to 1 July 1983.

	House-holds	% of energy requirement	% of unga (meal) bought	% of time own maize
Pingilikani	4	38	49	38
Mbuyuni	5	42	45	55
Chilulu	4	39	44	35
Kinarani	5	36	31	29

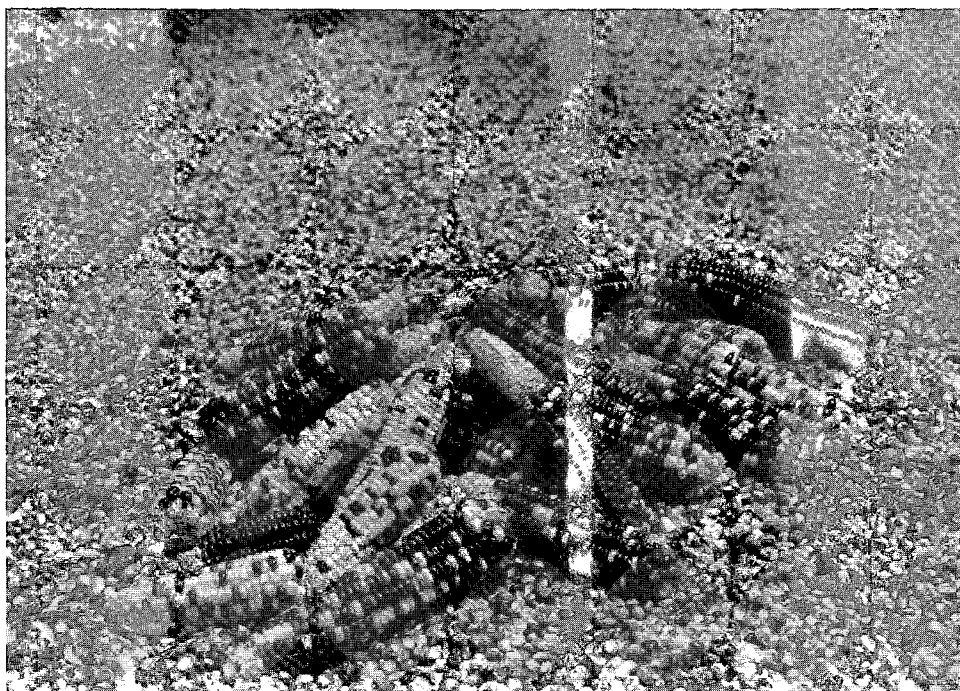
The first two estimates are quotients of estimated yields and needs, computed per household and then averaged per village, the third is based on table 5.19.

7.4 Self-sufficiency

In view of the large households, modest areas planted and low yields it is no surprise that in 1982 there was a negative balance between production and consumption (table 5.18). Although the estimates for individual cases did not always agree well, because of inaccuracies in interviews and measurements, the overall picture was quite clear: none of the

households managed to grow all the maize they needed. As for the household needs, there is no rule about the proportion of maize in the diet. However, the spending behaviour of Mijikenda households leaves little doubt that they like it to be substantially above the 40 % they produced in 1982 (table 5.18).

For an indication as to whether 1982 was a representative year, the farmers surveyed were asked to rate its long and short rains on a scale of -2 (very bad), -1 (bad), 0 (normal), +1 (good), +2 (very good). In 1982 their opinion was quite negative, but when asked again in 1984 they rated 1982 as a normal year. Thus although 1982 was certainly not a good year, it can be concluded that it was not exceptional.



Photograph 5.9. Ears and grain of "*Mzihana*", a common local maize cultivar in the Kaloleni area.

7.5 Variation

Shortages of home grown maize are common in the Kaloleni area. However, there is much variation between seasons and years and between villages and households. In most years, there is a maximum in self-sufficiency in August, just after the main harvest, and a minimum in May and June, unfortunately coinciding with a peak demand for labour (weeding). Table 5.19 reflects that 1981 was a good year; several households in Pingilikani, Mbuyuni and

Chilulu had maize from their own harvest until far into 1982, and only in Kinarani were the stores empty. Note too that the short rains of 1983 failed, as by January 1984 nearly all households had to buy maize meal from the shop.

The differences between households are striking. For example, the industriousness of the eager farmer in Chilulu shows up in an average score for self-sufficiency in spite of her low yields per hectare (C 042). By 1983 another farmer in Kinarani had solved the land tenure problems of the previous year and so improved his food situation notwithstanding the much less favourable rainfall (K 087). His neighbours, a well-to-do family with three off-farm workers including a teacher and a shopkeeper, not surprisingly produced less maize than they could have done (K 071). These cases remind us of the complex causes of self-sufficiency, which is determined not by soil type, rainfall or laziness alone but also by, for example, malaria during weeding or lack of commitment because of assured cash income. The exploration of technical bottlenecks and alternatives in next section, however important, is only part of the story.

Table 5.19. Self-sufficiency in maize production in four villages in the Kaloleni area, Coast Province of Kenya, 1982-1984: variation between farms, years and months.

Village and farm	1982												1983												1984														
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06									
Pingilikani																																							
P 005	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
P 019	1	1	1	1	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
P 032	1	1	1	0	0	0	1	1	1	½	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
P 067	1	1	1	1	½	0	1	1	1	1	½	0	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0		
Mbuyuni																																							
M 024	1	1	1	?	?	?	1	1	1	1	1	1	1	1	1	0	0	0	1	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0		
M 027	0	0	0	0	0	0	0	1	1	½	½	½	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
M 073	1	1	1	1	?	?	1	1	1	½	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
M 078	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	½	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
M 080	0	0	0	0	0	0	0	1	1	1	1	1	1	½	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
Chilulu																																							
C 012	0	0	0	0	0	0	0	1	1	1	1	1	½	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
C 033	1	1	½	0	0	0	0	1	½	0	0	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
C 042	1	1	1	1	1	1	1	1	1	½	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
C 082	0	0	0	0	0	0	½	½	0	½	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kinarani																																							
K 016	0	0	0	0	0	0	0	1	1	1	½	½	0	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
K 060	0	0	0	0	0	0	0	1	1	1	½	½	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K 071	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0
K 076	0	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
K 087	0	0	0	0	0	0	1	0	0	0	½	½	0	0	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Average (%)	39	39	36	24	21	6	44	92	81	69	53	50	29	25	17	6	3	0	39	72	72	56	44	28	11	11	6	6	0	0	0	0	0	0	0	0			

Explanation: 1 = eating own maize, 0 = buying in shop, ½ = eating from both sources.

8 PROBLEMS AND OPTIONS

8.1 Adding nutrients

The diverse problems of maize production can be summarized in terms of low returns to land and labour. Many soils are so poor that even with long hours of hard work they yield less

than one ton of grain per hectare. Table 5.20, which is based on agronomic trials I conducted in the land units studied, gives an idea of what yields would be like with improved soil fertility and pest control. In 1982 there was a significant fertilizer effect at all sites, and of pesticide in Pingilikani and Kinarani. In 1983 the fertilizer plus pesticide effect could not be tested per site. Use of fertilizer on the poor soils of Pingilikani, Chilulu and Kinarani more than doubled the maize yield. On the fertile soils of Ngamani the effect was smaller. The yields of maize without fertilizer in Mbuyuni were high compared to those obtained by farmers, as the trial plot was on one of the few places not shaded by coconut palms. At all sites homogeneous spacing and weed control may have contributed to experimental yields and caused some bias with average farmers' yields.

Table 5.20. Maize yield levels in experiments in farmers fields in the Kaloleni area, Coast Province of Kenya, long rains 1982 and 1983 (kg ha⁻¹).

Year	Density (pl ha ⁻¹)	Carbofuran (kg ha ⁻¹)	Fertilizer (kg ha ⁻¹)		Land unit (abbreviation)				
			N	P	Ping	Ngam	Mbuy	Chil	Kina
1982	37000	0.0	0	0	100	1700	1700	500	400
		0.0	50	15	500	2100	2300	1500	900
	37000	1.5	0	0	200	1600	1800	500	1100
		1.5	50	15	1200	2200	2400	1400	2100
1983	37000	0.0	0	0	-	800	2500	200	700
		1.0	50	20	-	1900	3400	1200	2400
	25000	0.0	0	0	-	1300	2600	300	700
		1.0	50	20	-	1400	3200	900	1900

Designs: 1982, strip-split-plot with 2 (fertilizer) x 3 (block) x 5 (cultivar) x 2 (carbofuran) = 60 units of 6 plants per site; 1983, split-split-plot with 2 (density) x 2 (fertilizer+pesticide) x 12 (cultivar) = 48 units of 8 or 12 plants per site (Vervoorn 1986a). Grain yields are with 13 % moisture.

Husbandry: spacing 90 cm x 60 or 90 cm, 2 or 3 plants stand⁻¹; P (TSP) was applied in the plant hole; N (CAN) was split into 2 or 3 gifts; carbofuran (Furadan 5G) was given in plant hole and whorl (1 MAP); in 1983 trichlorphon (Dipterex 3.5G) was used for the 2nd application; all maize was weeded well.

Experiments on similar sites in Kilifi District in 1981 had shown that on all the soils studied P was limiting, that on most soils maize or sorghum also responded to N, and that on only one soil sorghum also responded to application of K. Doubling the rates to 100 kg N and 30 kg P ha⁻¹ did not increase yields further, indicating that other factors became limiting (Bie 1982). In 1982 and 1983 several small trials were carried out to see whether other elements than N, P or K were limiting the maize yields. There were no effects of S (tested in Pingilikani, Ngamani, Mbuyuni, Chilulu and Kinarani), Ca (Ngamani) or micro-nutrients (Chilulu), and a negative response to Mg (Mbuyuni) application (Hempenius 1983a; Schreurs 1984; own unpublished data). Because rainfall was not optimal most yields were low, 1,000-3,000 kg ha⁻¹. When high yields are maintained for several seasons deficiencies other than those of N, P or K may show up, but in the short term and at the current yield levels they appear unimportant.

Liming experiments elsewhere in Kwale and Kilifi Districts, on soils similar to those in Pingilikani (tables 5.1-5.3), gave variable results. In Matuga, southwest of Mombasa, gypsum applied in 1958 had a residual effect on maize yields in 1960 (DoA 1960b). In Sokoke and Ngerenya, northwest of Kilifi, agricultural lime and calcareous dune sand failed to raise maize yields in 1982; nitrogen was the most limiting factor (Leeuwen 1989).

The most straightforward "solution" to the problem of low fertility is to add extra nutrients in the form of mulches, manures or fertilizers. Between 1952 and 1957 the Department of Agriculture conducted several experiments that included mulching in Shimba Hills, Matuga and Gedi (DoA 1952b-1957b). In most years sorghum or maize (long rains) and cowpea, green gram or velvet bean (short rains) showed a positive response to a mulch of dry grass applied at the start of the long rains. As the quantities and compositions of these grass mulches are unknown it is not possible to estimate how much of the response resulted from the nutrients they contained rather than from their physical properties.

In another Department of Agriculture experiment, between 1953 and 1960 in Matuga, farm-yard manure and artificial fertilizer were compared (Grimes & Clarke 1962). Both had a large and significant effect on the yields of maize, sorghum, cassava and sweet potato, with no difference between 7.5 ton ha⁻¹ year⁻¹ manure and the equivalent amount of NPK given as artificial fertilizers. The latter, however, lowered the pH of the soil, probably because of the acidifying effect of sulphate of ammonia. There was little difference between 7.5 tons of manure every year or 22.5 tons once in three years. Unfortunately, the experiment was carried out on an extremely poor soil, comparable to those in Pingilikani. The average maize yield in the best treatment was 1,000 kg ha⁻¹ and the highest 1,900 kg ha⁻¹ (after an extra 25 kg ha⁻¹ P); sorghum did somewhat better. However, other experiments on various soil types also showed responses to manure and N or P fertilizers (DoA 1952b-1968b).

In 1987 the Kenyan Fertilizer Use Recommendation Project (FURP) started a new series of experiments involving fertilizer and farmyard manure (Smaling *et al.* 1992). The site in Shimba Hills was similar to Chilulu with somewhat higher rainfall and sandier soil. In the period 1987-1990 maize without fertilizer yielded 1,600 kg ha⁻¹, with approx. 17 kg ha⁻¹ P 2,200 kg ha⁻¹, with 22 kg ha⁻¹ P and approx. 38 kg ha⁻¹ N 2,900 kg ha⁻¹ and with 5 ton ha⁻¹ manure as well 3,600 kg ha⁻¹ of grain. There was much variation between years, and for several year and treatment combinations the value/cost ratios were less than unity. The cheapest and most profitable option was to apply P only. Fertilizer plus manure gave the highest yield and its profitability appeared to increase with time, but this treatment cost the equivalent of 1,500 kg of maize.

For the short term, until more detailed studies become available, the best option appears to recommend P only; the element is lacking almost everywhere, is relatively cheap, easy to transport, and is not lost in case of crop failure. Application of N should be limited to cases where cropping history (or experiments) or deficiency symptoms and financial resources indicate its use; the contribution of N from biological sources should be explored. In Kwale

and Kilifi Districts only some of the farmers have manure in any quantity near their fields. A study should be done to find out why they do not use it more systematically; some decades ago 268 farmers in the Kaloleni area, in response to demonstration plots, did manure their fields (DoA 1953a).

8.2 Auxiliary species

Another way of alleviating the problems of low returns to land or labour is by means of auxiliary species. Here the term is used for any plants, from wild to cultivated, that help the farmer to make better use of his limited resources. At one extreme are herbs and shrubs whose function, apart from an occasional leaf for medicine or a twig for fuel, is to improve soil fertility and thus maize yields. At the other extreme are crops that do not improve the soil, but when planted together with maize produce consumable or saleable parts for little extra labour. In this section the focus is on the practices of relay and alley cropping.

The main **relay crops** grown by the Mijikenda are cassava and cowpea. Growing them this way saves labour. Cassava is planted just after the first weeding of the maize, which had to be carried out anyway. To plant cowpea, some of the maize is weeded for a second time, but because of shading by the maize the weed cover tends to be lighter than the vegetation that would have to be cleared if the cowpea were to be grown as a sole crop. Moreover, the maize foliage suppresses the growth of weeds during the early stages of the relay crops. In my experiments in the Kaloleni area maize was the principal crop; information on relay crops was considered an extra. Table 5.21 presents some yields obtained in experiments carried out simultaneously on all or most land units studied.

Cassava is an insurance crop; under all but the worst conditions there will be at least something to harvest. The crop in table 5.21 was planted as a double hedge with a spacing of 180 cm x 90 cm; the conversion of kg plant⁻¹ to kg ha⁻¹ is somewhat arbitrary. The low average yields of 0.6 to 1.5 kg plant⁻¹ must be seen against a background of failed short rains and heavy infection with ACMV (*Vervoorn 1986a*). Other experimental research showed that the incidence of ACMV can be over 50 %, with affected plants showing a yield reduction of 80 %; losses could be reduced by planting healthy material and by roguing regularly (Robertson 1987). However, many Mijikenda farmers consider ACMV a normal condition of the crop and do not recognize it as a disease. They are often short of cuttings, and reluctant to pull out plants. Losses due to another major pest, the cassava green mite, have been shown to be much smaller (KARI 1981; Markham *et al.* 1987).

Growing cowpea is a gamble, with yields on the same site varying from about zero to more than one ton of dry seeds ha⁻¹ (table 5.21). The causes of the variation were not studied in detail, but it appeared that heavy rain in the vegetative stage reduced flowering. After that insects took their toll on buds and young pods, and in humid weather the ripening pods were

devastated by moulds. There is some conflicting evidence that intercropping reduces the incidence of pod borers and other pests, which may explain why cowpea is seldom grown as sole crop (Gethi & Khaemba 1985; Giga & Munetsi 1989). A small experiment with sole cropped cowpea during the long rains of 1982 did indeed fail completely, but that may as well have been because of the excessive rainfall (see table 5.4).

Relay crops of minor importance are bambara, groundnut and sesame. On several occasions bambara did very well, but in Kinarani and Chilulu the crop was affected by a fatal wilt disease, possibly *Fusarium* sp. (which in the 1930s affected groundnut; Humphrey 1939c). Even on hard or sticky soils the shallow and concentrated bambara pods were easy to harvest, unlike the deep and dispersed ones of groundnut. Apart from that and its lower yields, groundnut had several more disadvantages. It often germinated poorly, the crop suffered from rust and leaf spot, and the harvest was easily lost by germination or moulds spoiling the seeds, or taken by passers by (the crop was popular). Sesame also gave low yields and because of marketing problems it was grown by few farmers and in small areas. Experiments of the Department of Agriculture showed that the local black seeded material surpassed imported cultivars in pest resistance and yield (DoA 1962b, 1963b).

Relay cropping is attractive from the viewpoints of optimizing labour use, getting more from one plot of land, and maybe control of pests. In several of the experiments mentioned in section 8.1 researchers found residual effects of mulch, manure or fertilizer applied to maize or sorghum during the long rains on cowpea or green gram during the following short rains. In my trials (see table 5.21) in some crop--site--year combinations there were also small effects of residual fertilizer on the vegetative growth of relay crops, which in some cases were expressed as higher yields. The implication is that the use of fertilizers may be more profitable than an analysis on the basis of maize yields alone would suggest.

The other side of the coin is whether relay crops, by fixing nitrogen, taking up other nutrients, producing organic matter, or suppressing pests, contribute to higher maize yields. Experiments of the Department of Agriculture in the 1930s with green manures, including cowpea, were inconclusive (DoA 1936a, 1937a). In a trial two decades later velvet bean grown during the short rains and dug into the soil had a positive effect on sorghum grown in the next long rains, but when left as a mulch it reduced the sorghum yield. Unfortunately, the way the trial was carried out and reported hampers analysis (DoA 1955b, 1956b). In another experiment cowpea and velvet bean grown during the short rains of 1961 were incorporated at maximum growth or after they had gone to seed. In the next long rains the yields of maize grown on land that had been under these legumes was 900-1,100 kg ha⁻¹, compared to 700 kg ha⁻¹ on land that had been left fallow during the short rains (DoA 1962b).

Experiments with pigeon pea showed more promising results. In Kibarani one year of pigeon pea, compared with a natural fallow, raised maize yields in the next year from 1,100 to 2,100 kg ha⁻¹; one year later the effect had disappeared (DoA 1937a, 1938). Two decades

later in Matuga (poor soil!) a three-year pigeon pea + weeds fallow, compared with continuous cropping, increased the mean yield of sorghum without manure or fertilizer over the next three years from 600 to 1,000 kg ha⁻¹. A cassava + weeds fallow and a grazed star grass ley had less effect. A similar experiment in Kibarani confirmed the beneficial influence of the pigeon pea fallow (Clarke 1962).

Several of the Department of Agriculture trials were difficult to interpret because of lack of soil and rainfall data, variation in the establishment or growth of "resting" crops, use of sorghum as a test crop, confounding with effects of ridging or ploughing, and presentation of results as means over manure or fertilizer treatments. Nevertheless, they do show that crops like cowpea or pigeon pea have some potential to improve maize yields. At present these crops are grown on a minor fraction of the land (cowpea) and by very few farmers (pigeon pea). Among the conditions for their widespread use (at present they are grown on a minor fraction of the land) are better availability of seeds, control of pod borers, and marketing outlets for pigeon pea.

Table 5.21. Yield levels of relay crops in experiments in farmers fields in the Kaloleni area, Coast Province of Kenya, 1982 and 1983 (kg ha⁻¹).

Crop & year	Approx. density (pl ha ⁻¹)	Nett area (m ²)	Land unit (abbreviation)					Remarks
			Ping	Ngam	Mbuy	Chil	Kina	
Cassava								
1983	6200	100	-	4700	9400	6900	3700	Cv. "Kabandameno"
Cowpea								
1982	37000	86	200	900	200	400	0	Local cultivars and
1983	37000	38	-	300	100	100	400	seeds from the market
Bambara								
1982	74000	4	700	1800	600	700	0	Local cv.; in Kinarani
1983	148000	9	-	400	500	500	0	all plants died (wilt)
Groundnut								
1982	74000	4	400	300	300	400	-	Seeds from the market;
1983	74000	9	-	200	100	300	200	bunch and runner type
Sesame								
1982	74000	27	300	200	200	300	400	Local cv. with black
1983	37000	9	-	200	100	100	100	seeds; ± 10 kg ha ⁻¹

Nett area refers to one randomly chosen main plot per site; each figure is mean of 2 to 4 subplots (fertilizer and insecticide applied to maize, with in some cases small residual effects on relay crops). Yields are given as fresh roots (cassava) or oven-dry seeds (other crops). For details on 1983 methods and results see Vervoorn (1986a).

In 1982 an alley cropping experiment, with *Leucaena leucocephala*, was started at CARS in Mtwapa (Jama *et al.* 1986, 1991; Macklin *et al.* 1988; Getahun & Jama 1989). In 1985 the trees were coppiced for the first time and during the long rains of that and the next year "Coast composite" maize was grown between the rows. The maize received 20 kg ha⁻¹ P and 40 kg ha⁻¹ N, was weeded and protected against borers. In the course of the season the

Leucaena hedges were pruned twice, and leaves and small twigs were incorporated into the soil. The closest spacing of the *Leucaena*, 2.0 m x 0.5 m, raised the maize yields from 2,500 to 4,000 kg ha⁻¹ (1985) and from 500 to 2,600 kg ha⁻¹ (1986). The increases were attributed to green leaf manure and weed reduction, and to the effect of these factors on e.g. water conservation.

Several questions raised by the experiment cannot be answered with the information published: How much of the yield increase was due to the fallow effect of the establishment phase? What were yields of the control plots during that period? How can weed reduction have an effect if all treatments were weeded well? Were the control plots also tilled when the leaves and twigs were worked into the soil between the hedges? What is the potential of the system in drier places than Mtwapa, where it may prove more difficult to establish and maintain the *Leucaena* alleys and where the benefits of agroforestry may be less pronounced? For a discussion of the potential of agroforestry in dry areas see Kessler & Breman (1991). What are the effects of alley cropping on the yields of e.g. cowpea? This crop in general responds less well to alley cropping than maize and cassava (Kang & Wilson 1987)? Such questions should not detract from the potential of the system which in the experiment showed high economic returns from the extra maize and from the sale of firewood (Macklin *et al.* 1988).

The alley cropping system might be improved by including local tree or shrub species. There are many fast growing tree and shrub species in farmers' fields. In fact, most farmers already practice some variant of alley cropping, as during land preparation and weeding they cut down the regrowth of shrubs and pollard trees that are too large or valuable to be felled. Multi-species systems may give extra returns from fruits, fibres or twigs for house construction, and buffer the variation in pests or weather; by 1992 the *Leucaena* psyllid was causing damage throughout Coast Province (Reynolds & Bimbuzi 1992).

Several benefits of alley cropping may also be obtained from other species than *Leucaena* and other arrangements than alleys, for example, by planting *Casuarina equisetifolia* along the borders of the field and relay cropping maize with pigeon pea. *Casuarina* grows well in the Kaloleni area and is becoming popular with farmers; the tree fixes N, the straight trunk makes good fuel and useful timber, and the open crown gives little shade (Teel 1984).

8.3 Maize under palms

Several farmers in the Kaloleni area have little choice but to grow maize in between or under coconut palms. Where the palms are widely spaced the maize yields are similar to those of maize grown in the open, but usually they are lower. The differences are probably caused by competition for sunlight, water or nutrients. Therefore, in 1982 and 1983 we studied the effect of fertilizers and extra water on the yield of maize under coconut palms and in full

sunlight (table 5.22). Under both conditions fertilizers had a positive effect on the maize, but responses and yields were larger in the open. Under palms nitrogen appeared the most limiting factor, up to a yield level of 1300 kg ha⁻¹, above which probably light became limiting. Additional water applied during short dry spells had some effect on dry matter production, but not on grain yields.

The experiments were conducted in a field with 70-85 palms ha⁻¹, about 35 years old and with trunks 13 m tall. As regards the factor light, opportunities for intercropping are best between young palms with small leaves or under old ones of differing heights or with drooping leaves (Nair 1979). The palm density not only affects the growth of the maize, but also the area effectively planted with it. The plants in the trials were kept at least 2.5 m from the palms trunks, as it had been observed that those planted closer remained very small and yielded almost nothing. With 80 palms ha⁻¹ some 15 % of the land cannot be used for maize, so that the real yields per area are even lower than those in table 5.22. Moreover, some maize plants are likely to be damaged by falling coconut leaves.

Table 5.22. Yields of maize in full sunlight and under coconut palms in Chilulu, Coast Province of Kenya (kg ha⁻¹).

Fertilizer (kg ha ⁻¹)		Short rains of 1982			Long rains of 1983	
		In full sunlight		Under palms	Under palms	
		Rainfed	+ 27 mm	Rainfed	Rainfed	+ 19 mm
0	0	800	800	600	700	700
0	15	-	-	-	400	700
30	0	-	-	-	900	1000
30	15	-	-	-	900	1000
50	15	1500	1800	1300	-	-
60	30	-	-	-	1300	1300
100	30	2500	2500	1300	-	-

Designs: 1982 in the open, split-plot with 4 (block) x 2 (irrigation) x 3 (fertilizer) = 24 sub-plots; 1982 under palms, random block, with 8 (block) x 3 (fertilizer) = 24 plots; 1983 under palms, split-plot with 6 (block) x 2 (irrigation) x 5 (fertilizer) = 60 sub-plots; all (sub-)plots had 11 plants. **Husbandry:** "Coast Composite", 90 cm x 30 cm with 1 plant stand⁻¹, weeding with hoe, chemical borer control; 70-85 about 13 m tall coconut palms ha⁻¹; for details about methods and results see *Wassink (1983)* and *Sprenkels (1985)*.

The experiments did not take into account the possible beneficial effects of the maize and fertilizer on the coconut palms. A survey of farmers' fields in 1980 indicated that palms intercropped with maize did somewhat better than those with an undergrowth of shrubs which, unlike maize, compete throughout the year for water and nutrients (Floor 1981). The palms are likely to benefit from the fertilizers applied to the maize, assuming that the amounts given exceed those taken away with the harvested ears. However, so far there is no evidence that coconut palms in the area respond to fertilizers (chapter 6).

As long as other land is available growing maize under palms is only worthwhile if the lower maize yields are compensated by an increase in the yields of the palms, and if the farmer is able and willing to wait for the latter to show up. For a quick return, effort and money are better spent on maize grown in full sunlight: In fields with only few palms ha^{-1} , so that light is not limiting, maize yields may equal those in the open. In such cases any beneficial effect of the care given to the maize on the growth and yield of the palms is a free gift.

8.4 Tractor ploughing

In section 5.3 it was argued that land preparation for maize can be spread over a long period and hence does not make great demands on farm labour. Nevertheless, it remains a strenuous activity that several of the farmers are glad to leave to tractor ploughs. No published explicit comparisons between tractor ploughing and hoe cultivation or zero tillage in Coast Province were found. Experiments by the Department of Agriculture with ridges in Shimba Hills, Matuga and Gedi showed little or no difference with planting on the flat. Some of the positive effects were probably due to the incorporation of organic matter and negative results were attributed to the drying out of ridges not adequately covered with mulch (DoA 1952b-1957b).

An experiment of mine in Chilulu during the short rains of 1983 failed because of drought. The only result was that maize plants on tractor ploughed land were larger, and survived longer, than those on land prepared with the hoe. In view of the variable and often low rainfall in this area the importance of the phenomenon is clear. Among the explanations may be one or a combination of the following factors: improved infiltration, interruption of capillary rise, and better root growth. Under dry conditions the unploughed soil becomes hard and compact like a brick. In the next long rains the field was replanted (table 5.23). Ploughing slightly boosted the maize yield ($p = 0.20$), and reduced the labour needed for the second weeding ($p = 0.10$). There was an unexplained interaction of plant arrangement and land preparation on the maize yield ($p = 0.10$). Planting in rows with one plant stand^{-1} increased the labour input for the second weeding of the maize crop ($p = 0.03$).

In the same season two other experiments, with land preparation and fertilizer, were planted in Chilulu and Ngamani (table 5.24). The soil in Chilulu was so hard in February that the plough could not penetrate, so that we had to wait for the onset of the rain. Ploughing in Chilulu increased the yield of maize and reduced the labour needed for its first weeding. Fertilizers greatly boosted the yield, but more labour was required for the second weeding to cope with the enhanced weed growth. All effects were statistically significant, apart from that of land preparation on the maize yield ($p = 0.15$). In Ngamani ploughing increased the yield ($p = 0.08$) and reduced the labour needed for the second weeding of the maize ($p = 0.03$). Fertilizers had a positive effect on the yield of maize ($p = 0.01$) and on the growth of weeds, which resulted in higher labour inputs for the second weeding ($p = 0.10$).

Table 5.23. Effect of land preparation and plant arrangement on maize yields and weeding efforts in Chilulu, Coast Province of Kenya, long rains 1984.

Land preparation	small hand hoe		tractor plough (disc)	
	90x90 (3)	90x30 (1)	90x90 (3)	90x30 (1)
Spacing (plants stand ⁻¹)				
Grain yield (kg ha ⁻¹)	3100	2800	3200	3800
1st weeding maize (h ha ⁻¹)	100	140	80	110
2nd weeding maize (h ha ⁻¹)	210	340	160	220
1st weeding relay (h ha ⁻¹)	50	60	40	40
2nd weeding relay (h ha ⁻¹)	120	120	100	100
Sum of 4 weedings (h ha ⁻¹)	480	660	380	470

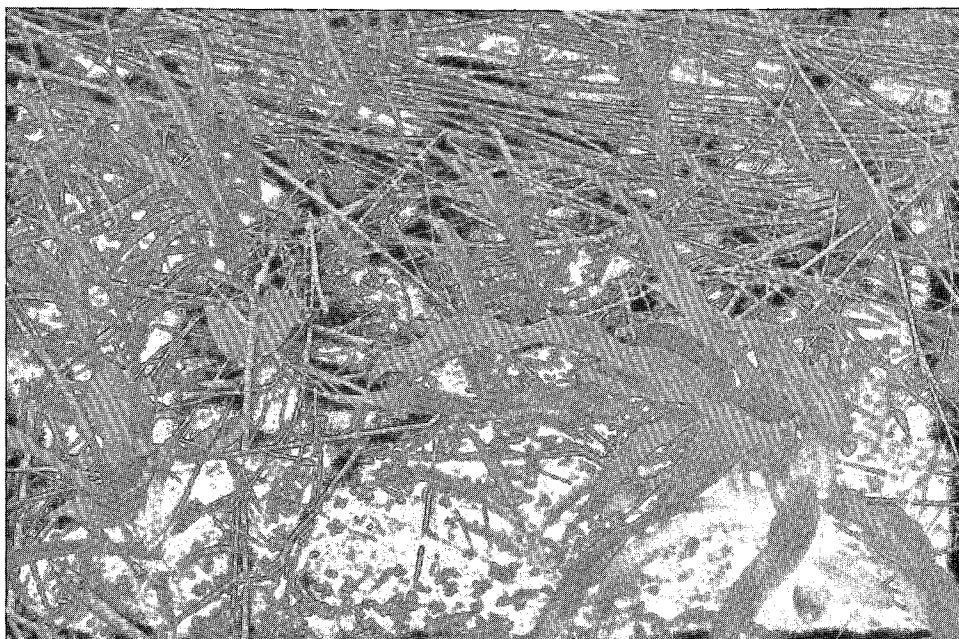
Design: split-plot with 5 (block) x 2 (land preparation) x 2 (plant arrangement) = 20 sub-plots of 19.4 m² or 72 plants. **Husbandry:** prepared and planted in November 1983; replanted with "Mdzihana" on 26 April 1984; trial received 20 (1983) + 10 (1984) P and 20 (1983) + 50 (1984) N; on 8 or 9 May 1984 all maize was sprayed with 0.8 kg ha⁻¹ Sevin-85 (carbaryl) to protect from armyworm; weeding was done with the hoe.

Table 5.24. Effect of land preparation and fertilizer on maize yields and weeding efforts at two sites in the Kaloleni area, Coast Province of Kenya, long rains 1984.

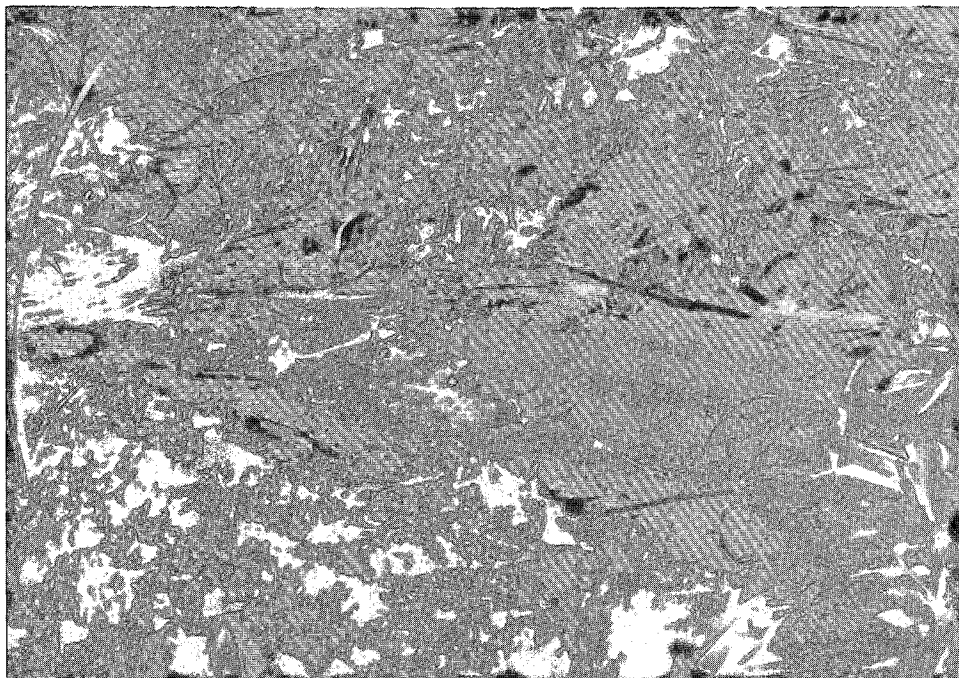
Land preparation	small hand hoe		tractor plough (disc)	
	0 + 0	50 + 20	0 + 0	50 + 20
Chilulu				
Grain yield (kg ha ⁻¹)	1300	3300	1800	4000
1st weeding maize (h ha ⁻¹)	100	110	80	70
2nd weeding maize (h ha ⁻¹)	210	260	200	320
1st weeding relay (h ha ⁻¹)	70	50	40	50
2nd weeding relay (h ha ⁻¹)	60	70	70	60
Sum of 4 weedings (h ha ⁻¹)	440	490	390	500
Ngamani				
Grain yield (kg ha ⁻¹)	700	1900	1400	2600
1st weeding maize (h ha ⁻¹)	- - - 150	- - -	- - - 140	- - -
2nd weeding maize (h ha ⁻¹)	220	250	160	190
1st weeding relay (h ha ⁻¹)	100	90	140	120
2nd weeding relay (h ha ⁻¹)	290	230	230	220
Sum of 4 weedings (h ha ⁻¹)	760	720	670	670

Design: Chilulu, strip-plot with 5 (block) x 2 (land preparation) x 2 (fertilizer) = 20 sub-plots of 19.4 m² or 72 plants; Ngamani, split-plot with the same treatments and number and size of sub-plots.

Husbandry: ploughing Ngamani in February, Chilulu in April; planting on 24-25 April; spacing 90 x 90 cm², 3 plants stand⁻¹; cultivar etc. are as in table 5.23.



Photograph 5.10. Young plants of maize, itch grass and goat weed on unploughed land in Ngamani.



Photograph 5.11. Deterioration of the structure of the topsoil on ploughed land in Chitulu.

Although these experiments were not very convincing individually, all indicated that ploughing reduces the labour needed for weeding and increases the yields of maize. Weeds were visibly less numerous or more easily controlled on ploughed land. Ploughing reduced the number of *Ageratum* plants in Ngamani. In Chilulu farmers normally sever *Cyperus* plants just below the hard soil surface, but in the loose soil after ploughing the plants could be pulled out completely. As all treatments were weeded well, weed competition had little or no influence on the yield of maize. Therefore, other beneficial effects of ploughing must account for the increased maize yield. In the short rains of 1983 there was evidence of improved water availability. During the long rains of 1984 the rainfall was ample and well distributed (see table 5.4), so that better root growth and nutrient uptake may have been determining factors. In the longer term incorporating organic materials rather than burning them or leaving them exposed to the elements, may contribute to better crop growth. For Mijikenda farmers, ploughing not only has a more direct effect on maize yields, but also an indirect one, because it allows a larger area to be weeded in time.

There are indications that the effects of ploughing may last some time: in plots ploughed in November 1983 the maize yields and weeding efforts were still affected in 1984. Nothing is known about even longer-term consequences for aspects such as erosion hazard and weed population. In Ngamani the large and irregular clods left after ploughing may offer some protection against erosion. In Chilulu soil aggregates easily break down under the impact of rain, causing splash, sheet and gully erosion (photograph 5.11). At first ploughing usually reduces weed problems, as superficial seeds are buried and soil without seeds is brought to the surface. In the longer term that effect is lost, and the weed population may change.

In farmers' fields a positive effect of ploughing was often observed at the transition from one type of land preparation to another. Most farmers' asked agreed that ploughing increases maize yields and reduces weed problems, provided it is done properly. Some consider that the effects last more than one season, and that ploughing once per two years is a good and cheap alternative to ploughing every year.

8.5 Control of stalk borers

During the 1930s and 1950s agronomy research in Coast Province was focused on the fertility of the soil and the sustainability of production. In the course of the 1960s the emphasis shifted somewhat towards the study of harvest losses caused by stalk borers (Croix 1967; Mathez 1972; Scheltes 1978; Warui & Kuria 1983). Although the work concentrated on population dynamics, and the importance of a closed season and the destruction of crop residues were recognized, the extension service encouraged farmers to use chemical control. During my fieldwork period, the method of control shifted from DDT powder to trichlorophon granules, both applied in the whorl of young plants. Experiments and demonstrations in Magarini Settlement Scheme indeed showed that insecticide use boosted the maize yield, and farmers quickly showed interest in the use of DDT. The most effective chemical was carbo-

carbofuran, applied at planting, which in spite of its high cost proved profitable (Reeves *et al.* 1979ab; Islam *et al.* 1981).

My experiments in the Kaloleni area showed responses to carbofuran in Pingilikani and Kinarani (table 5.20). In Pingilikani little maize is grown and conditions are so variable that it is difficult to extrapolate the results. In Kinarani, with its year-round breeding of borers, the response was not surprising. In Ngamani, Mbuyuni and Chilulu the carbofuran had no effect on the yields of maize. In later trials only carbofuran proved effective; other insecticides had to be applied at exactly the right moment or several times to give adequate protection. In general, the effects of insecticides were variable and smaller than those of fertilizers. Sometimes there was an effect on symptoms of borer damage but not on grain yields (see also Mathez 1972). There were indications that a dose smaller than the 1-2 kg carbofuran ha⁻¹ applied might be as effective, and that when given at planting it was more efficient at 90 cm x 90 cm and 3 plants stand⁻¹ than with 90 cm x 30 cm and 1 plant stand⁻¹ (Vervoorn 1985).

The trials were very small and far from realistic as they aimed at the protection of individual plants instead of at reduction of the borer population. Nevertheless, they raised doubt about the "blanket" recommendation to control stalk borers by means of insecticides. Control should not be automatic, but based on proof or probability that borers are or will be present in sufficient numbers to cause appreciable damage to a crop that is worth to be protected. The economic injury level varies with the costs of protection, value of the harvest and ability of the crop to withstand damage (Mathez 1972; Seshu Reddy & Sum 1991). In spite of harbouring more borers, healthy and large plants produced more grain than smaller plants (table 5.25). That may explain why no correlations were found between the length of borer tunnels in the stalk or the amount of grains damaged and the yield of the plants (Vervoorn 1986b)

Table 5.25. Incidence of stalk borers in relation to fertilizer application and age and height of maize plants in an experiment in a farmer's field in Chilulu, Coast Province of Kenya, long rains 1984.

Months after planting	1		2		3		4	
	no	yes	no	yes	no	yes	no	yes
Fertilizer (50 N,20 P)								
Height of maize (cm)	8	12	38	71	135	149	129	155
Symptoms (% of plants)	6	22	4	10	14	28	20	32
Borers (# plant ⁻¹)	0.10	0.60	0.00	0.26	0.32	0.46	0.42	0.36
Grain (g plant ⁻¹)	-	-	-	-	-	-	59	91

The data are from the trial in section 8.6; 8 extra plots were laid out to monitor the borer incidence: 4 (block) x 2 (fertilizer) x 12 or 13 (plants plot⁻¹) x 4 (date) = ± 400 plants were sampled. All figures are means of 50 plants per date and treatment (Vervoorn 1986b).

Starting points for the control of stalk borers must be the history of the field and the variation in incidence through the year. At CARS, in Mtwapa, maize planted at the very start of the long rains proved least affected, as it took the borer population some time to build up after the dry season and, probably, the ploughing in of crop residues. Later in the year the incidence usually remained high although with large fluctuations (Warui & Kuria 1983).

A small experiment in the Kaloleni area showed a different picture (table 5.26). At all sites the first sown maize was infested most severely, probably by larvae from eggs laid by moths that had survived the dry season as larvae in diapause. *Chilo* spp. have a 27-57 day life cycle (Croix 1967), and therefore there may have been other peaks later which were not detected because the experiment did not last long enough. Borer infestation was least in Ngamani and greatest in Kinarani, which was the only site where the numbers of larvae exceeded the critical thresholds reported by Seshu Reddy & Sum (1991).

Table 5.26. Stalk borers found in maize plants at three sites in the Kaloleni area, Coast Province of Kenya, long rains of 1983 (number of larvae + pupae plant⁻¹).

Planting dates	Ngamani			Chilulu			Kinarani		
	22/4	06/5	20/5	21/4	05/5	19/5	25/4	09/5	23/5
Observation dates (DAP)									
14 - -	0.0	-	-	0.0	-	-	0.0	-	-
28 14 -	0.0	0.0	-	0.0	0.0	-	2.2	0.0	-
42 28 14	0.6	0.0	0.0	0.7	0.0	0.0	4.2	0.0	0.0
56 42 28	0.0	0.0	0.0	0.3	0.1	0.0	2.8	0.0	0.0
70 56 42	0.0	0.0	0.0	0.8	0.7	1.3	0.7	0.9	0.0
84 70 56	0.0	0.7	0.0	1.4	1.0	0.6	1.3	0.0	0.3
98 84 70	0.5	0.0	0.2	3.6	0.7	0.5	0.5	0.1	0.1
- 98 84	-	0.0	0.0	-	2.0	1.0	-	0.2	0.5
- - 98	-	-	0.4	-	-	1.1	-	-	1.1
Total number	1.1	0.7	0.6	6.8	4.5	4.5	9.7	1.2	2.0
Larvae in crop residues ± 6 MAP	0.1	0.7	0.2	0.2	0.1	0.2	0.2	0.7	0.2
Rainfall during 0-3 MAP (mm)	846	712	533	663	685	557	517	508	316
Grain yield (g plant ⁻¹)	65	49	10	19	28	12	23	12	7
Ears with borer symptoms (%)	5	2	21	52	22	43	42	48	50
Ears with rot symptoms (%)	19	28	42	9	14	23	10	29	53

Explanation: days and months after planting (DAP and MAP). **Design:** per site 3 plots of 150 nett plants were planted with 2 weeks intervals; from each plot every 2 weeks 10 plants were taken and dissected. **Husbandry:** cultivar "Coast Composite"; 90 cm x 30 cm, 1 plant stand⁻¹; no fertilizer, no pesticides, weeded with the local hoe (Verwoorn 1985).

Two months after the experiment had been harvested the maize stalks left in the field were sampled. At all sites these contained stalk borer larvae that had gone in diapause (table 5.26). Samples taken at another site in Chilulu showed that such larvae can survive for considerable periods, provided they do not fall victim to termites eating the dry maize stalks (table 5.27).

Table 5.27. Stalk borers in maize stalks left in farmers' fields in Chilulu, Coast Province of Kenya, February 1984 (Verwoorn 1986b).

Origin of the stalks (1983)	Maize stalks (#)	Borer larvae (#)	Stalks with termites (#)	Stalks with termites and borer larvae (#)
Long rains	15	0	13	0
Short rains	72	32	54	9
Short rains	53	14	13	7

What are the implications of this research on stalk borers for maize planting strategies? Where only a few larvae survive the closed season and drought, termites and the burning or ploughing in of crop residues, farmers should plant as quickly as possible after the onset of the rains. When large quantities of maize stalks and borers are left in the field, postponing planting for some weeks may help to avoid the first "wave" of larvae. However, maize planted late is likely to suffer more from weed competition, leaching of nutrients, or an early end of the rains. No specific studies on planting dates were done, but in the experiment described late maize did indeed have lower yields which showed some correlation with decreasing rainfall (table 5.26). The reason for the increase in ear rot is unclear; there was no correlation with borer damage or rainfall during ripening.

In general, farmers should plant as soon as the rains allow and in large areas, in order to "dilute" the borer population sufficiently. Planting small areas out of season is asking for trouble, as illustrated by an experiment I planted in July 1984 in Mbuyuni. The farmers' maize was maturing and all moths seem to have converged on the trial plot, and their offspring left the maize riddled with holes (photograph 5.12).

As most Mijikenda farmers do indeed plant the bulk of their maize at the onset of the long rains, when the borer incidence is at its lowest level, additional control measures are usually not required. Before turning to expensive and dangerous chemicals, it should be evaluated on a per field basis if these indeed are the best way to spend money.

"...maize is unlikely to succeed in Coast Province as a cash crop and if it is grown for local consumption, any money available must be used for weeding and the purchase of fertilizers. ... The stalk borer is the last adverse factor." (Mathez 1972: 267, 288)



Photograph 5.12. Stalk borer damage in a small trial plot of maize grown out of season in Mbuyuni.

8.6 Farmers' choices

The quotation at the end of section 8.5 points to the importance of making decisions. Most experiments described so far have focused on one or two factors. The experiment discussed in this section considered several at once: the benefits to be expected from improved fertility (N+P fertilizer), reduced weed competition (weeding once or twice), and pest control (carbofuran). Its results are summarized in table 5.28 and presented in detail in *Vervoorn (1986b)*. All effects were statistically significant and there were no interactions, and therefore the grain yield increases can be averaged over all levels of the other factors.

Weeding was the cheapest of the factors considered: doing it twice meant only 3 extra hours of work ha^{-1} and gave a yield increase of 900 kg ha^{-1} . The possible gain of weeding only once was offset by the dense weed cover caused by weeding later. If all weeding was done with hired labour it would cost about $\text{Ksh } 800 \text{ ha}^{-1}$.

N+P fertilizer gave the largest yield increase: $1,700 \text{ kg ha}^{-1}$ at a total cost of $\text{Ksh } 1,100 \text{ ha}^{-1}$ (extra labour valued in cash). Even at the lowest price of maize that would mean more than 200 % profit. As fertilizers have to be bought in Kaloleni or Mombasa and transported to the homestead and later to the field, the real costs are somewhat higher than those given in table 5.28.

Pest control was the most expensive factor, and gave the smallest yield increase: 800 kg ha⁻¹ for Ksh 1500 ha⁻¹ (extra labour valued in cash). Part of the effect may have been due to control of armyworms, a benefit that in most years is not required. On the other hand, the armyworm attack may have reduced the stalk borer infestation. The second carbofuran gift, in the whorl, caused some slight symptoms of phytotoxicity.

Table 5.28. The effects of weed control, N+P fertilizer and pest control on the costs and yields of maize grown in Chilulu, Coast Province of Kenya, long rains of 1984.

Combinations of treatments			Extra costs and returns		
Weeding (WAP)	N + P (kg ha ⁻¹)	Carbofuran (kg ha ⁻¹)	Extra work (h ha ⁻¹)	Extra cash (Ksh ha ⁻¹)	Grain yield (kg ha ⁻¹)
5	0 + 0	0 + 0	270	0	400
5	0 + 0	1 + 1	300	1400	1100
5	50 + 20	0 + 0	310	1000	2000
5	50 + 20	1 + 1	340	2400	3100
2 + 6	0 + 0	0 + 0	270	0	1400
2 + 6	0 + 0	1 + 1	300	1400	2100
2 + 6	50 + 20	0 + 0	310	1000	3000
2 + 6	50 + 20	1 + 1	340	2400	3700

Design: factorial with 5 (block) x 2 (weeding) x 2 (fertilizer) x 2 (carbofuran) = 40 plots of 48 plants or 13.0 m² (+ 8 plots for stalk borer studies). **Husbandry:** land preparation with hoe; "Mdzihana" maize, planted 20 April 1984, spacing 90 cm x 90 cm, 3 plants stand⁻¹; weeding with hoe; P at 0, N at 0, 4 and 8, carbofuran at 0 and 4 WAP (weeks after planting) (Vervoorn 1986b). Extra labour refers to that above land preparation, planting and harvesting; extra cash is above the cost of e.g. seeds (few farmers use cash inputs). Approx. prices in 1984: labour Ksh 3 h⁻¹; CAN (26 % N) Ksh 135 per 50 kg; TSP (20 % P) Ksh 220 per 50 kg; Furadan 5G Ksh 36 kg⁻¹; maize Ksh 2-4 kg⁻¹ (Ksh 1.00 ≈ US\$ 0.10). Prices do not include transport or time lost.

The experiment was intended to give an idea of the magnitude of the benefits to be obtained from improved weed control, soil fertility and pest control. It should not be used for cost/benefit analyses and recommendations to farmers. The factors studied might have been cheaper or applied more efficiently, for example, by weeding once but early, using other N+P rates or proportions, reducing the amount of carbofuran, or omitting its second application. The weather during the experiment was favourable, and the benefits may not always be that large. Moreover, the experiment was conducted at one site only, with a specific combination of soil fertility and weed and pest population.

On the other hand the results agree well with those of other experiments, most of which showed stronger and more consistent responses to fertilizers than to pesticides. They also correspond with the practices of local farmers, who spend their money on hired labour rather than on chemical inputs. Therefore, it seems clear what the farmers should do: weed well at all costs. In practice, decisions are not that easy. Most farmers do not have enough farm

labour to weed all maize in time. Farmers that do not have money to hire labour, face a choice of weeding their own maize and going hungry now or weeding for a neighbour and going hungry later. Those who do have money may think twice before spending it on a crop that might be lost later in the season because of drought, instead of using it for safer investments or to buy food.

9 DISCUSSION

Methodological questions

The information was obtained from published sources, interviews, observations and experiments. The benefits and drawbacks of these methods will be commented on briefly. For a more thorough treatment of on-farm research methodologies, see Mutsaers & Walker (1991).

The **published sources** were especially helpful for the reconstruction of the historical context. The review articles of Humphrey (1938) and Grimes & Clarke (1962) led to a search in the Kenya National Archives, and through old reports of the Department of Agriculture. The focus in these documents, on food security and ecological sustainability, has lost none of its topicality. Future work on these themes should not overlook the treasures hidden in these old papers and but partly explored in the present study.

Most **interviews**, especially at the start of the field work, were of the structured and formal type. The interviewees answered lists of questions, which left them little room for open ended discussion of their own views. Topics and formats were based on preconceived ideas, gradually complemented by knowledge of the area. In later phases informal talks contributed to a better understanding of the views and practices of the farmers.

The **observations** in farmers' fields were aimed to study reality with a minimum of disturbance. Once mutual confidence had been established work could proceed efficiently without inconveniencing the farmers. Major diagnostic problems were the variation and confounding of factors, which can be solved only partly and at high cost by increasing the sizes of samples. Farmers' fields are good places for inspiring researchers with ideas and raising questions, but often less suitable for supplying answers. The latter should not deter researchers from getting acquainted with conditions in farmers fields (Edwards 1987).

Researcher managed **experiments** enabled variability to be reduced, confounding to be excluded and new factors to be introduced, partly at the cost of their representativeness of farmers' conditions. For example, most experiments received better than average care (e.g. more uniform spacing and timely weeding). Nevertheless, in most cases the yields of control treatments were similar to those obtained by farmers. An advantage of researcher management is that it is often easier to borrow a few small plots than to organize full farmer

participation. However, the researcher must allocate plenty of time for discussing the experiments with farmers.

Lessons from history

From the start of this century until today officials have claimed that the Mijikenda have not learnt from history but have stubbornly clung to inappropriate crops and practices. Yet the historical record shows the opposite, as evidenced by the enthusiastic adoption of maize, its numerous cultivars and the interest in tractor ploughing. The Mijikenda have always been receptive to changes.

On the other hand, the failed attempts to reintroduce **sorghum** proceeded from a stubborn belief in its potential. There are indeed sites -- e.g. on the poor soils of Pingilikani or on the dry sands of Kinarani -- where sorghum could outperform maize. However, the crop has been ineptly promoted: plans or cultivars were developed in offices or up country and were expected to trickle down from Katumani via Mtwapa to farmers who, with few exceptions, are not convinced that they need them. Although breeding and introduction programmes cannot be based on the whims of each and every farmer, it would be worthwhile to investigate why sorghum never got through.

The Department of Agriculture's discouragement of **maize** as a cash crop is justifiable. Surpluses were only generated by burning forests or woodlands and by depleting the accumulated soil fertility. However, it is hard to blame farmers who were faced with demands for taxes, clothes or schooling and had only a few alternatives. The landscape they left is no paradise, but it could have been much worse.

Any *ex post* analysis of historical processes is somewhat unfair to the actors involved in them, as with hindsight it is easier to see what went wrong. It is much more difficult starting from the present to indicate in which direction and how Mijikenda agriculture could develop further.

Falling food production

Mijikenda **food production** is not meeting Mijikenda needs. Even in years with good rainfall few farmers manage to grow all the maize they want. The areas and yields of rice and cow-pea are too small or variable to compensate for the shortages. Cassava is not popular with most Mijikenda, although they wisely appreciate its reliability. So much of the cash income from tree crops or off-farm work is diverted to buying food that little is left for "luxuries" like clothes and still less for investment in farming. Mijikenda farmers by necessity are mining the base of their existence.

As a result of rapid population growth there is less **farm land** per capita and it has decreased in quality. Whereas some old people still remember throwing away or burning old maize stocks at the harvest of the new crop, most children have never seen a full store. In several areas there are fields which are so exhausted that even assuming an almost zero opportunity cost of (female) labour it makes no sense to waste valuable maize seeds. Therefore, these fields lie under an indefinite fallow of thin and patchy grasses or herbs, with little hope of improvement.

The degree of **self-sufficiency** varies between villages and seasons, and not all cases of deficient maize production should be seen as problems. Some households have an adequate income from employment or from the sale of palm wine, coconuts, fruits, milk or other farm products. In such cases there is little incentive to do the strenuous work required for producing a little maize. If people could be sure about the supply of maize in the shops, maybe many would give up growing the crop. However, most households have little choice.

Factors limiting yield

When asked what factors limit the yields of maize, Mijikenda farmers usually first answered with "**rainfall**". They considered it "*Shauri ya Mungu*" (Act of God), and as such, beyond human control. In this study the question of rainfall received little explicit attention; a thorough analysis of its effects would require long-term observations and detailed information on soil properties and crop husbandry. The maize yields in surveys and experiments showed seasonal differences in the order of a factor of two or three. Historical rainfall records suggest that the variation could have been even larger. Precipitation itself is indeed beyond the farmers' control, but appropriate water and crop management would enable losses to be limited in poor seasons and high yields to be obtained in better ones.

When questioned further, farmers would mention **low returns** to land or labour: whereas in the past a small field gave high yields with little work, people now have to work long days for a small harvest. In fact, it is questionable whether farmers would still grow maize if female labour were not considered to be so cheap or if they had any alternative use for their land. The main factors behind this low productivity are the decline of soil fertility, the occurrence of weeds and the incidence of pests or diseases. These in turn are the result of overexploitation of the land.

As for **soil fertility**, in all experiments there were responses to fertilizer application, although the value/cost ratios were often too low to make it worthwhile. Trials with tractor ploughing indicated that the physical characteristics of the soils were also limiting and can be improved. Abundant **weed growth** and frequent rain mean that weeding requires much more labour than most households can mobilize. Relatively rich farmers can overcome the bottleneck by hiring their poorer neighbours. Of the **pests and diseases** stalk borers appear to have received more attention in research and extension programmes than they deserve, at the expense of pod borers in cowpea or pigeon pea and wilt in bambara nut.

Improved techniques

This study has not yielded ready-made solutions or techniques to help the Mijikenda. It can, however, give some clues about how these can be found and what they should look like. Any work aiming at improving Mijikenda agronomy must proceed from a **systems approach**. This does not necessarily imply complicated diagrams, flow charts or simulation studies. It just means that the connections between problems or solutions must be taken into account. For example, better weeding without paying simultaneous attention to soil fertility would further deplete the already poor soils, as every extra ton of grain removes another 20 kg of N and 4 kg of P (Geus 1973). By limiting yields weeds prevent depletion of the soils. They produce organic matter, recycle nutrients, and protect the soil from the impact of sun, wind or rain. When fallows are short or nonexistent, weeds far from a problem are also a major buffering element of the cropping system. Other examples are the relation between stalk borer control and destruction of organic material or between maize density and the growth of relay crops.

Most agricultural research in Coast Province has lacked a **systems view**. It has been oriented on discrete elements of cropping systems without a clear picture of what these would add up to or what the total system should be like. This has a certain danger, as piecemeal improvements may interact positively or negatively and cannot be added up indefinitely, because a ceiling is imposed by a factor that has not been considered. An implicit basis of the research done to date appears to be the "maize diamond" (Allan 1968). This model, based on research in West Kenya, proceeds from a positive interaction between hybrid seeds and good husbandry. The latter is supposed to include early planting, manuring or fertilizing, timely weeding and stalk borer control. Champions of such a perfectionist model, which certainly has its benefits, tend to find it difficult to answer questions of the kind: what to do when I can plant 1.0 ha, have money for 0.3 ha fertilizer or 0.8 ha pesticide, and labour to weed 0.6 ha?

In maize growing many problems and solutions are **site-specific** and it is difficult to extrapolate e.g. fertilizer rates or plant densities from one site to another. So far, most research has been conducted on government research stations in or near the coastal strip, notably Kibarani, Matuga and Mtwapa, whose soil types and rainfall are not representative of most maize production areas. The trials of the Fertilizer Use Recommendation Project (FURP) are an important step in the right direction, but they are restricted by their focus on soil fertility (Smaling & Weg 1990; Smaling *et al.* 1992). Within the Kaloleni area a distinction should be made between maize plus cowpea or rice in Ngamani, maize under or between coconut palms in Mbuyuni or Chilulu, and staggered planting of maize and cowpea in Kinarani.

Improved maize cropping systems for the Mijikenda area should build upon existing practices and be of the **multi-species** type. Among the options that deserve attention are relay cropping of maize and pulses and locally intercropping of maize and rice. Another avenue to be explored is intercropping of perennial and annual crops, e.g. maize, cassava and banana under widely spaced coconut palms with or without auxiliary species. Alley cropping has

already shown promise, but the system might be improved by including indigenous species or by adapting the layout to the topography and cropping patterns in Mijikenda fields. Multi-species systems can make a more efficient use of space, water and nutrients than short-lived sole crops or incidental mixtures of crops. So far, little experimental work has been done on systems with more than two species, but there are indications that the Land Equivalent Ratio (LER) increases with the number of crops grown together (Steiner 1984).

Finally, the **response farming** approach, which is usually associated with adapting to rainy season characteristics (Humphrey 1939a; Stewart 1988) deserves mention. The term could be given a wider meaning and so refer to any modification of cropping practices to changes in conditions. Present research and extension approaches are based on few and inflexible standard messages or packages, instead of communicating with farmers in terms of "if ..., then ...". For example: "if you plough your land and plant early, don't waste money on insecticides". In that way researchers, extensionists and farmers would be stimulated to reflect and communicate.

Alternative strategies

The **basic question** facing the Mijikenda is whether they should produce maize (or sorghum) for cash or food, or invest in other alternatives and leave the food crops to more suitable areas inside or outside Kenya. Elsewhere in Kenya the maize yields and responses to inputs are far higher, so it is not macro-economically justifiable for the Mijikenda to grow maize as a cash crop (Mathez 1972). Yet maize remains the favourite for home consumption and its supply in the shops is felt to be unreliable. For these reasons and as long as there is no better employment for especially female labour, Mijikenda farmers will continue to grow maize.

A large part of the Kenyan government's support to maize production has been channelled into the selection and breeding of **maize cultivars**, so far with little result. There are no indications that at the present and even at higher yield levels, the genetic potential of local cultivars is a major limiting factor. In my own trials with "*Mdzihana*" yields of up to 4,000 kg ha⁻¹ were obtained, and in comparisons made at CARS improved materials failed to surpass local maize (CARS 1979-1983). Moreover, it may be doubted whether the 50,000 ha of maize in Coast Province warrant expenditure on breeding, unless the material is also adapted to conditions elsewhere, like on the Tanzanian or Mozambique coast. It might be much cheaper and more effective to import seeds from elsewhere and, after some screening, let farmers choose for themselves.

More attention should be paid to **pulse crops** like cowpea, pigeon pea or bambara nut. These can contribute to soil fertility, improve the local diet and provide surpluses for sale. The government regularly exhorts Mijikenda farmers to diversify their food production. They could make a practical contribution by facilitating the preservation and multiplication of local cultivars of minor crops, like cowpea or bambara. Seeds cannot be kept long under the

them and by harvesting new ones. After each crop failure many people are left without seeds, which implies genetic erosion and crop areas even smaller than necessitated by other limitations (KNA 1944).

As for **decision making**, more room for manoeuvre might be left for the farmers themselves. Exhortations to modernize farming and assume responsibility for local development are incompatible with outdated attempts to regulate farming to the point of forbidding the profitable sale of green maize ears (Sauti 1984b; Nation 1985).

Breathing space

Although its green coconut palms make it look like a paradise compared with the drought-stricken plains of most of Kenya, the Mijikenda area is not an easy area for maize production. It may be difficult or impossible to improve food production on a sustainable basis. The rapidly increasing population and deteriorating resources do not give reason for optimism. Nevertheless, this paper has shown that there is still considerable elasticity in ecological and human resources. That may not be enough to turn the Mijikenda area into a bread basket, but sufficient to give some breathing space in order to find a lasting solution.

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6 The coconut palm in Coast Province of Kenya:
tree of life and bone of contention

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1 INTRODUCTION

Mijikenda people

The Mijikenda (derived from *makaya* or *miji chenda*; nine towns or villages) are a Bantu people numbering about one million persons and consisting of nine tribes. These are, proceeding northwards: Digo, Duruma, Rabai, Ribe, Kambe, Jibana, Chonyi, Giriama and Kauma. They live in the hinterland of the southern Kenya Coast, from the Tanzania border to half way between Malindi and Tana river. The area they live in roughly coincides with Kwale and Kilifi Districts of the Coast Province of Kenya (figure 6.1).

According to their own saying, they settled there several centuries ago. Until the 19th century they lived in nine *makaya* (singular *kaya*), fortified villages on densely wooded hill-tops of the coastal uplands and plateaus (figure 6.1). They grew sorghum, millets and cowpea, kept some cattle or goats, and traded agricultural surpluses, forest products and ivory with their neighbours in the coastal strip and the interior of the country.

In the course of the 19th century the Mijikenda left the protection of their *makaya* and spread over surrounding countryside. Most of them still live in the uplands and plateaus, but large numbers have migrated towards the coast. Nowadays they live in dispersed homesteads, on small farms of mostly less than 5 ha. They grow maize, rice, cassava and cowpea, and harvest the nuts of semi-wild cashew trees. A few households own cattle, most keep goats or sheep, and nearly all have one or more members working off-farm.

However, the most conspicuous feature of Mijikenda agriculture is the coconut palm, which covers nearly every suitable square metre of their land. It is hard to imagine the Mijikenda economy and landscape without the omnipresent coconut palm. Looking out over the vast undulating seas of waving green fronds one is tempted to believe that the palms have always been there. However, less than two centuries ago the coconut palm was still a rare occurrence in the Mijikenda area.

Tree of life

In spite of its recent introduction the coconut palm exercises a decisive influence on the world of most Mijikenda. Its presence has not only transformed the look of the landscape and led to concentrations in the population distribution, but has also changed land tenure and use, and influenced the social and economic relations between the people. The affection the Mijikenda feel for the coconut palm is reflected in reluctance to cut down their "tree of life".

"The destruction of a cocoa-nut tree is regarded as equivalent to matricide, because that tree gives them life and nourishment, as a mother does her child." (Krapf 1860: 198)

Bone of contention

The coconut palm is not only a focal point in the life world of the Mijikenda themselves, but also plays a role in the often negative views of outsiders about the culture and agriculture of the Mijikenda and other peoples of the Kenya coast.

"... there was a joke about Coast Province people lying under their coconut trees and waiting for the nuts to drop so that they could sell them." (Andere 1983)

Many jokes -- and recriminations -- focus on the moral and economic consequences of the production, trade and use of the wine extracted from the inflorescences of the palm. The Kenya government, from the early colonial time until today, would rather have seen the flowers develop into nuts for the production of copra. The choice between copra and palm wine has for long embittered discussions about the development of Mijikenda agriculture.

"But at the Kenya Coast we still have a potential if people will turn to bottled beer instead of imbibing what was meant by Providence to make a lovely bunch of coconuts." (Rodwell 1973: 112)

Farmers' choices

This paper describes the short and intensive relation of the coconut palm and the Mijikenda. It discusses how the palm was introduced, what roles -- from ritual to economic -- it plays in their lives, how this affects their relations with others, the ways the valuable crop is grown, and the changing uses of its various products. The paper is about coconut palms, but it focuses on the choices faced by the Mijikenda farmer. He had to find out which nuts to choose, where to plant them, how to care for the palms, which ones to tap, how to use or sell the products, and how to deal with people who would like him to make different decisions.

On the one hand, this paper presents a unique case. The same historically determined mix of soils, climates, peoples, animals and plants is not found elsewhere. On the other hand, the themes are universal. The study deals with the introduction of a new crop in a marginal area and discusses the encounter of local people and their alternatives with development views and practices that are not their own.

The paper starts with the historical, social and economic aspects of the introduction of the coconut palm. Then the ecological conditions, cultivation practices and crop characteristics are described. Finally, the multiple products of the palm are discussed, with emphasis on the conflicting choices between palm wine, dry copra or fresh nuts.

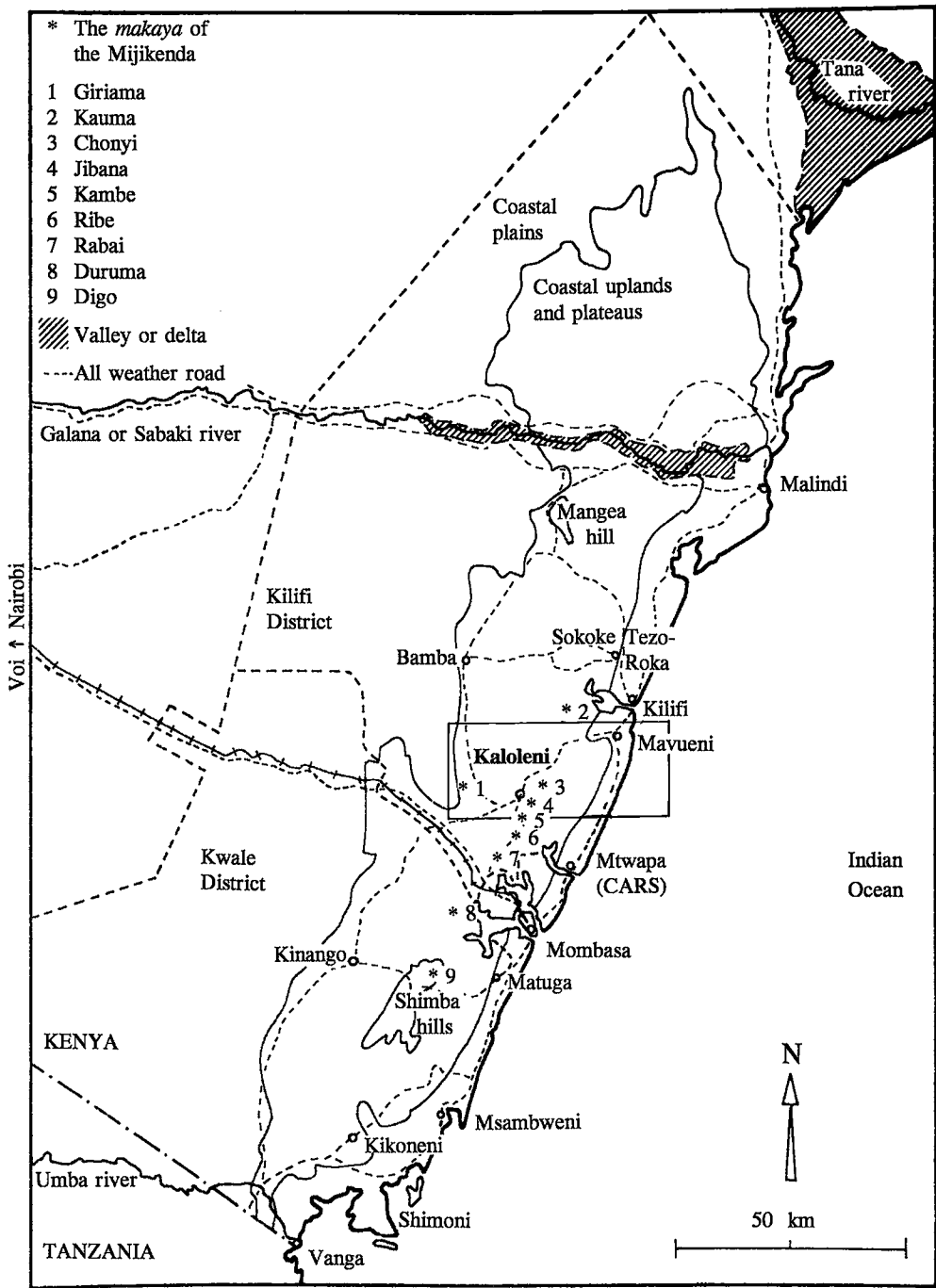


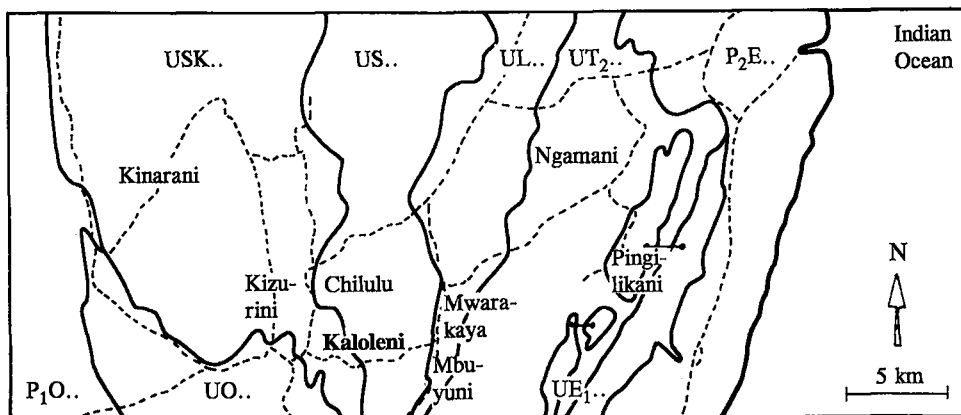
Figure 6.1. Geography of the southern Kenya coast.

2 METHODOLOGY

This paper presents a part of a study carried out between 1981 and 1985 on the farming and cropping systems of the Mijikenda of Kenya; it formed part of a larger soil mapping and land evaluation project in the southeastern part of Kilifi District (Boxem *et al.* 1987). The study integrates information from several sources, including literature review, questionnaire interviews, and field experiments and observations.

The review of literature included archival sources, reports by government officials, academic studies, reports by students of the above project, and newspaper articles. The latter are often suspected of being less accurate and none too truthful, but they have the advantage of covering topics that more respectable media tend to avoid. References to reports of students I supervised and to interviews by myself or assistants are given in italics.

Most general information on Mijikenda farming and cropping systems was collected by means of structured baseline interviews carried out in November and December 1981 on a total of 131 farms in the villages Pingilikani, Mbuyuni, Chilulu and Kinarani of Kaloleni Division of Kilifi District (figure 6.2). In July and August 1983 a subsample of in total 31 coconut growers in the above villages was interviewed for more specific information on the management of coconut plantations and on the use of the products of the palm. As I had only a limited grasp of Swahili and of the various Mijikenda dialects, most interviews were carried out by or with assistance of Giriama interpreters.



--- All weather road or track

Figure 6.2. Soil units and villages in the Kaloleni area, Coast Province of Kenya (see section 6.1).

The production of maize under coconut palms was studied by means of **experiments** and quantitative observations in farmers' fields in the villages Mbuyuni, Chilulu and Kizurini. These studies were carried out during the short rains of 1982 and the long rains of 1983 and focused on maize growth and yield and on the characteristics of the roots, trunks, leaves and inflorescences of the palms.

The data collected by means of formal methods were complemented by open and informal interviews on the history of farming and on the views and practices of the farmers, and by my observation of and partitioning in their daily life during the years I worked and lived in Kaloleni. From the above it is evident that most field data were collected in and refer to Kilifi District, and in particular to the area around Kaloleni. This might colour the following story somewhat. However, from the literature review and from conversations with farmers and officials, it is clear that most of the findings apply to other coconut growing areas of Coast Province as well.

3 HISTORICAL CONTEXT

The coconut palm arrived in East Africa long ago; the first century sailors' handbook "Periplus of the Erythraean sea" already recorded the export of coconut oil (Freeman-Grenville 1962). When in 1498 the Portuguese arrived, most coastal towns had large coconut palm groves which were apparently of considerable economic interest, as cutting them down often formed part of Portuguese tactics to force the towns to surrender (Strandes 1899).

The Digo, who lived near the coast south of Mombasa, were probably the first Mijikenda to grow coconut palms, sometime in the 17th century. About a century later the Rabai started to plant them, and in the mid 19th century they were observed in most *makaya* (Krapf 1860; New 1873; Herlehy 1985). As the first palms were planted around the houses, the *makaya* nowadays are still recognizable from the air as rings of palms in the forest.

Given the short distances between most *makaya* and the coast and the liking of the Mijikenda for palm wine one would have expected a more rapid introduction, from east to west. The above described spread of the cultivation from south to north (which was not necessarily that of the planting material used) may be explained by the following factors:

- The Digo had intimate social links with the Vumba, who lived between Shimoni and Vanga (McKay 1975; Herlehy 1984b).
- The elders of the Rabai restricted the distribution of planting materials, and it is likely that other groups also tried to monopolize the valuable palms (Herlehy 1984b).

- From Mombasa to Kilifi the Mijikenda were separated from the coast by a belt of heavy cracking clay soils, which could have acted as a barrier for the spread of coconut palm cultivation.

When the Mijikenda left their *makaya* the cultivation of the coconut palm spread over the surrounding landscape. Until the 20th century the Rabai, and to a lesser extent the Ribe, remained the main coconut growers and producers of palm wine. The other tribes had smaller numbers of palms. They continued to go to Rabai for buying palm wine, and for their own palms many people employed experienced tappers from Rabai (Herlehy 1984b, 1985; *Wakanyoe 1984*). Indeed, Rabai was most suitable for coconut growing and palm wine production. The area has well drained soils and relatively favourable rainfall and was situated near the main trade routes between the Duruma, Taita and Kamba on one side and Mombasa on the other.

The Duruma and Giriama, living in relatively dry areas, were the last to plant palms on a large scale (Herlehy 1984b, 1985). In the first half of the 20th century several Giriama, in reversal of the 19th century expansion from their *makaya*, moved back southwards from the land near Sabaki river to the wetter area around Kaloleni where coconut palms could be grown (Parkin 1972). Elsewhere similar redistributions of the population took place: many Duruma moved from the dry lands in the Kinango area to wetter places like Kikoneni (MENR 1985). Large numbers of farmers from all the Mijikenda tribes moved into the coastal strip, to tap or harvest the palms planted there by Arabs and Swahili, or to plant their own (Cooper 1981; Herlehy 1985).

Although the Mijikenda also consumed fresh nuts, and farmers near Mombasa sold copra, the tapping (*kugema*) of palm wine (*uchi*, *pombe* or *tembo ya mnazi*) was for long the most popular and important use of the palm:

"The liquor is a favourite beverage with the Wanika [Mijikenda]; many of them almost live upon it." (New 1873: 85)

Palm wine was used in nearly all social and ritual affairs, when receiving guests, during initiation ceremonies, for paying bridewealth, in funerals, and as offer to the spirits of the dead. Palm wine was also a popular drink and became an important cash earner.

The planting of coconut palms was stimulated by the wish to cope with an increasing demand for palm wine and a growing need for cash income. However, palm wine production alone cannot explain the 20th century increase in the numbers of palms. The area under coconut in Coast Province was estimated at 35,000 ha (Ouko 1982). Assuming 60-100 palms per ha, this corresponds to 2.1-3.5 million palms; more than half in Kilifi and of the rest most in Kwale and Mombasa districts. In ecologically suitable areas the average is more than one hundred per farm (table 6.1). For home use a few palms per household are enough and production for the market is limited by the 20 palms a tapper can handle at any given time, plus some reserve, as palms cannot be tapped continuously (Hobley *et al.* 1914). Indeed,

before the prohibition of tapping in 1981 only a small proportion of all palms was tapped: 2 % in Kwale, 8 % in Kilifi and 20 % in Mombasa district (Hendrickx 1981). The principal other products of the coconut palm were fresh nuts and copra, with lower yields and gross margins per palm than palm wine, but with the advantage that a single man can handle many more palms.

Table 6.1 shows that the planting is still going on. Of the 31 coconut growers interviewed 28 intended to plant more palms, although in Chilulu and Mbuyuni land is becoming very scarce, the soils in Pingilikani are not very suitable, and the rainfall in Kinarani is quite low. The farmers said that they see the planting of palms as a form of investment -- building up "treasure" for themselves and their children -- and as an insurance for future financial problems.

The planting of coconut palms completely changed the appearance of the landscape. In the area around Kaloleni, for example, extensive grazing, bush fallow and annual crops gave way to a nearly continuous palm forest with only a few open spaces (Parkin 1972). In fact, in all densely populated areas of Kwale and Kilifi Districts palms determine the land use; they were planted wherever the soils, rainfall and land tenure permitted. Only the remaining space was available for other crops and grazing.

Table 6.1. Coconut palms in four villages in the Kaloleni area, Coast Province of Kenya, 1981.

	Pingilikani	Mbuyuni	Chilulu	Kinarani
Farms in sample*	31	37	32	31
Palms of bearing age				
Presence (% of farms)	77	89	91	77
Mean (palms farm ⁻¹)	48	113	184	38
Median (palms farm ⁻¹)	19	40	90	25
Total (palms sample ⁻¹)	1158	3719	5343	832
Palms not yet bearing				
Presence (% of farms)	45	59	69	74
Mean (palms farm ⁻¹)	21	31	25	19
Median (palms farm ⁻¹)	20	20	20	15
Total (palms sample ⁻¹)	292	676	545	371

Random samples in four selected villages; means and medians refer to the farms with coconut palms. In a stratified random sample of 78 small farms in the coastal strip 71 % had coconut palms; on average 80 of bearing age and 77 younger ones per farm; many farms were recently established (Lieshout & Straver 1984). In a small and not representative sample of 11 farms in Tezo Roka (north of Kilifi) much higher numbers per farm were counted (Bijnatten et al. 1977).

4 SOCIAL FUNCTIONS

In spite of their relatively recent introduction, coconut palms and palm wine have obtained an important role in defining and expressing social and ritual differences and relations. In African societies these include both horizontal relations between the living and vertical relations with the already dead and those still to be born (Mbiti 1969). The following sample of events in the course of life and death of Mijikenda people illustrates this. Some practices are still very much alive, others have lost all or part of their strength due to the influence of Islam, Christianity or modernity.

It was common practice to plant a coconut palm or another tree at the birth of a Mijikenda child (*Kombe* 1985; Herlehy 1985). When a Duruma girl was born her father would say that he had "got palm wine" referring to the palm wine he was going to receive at her marriage (Griffiths 1935: 268). Marriage negotiations were opened by sending a gift of palm wine, which also formed an important part of the bridewealth. By giving palm wine to his father-in-law the husband obtained the right to sue other men for adultery with his wife, and he established his rights over the children born during the marriage (Barrett 1911; Champion 1914a; Griffiths 1935; Ngala 1949).

"Drunkenness ... may be regarded as the special privilege of the older men." (New 1873: 96).

Long ago, when coconut palms still were scarce in Chonyi, young boys were sent to Rabai to collect palm wine for their fathers. After returning they were not allowed to drink it, but were even sent away from the place where elder people were drinking (*Wakanyoe* 1984). In the past the drinking of *uchi ufuu* (fermented palm wine) was restricted to elder men; *uchi utsii* (fresh, sweet palm wine) was consumed by women and children (Herlehy 1985). During the 20th century the drinking of fermented palm wine by women and young men became more common, the first usually drinking inconspicuously in the houses, the latter among themselves or with the elder men.

Among elders their rights to consume palm wine reflected their status, which was based on age and wealth. The grades or ranks of Digo elders were expressed in terms of increasing rights to use palm wine (Kayamba 1947). At present, status is determined less by age and numbers of cattle, and more by numbers of palm trees, cash income and education. However, status still forms the guiding principle in the order in which in drinking groups the *mboko* (calabash cup) is passed, and usually the palm wine is served by a junior member of the group. The Mijikenda way of drinking expresses both social distinction (the order in which the cup is passed) and group unity (all drink from the same cup and use the same straw). Palm wine was not drunk during working parties, unlike local wines and beers elsewhere in Kenya and Africa (Platt 1955). The difference may be related to the age and status of the original users, which permitted them to dedicate themselves to the pursuit of leisure.

Young people seeking the advice of elder men used to carry a *kadzama* (large calabash) of palm wine to put the elders in the right kind of mood. Over time, *kadzama* became the word for a present (Herlehy 1985). Young researchers interviewing old people may be asked for a *kadzama* (Salim 1985).

Status crosses the boundary between life and death. Lavish amounts of palm wine and food served during funeral and mourning ceremonies like *matanga* and *msiba* (Standard 1982c) augment the standing of the deceased and his family. Often coconut palms are planted on or near graves. These are seen as homes for the *koma* (spirit of the deceased). In periods of drought, illness and other distress, offerings of wine may be made at these palms or at the *vigango* or *koma* (small statues representing the deceased). Before people start drinking a small libation is poured on the ground.

The diverse links between men and palms explain why many Mijikenda are unwilling to cut coconut palms, even unproductive ones. For some people, these sentiments are very strong and the palms nearly sacred; they are regarded -- like mankind -- as the offspring of the union between earth and sky (Johnstone 1902). Others do not cut palms out of respect for their being planted by living or deceased relatives.

Outsiders tend to see the refusal to cut unproductive palms as irrational behaviour. However, the apology below shows that, although based on a particular way of looking at reality, this behaviour may stem from quite rational thinking:

"If a wife does not give children, do you have to kill her? No, but you marry a second wife. Likewise unproductive trees are replaced by planting new ones next to them, not by cutting them down. Moreover, lack of production may also be due to lack of rain or to invisible soil effects. So cutting down and replacing often does not solve the problem." (remark by a son of Wakanyoe 1984)

The second half of the apology tries to link up with the outsiders' approach to reality. It appears that the cutting of coconut palms is no longer unthinkable, but is becoming an accepted practice: of 31 coconut growers asked if they did cut palms, 8 answered "no" (custom, social pressure), 9 "yes" (pest control, building materials) and 14 "not yet" (young palms, not specified). The change may have to do with the increasing scarcity of land, as most of the farmers answering "yes" lived in the densely populated Mbuyuni and Chilulu areas, where there is little space to plant new palms next to old ones.

5 ECONOMIC IMPORTANCE

5.1 Stable yields

It would be wrong to conclude that palms have mainly ritual, social or sentimental value. The fact that they obtained this value so quickly after their introduction undoubtedly had to do with their economic benefits. The quotation from Krapf (1860) at the beginning of this paper points indicates this. Key words in the evaluation of the economic value of the coconut palm are diversity and stability. Because of the reliable yield of a variety of products which are in continuous demand for home consumption and sale, the crop is a secure source of employment, food and cash. Moreover, the palm offers a safe investment, which in emergencies can be mortgaged for cash. In short, the palm acts as a buffer in the otherwise insecure economy of the Mijikenda. Table 6.2 gives a summary of palm ownership, changes by mortgage, and use among the 31 coconut growers interviewed in 1983.

Compared with the yields of the other main crops grown by the Mijikenda -- maize and cashew -- the yields of coconuts are stable. This may sound strange for those who know the coconut palm as water loving and the Mijikenda area as frequently drought stricken. However, maize yields can be reduced to zero by a few weeks of too little or too much rain, and cashew yields are sensitive to high humidity during flowering. Therefore a short period of adverse weather at the wrong time can cause an entire harvest to be lost. Coconut yields on the other hand are only affected by longer droughts, and even then are seldom reduced to zero. Most coconut palms are planted on well-drained soils where above-average rainfall does little harm and where they develop an extensive root system which helps them to withstand drought. Coconut palms produce leaves, inflorescences and nuts throughout the year and a short drought does not cause a total loss. Moreover, there are long time lags between the initiation, flowering and harvest of a bunch, in total 3.5 to 4 years (Ohler 1984). Drought affects only certain stages and its effect on nut yields is felt much later and not at the same time as the effect on other crops. The name *makoroma* (halfripe nuts) for a series of droughts between 1948 and 1954 illustrates the reliability of the coconut yields: people who had no grain often survived by eating the flesh of coconuts (DoA 1947; Herlehy 1984a).

5.2 Reliable income

The sale of palm wine contributed to stability in income and food supply. As early as 1900 the Rabai were already exporting palm wine and importing food. In spite of that there is no evidence that they suffered more from drought than the other Mijikenda who grew fewer palms and more grain (Herlehy 1985). The flow of the sugary sap from which palm wine is derived may continue long after the start of drought; in normal years production is highest in the relatively hot and dry months October to February (Mbotela 1974). Also the marketing of palm wine proved to be little affected by drought and famine; the Rabai always found a

market for their wine, for cash or in direct exchange for food (Hobley *et al.* 1914; KNA, 1940bc).

"The Waduruma say that now there is a food shortage it is more than ever desirable that they should take beer to the graves of their ancestors and pray [to] them for rain." (KNA, 1940a)

Many people saw and used palm wine as food -- as indeed it is -- and even during famines there were people who kept drinking for its own sake, so that there was always a certain market for palm wine.



Photograph 6.1. In drought-prone areas perennial crops are a stabilizing element in agriculture.

5.3 Secure employment

The trade in palm wine benefited not only the owner of the tree, but also offered employment and income to many people (Herlehy 1985). Palm wine tapping, transport and sale were very labour intensive. A skilful tapper could handle some 20 trees per day, which meant that owners who wanted to tap many trees had to employ several tappers. The most common form of payment was sharing the palm wine on a fifty-fifty basis following the Mijikenda week: three days for the owner, on the fourth day shared, then three days for the tapper, and so on. Part of the wine was consumed on the farm or sold locally, with buyers coming to

collect it or drinking it on the spot. Most was sold to local female traders, who carried it to major roads, from where wholesale traders transported it to Mombasa and other towns in pickups (Nauta *et al.* 1981).

The labour intensity of palm wine production and marketing served as a means for distribution of work and income, between owner and tapper and between male and female. The Giriama even had a rule "allegedly enshrined in customs" that "men may never tap their own palms" as "a way of ensuring that all men have work" (Parkin 1972: 11). It probably dates from the time when few Giriama knew how to tap palms and employed Rabai tappers. Unlike the Giriama, the Rabai were allowed to tap their own trees (Herlehy 1985). The rule is no longer observed strictly among the Giriama (Nauta *et al.* 1981). At present the employment of tappers is a matter of convenience or specialization rather than of social obligation.

5.4 Permanent tenure

The introduction of the coconut palm not only changed the appearance of the landscape and the availability of land for other uses, but also the land tenure rules and practices. In the past, land was used for a few years and then left for a long fallow, after which the same user or another person might cultivate it again. The long life of coconut palms gave near permanency to the use of the land they were planted on and to the land use rights of the person who had planted them. The palms "tied" people to the same piece of land and excluded others from using it. The planting of palms not only enabled people to accumulate wealth in a form more secure than the disease-prone livestock, but moreover by investing in palms people unconsciously or consciously built up permanent claims to land (Waijienberg 1993).

5.5 Mortgage systems

Coconut palms derive part of their economic and social value from the fact that they can be mortgaged for cash, which may be needed for food, medical care, marriages, funerals, schooling or investment. In that way palm trees serve as some kind of saving and insurance fund.

"Coconut, mango and banana trees are the absolute property of the planter and can be inherited, sold or otherwise disposed of at will. They may also be mortgaged either to members of the tribe or foreigners. The AGiryama [Giriama] state that the system of mortgage is tribal and not introduced by the coast Muslims." (Champion 1914a: 22)

"The owner of a tree wishing to raise a loan assigns them to the lender, who thereupon has the right of access to the trees and of taking the fruit for so long as the loan remains unpaid. On

the other hand, the owner can pay off the loan at any time, whereupon the lender's right to take the fruit at once ceases." (Hamilton 1920: 18)

A stepwise discussion of these quotations may explain how the practice works:

- Other tree crops or animals can also be mortgaged, but the valuable coconut palm is more attractive than other tree crops, and only a few people have livestock which can be mortgaged.
- Usually, mortgage of coconut palms is a transaction between people who know and trust each other (Nauta *et al.* 1981). If mortgaged to foreigners, who are often business contacts, it occurs as a way of temporarily settling an incurred debt.
- The above system of mortgage may indeed have originated among the Mijikenda. The confusion in the Jibana land case (Hamilton 1920), which involved Jibana, Arabs, Indians and English, indicates this (see Waaijens 1993).
- The trees are mortgaged separately from the land they stand on, so that the land can be used for annual crops by other persons (when the tree crop density is high this has little practical value).
- The harvesting of the fruit may be regarded as interest on the loan. However, often there is no relation between the amount of the loan and the value of the trees mortgaged (Nauta *et al.* 1981). This is not surprising, as among many Mijikenda, such as the Rabai and Jibana, palm trees and the land they were rooted in could not be sold (Johnstone 1902; Hamilton 1920). Mortgage was for an unlimited period and after the loan had been repaid the trees would be handed back.
- In contrast with the Rabai and Jibana, amongst the Digo and Giriama the sale of trees was common (Kayamba 1947; Parkin 1972). According to Gillette (1978) the Digo distinguish several forms of mortgage: *kodi ya kuhesabu mavuno* (lender can harvest an agreed number of nuts), *kodi ya miaka* (he can harvest for an agreed number of years), and *rahani* (he can harvest for as long as it takes to repay the loan). The latter form was usual among Giriama but nowadays they also mortgage trees for limited time: if after an agreed period the loan has not been repaid, they become property of the lender (Parkin 1972).

5.6 Differentiation

The practice of debtor's palm trees becoming the lenders' property meant that mortgage could turn from a system for economic and social security into a means of losing or acquiring trees, and so to (permanent) differentiation in wealth. During the 1960s many people in the area around Kaloleni mortgaged and lost their palms a few enterprising and

more modern farmers. At that time copra prices were high, and making copra requires little labour and does not involve the intricate social ties and obligations related to the tapping and trade of palm wine. By accumulating many trees, these enterprising farmers were able to shift from palm wine to copra production (Parkin 1972).

Table 6.2. Information about 31 coconut growers in four villages in the Kaloleni area, Coast Province of Kenya, 1981 & 1983.

Farmer	Palms	Mortgage	Sale of palm products			
P 005	10	-	-	-	-	-
P 015	40	-	wine	-	-	<i>makuti</i>
P 019	10	gain	wine	-	-	<i>makuti</i>
P 032	30	gain	wine	-	-	-
P 067	1000	gain	wine	-	nuts	-
P 075	10	-	wine	-	-	<i>makuti</i>
P 088	40	loss	-	-	nuts	<i>makuti</i>
M 008	70	loss	-	-	-	<i>makuti</i>
M 024	20	loss	wine	copra	-	-
M 027	90	loss	wine	copra	nuts	<i>makuti</i>
M 044	30	loss	-	copra	nuts	-
M 073	500	gain	-	copra	nuts	leaves
M 078	350	gain	-	copra	nuts	-
M 080	50	-	wine	-	-	-
C 005	150	loss	-	copra	nuts	<i>makuti</i>
C 012	1000	-	wine	copra	-	<i>makuti</i>
C 033	700	gain	-	copra	-	<i>makuti</i>
C 042	70	-	-	copra	-	-
C 044	400	-	-	-	nuts	<i>makuti</i>
C 057	10	loss	-	-	nuts	<i>makuti</i>
C 082	50	-	-	copra	nuts	<i>makuti</i>
C 093	20	loss	-	copra	-	<i>makuti</i>
K 016	130	gain	wine	-	-	-
K 033	10	-	-	-	-	-
K 038	20	gain	wine	-	nuts	-
K 050	120	-	wine	-	-	-
K 060	50	-	-	-	nuts	-
K 067	50	-	wine	copra	nuts	-
K 074	10	-	-	-	-	-
K 076	50	-	wine	-	nuts	-
K 087	140	-	wine	copra	-	<i>makuti</i>

Farmer: first letter of village and number of farm on sample list. Palms: approximate number of productive palms, based on interviews in 1981 and 1983; exact number may be somewhat different due to confusion about palms that are mortgaged, not yet divided between sons of deceased, etc. Mortgage: gain or loss of usufruct in period 1981-1983; sometimes only the nuts or wine are mortgaged so that the other products like leaves can still be taken by the owner. Sale: refers to moment of 1983 interview (wine) or previous year (other products); quantity varies widely; *makuti* are pieces of palm leaf thatch.

6 CULTIVATION PRACTICES

6.1 Rainfall and soils

Although estimates of the minimum rainfall requirements of coconut palms vary between 1,000 and 1,500 mm year⁻¹, the ideal amount is closer to 2,500 mm year⁻¹ (Ohler 1984). The annual rainfall in Kwale and Kilifi Districts ranges from about 1,200 mm near the coast to less than 700 mm in the interior, with a potential evapotranspiration of at least 2,000 mm year⁻¹. That means that the entire area is marginal for coconut growing.

Table 6.4. Average monthly rainfall (mm) at three representative places in Kilifi District (Boxem et al. 1987).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mtwapa	26	23	54	211	265	148	104	72	81	103	111	53	1251
Kaloleni	37	26	46	118	204	97	75	66	91	125	115	75	1075
Bamba	19	14	61	88	127	31	28	32	44	65	79	78	666

Table 6.3 shows some representative rainfall regimes. Mtwapa is one of the wettest places on the Kenya coast. Around Kaloleni the rainfall is lower, but better distributed and the short rains are relatively reliable (Okoola 1978). Bamba has a rather well distributed rainfall but it is far too low for coconut palms. Between Kaloleni and Bamba the palms gradually disappear from the landscape. The boundary of their cultivation roughly coincides with the 1,000 mm annual rainfall isohyet, but it is far from regular, because of local differences in soil properties (Brom 1981). Most soils are sandy and poor, but there is a large variation in physical and chemical characteristics, both between and within soil units. Tables 6.4 and 6.5 show some representative soil units of Kilifi District. There are many similar and intermediate soils and moreover a wide range of soils of valley bottoms and bottomlands.

Under marginal rainfall conditions the productivity of coconut palms strongly depends on the selection of optimal soils, apart from cultivation techniques which increase water availability. The exact relation between soil, climate and productivity is not always clear. It is no surprise that on heavy cracking clay soils (UT₂c₁p) coconut palms cannot root and are not even planted, or that on very acid and poor sandy soils (UE₁l₁) they do not grow very well and are uncommon. However, there are many cases where it is difficult to attribute growth or yield characteristics to certain soil or climate factors (see section 7.1).

It appears that the Mijikenda farmers -- intuitively or by trial and error -- in general chose well where to plant their new crop. The first palms were planted inside the *makaya*. Convenience and the wish to monopolize palm wine production were undoubtedly among the reasons for choosing this location (Herlehy 1985).

Table 6.4. Some representative soils of Kilifi District, from the coast towards the interior (Boxem et al. 1987).

P₂El₁ - Ferric Luvisols and Acrisols

Well drained, very deep, dark red to yellowish red, sandy clay loam to sandy clay, underlying 30-60 cm medium sand to loamy medium sand. ABC profiles, mostly thick but weakly developed B horizon, low fertility, moderate to high permeability. (most other P₂E.. soil units have a lighter texture)

UE₁l₁ - Rhodic Ferralsols, ferric and chromic Luvisols

Well drained, very deep, dusky red to reddish brown, sandy loam to sandy clay; in places underlying 20-40 cm loamy medium sand. ABC profiles, gradual to diffuse horizon boundaries, low nutrient status, high permeability. (most other UE₁.. soil units have a lighter texture)

U₂c₁p - Gleyic and vertic Cambisols, chromic Vertisols

Well drained to moderately well drained, moderately deep to deep, yellowish red to yellowish brown, cracking clay; in places strongly mottled and/or calcareous; A(B)C profiles, clear horizon boundaries, high nutrient availability, variable permeability. (this soil is not suitable for coconut growing; it forms part of the barrier described in section 3)

UL_cl₁ - Dystric Nitosols, chromic Acrisols and Luvisols

Well drained, deep to very deep, red to reddish brown, sandy clay to clay; in places rocky. ABC profiles, gradual horizon boundaries, mostly thick B horizon, showing shiny ped faces; moderate nutrient status, high permeability.

US_cl₁ - Ferric and chromic Luvisols; humic, ferric and orthic Acrisols

Well drained, deep to very deep, red to yellowish red, sandy clay loam to clay; in places underlying 20-80 medium sand to sandy loam. ABC profiles, BC profiles in case of topsoil erosion, clear horizon boundaries, low nutrient status and moderate to high permeability. (US_s₁ and US_s₂p developed on similar parent material, but consist of friable or loose coarse sand throughout profile)

USKf - Albic and luvis Arenosols

Somewhat excessively drained, light brown to yellow, fine sand to sandy loam; in places with lamellae of clay accumulation. Profiles with little horizon development, a low nutrient status and a high to very high permeability. (USK_A₁ is similar, but has more clay in the subsoil and can probably hold more water)

However, these sites also offered relatively favourable growing conditions. On flat hill tops the organic matter content and water availability are usually better than on slopes. Moreover, in the *makaya* the palms also profited from waste water and organic refuse, and the tall forest around the *makaya* reduced wind speed and evapotranspiration. After palm growing spread outside the *makaya* they were planted in and around the homesteads, which were mostly situated on hill tops (Champion 1914a). In these early days many palms were also planted on the relatively fertile and moist soils of river banks (*Masha 1984*). The present distribution of the tallest and oldest palms still reflects this pattern. Coconut palms are still concentrated

Table 6.5. Physical and chemical characteristics of some soils used for coconut growing in Kilifi District (Brom 1981; Wassink 1983; Sprenkels 1985; Boxem et al. 1987; unpublished data).

	P ₂ E ₁ ..	UE ₁ ..	ULc ₁	USC ₁	USKf
0-150 cm depth*					
Available water (mm)	112-179	92-165	150	111-312	134-312
15-75 cm depth**					
pH-H ₂ O	5.8-8.1	5.2-5.9▶	6.0-7.5	5.6-6.3▶	5.4-6.1
pH-KCl	4.0-7.3	◀4.3-4.9▶	4.8-6.2	4.0-4.6▶	3.9-5.0▶
Organic C (%)	0.3-0.6	◀0.2-0.3	◀0.4-0.7	◀0.3-0.8	◀0.3-0.5
Ca (meq kg ⁻¹ soil)	20-44	◀ 7-11	◀30- 77	◀22-30	16-22
Mg " "	1-11	1- 1▶	◀ 5- 15	3-19	4- 8
K " "	1- 3	1- 4	3- 14	◀ 2- 9	1-10
CEC " "	24-92	◀14-24	40-118	◀46-76	22-52
0-20 cm depth***					
P-Olsen (ppm)	3-12	3-6	2-5	0-13	2-29

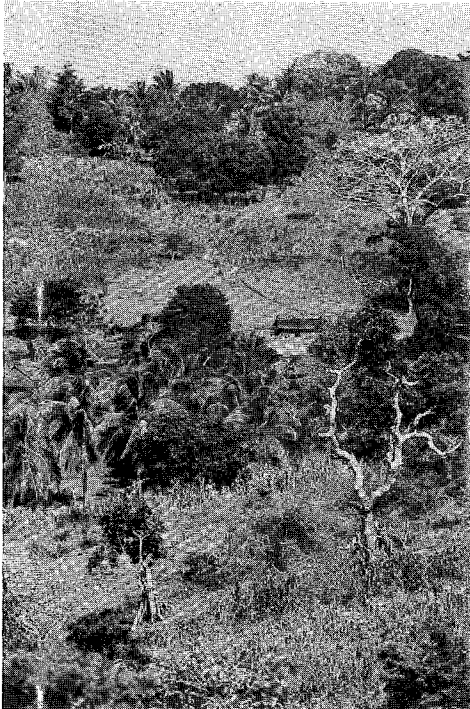
- ..: The data for P₂E₁.. and UE₁.. are from several similar soil units.
◀ ▶: The data for 15-75 cm depth are from Brom (1981); for some parameters samples taken by myself at other sites gave lower (◀) or higher (▶) values.
*: Between pF-2.3 and pF-4.2, determined in 1-4 pits per soil unit.
**: Composite samples in ≥ 3 plots per soil unit.
***: Samples from 1-5 pits or composite samples of topsoils; the highest value for unit USKf is probably an error.

on the tops of hills and in and along valley bottoms. The tendency is most marked under more marginal rainfall conditions and lower population density and less clear in wetter areas with higher population and palm densities.

The spatial distribution of coconut palms shows that most farmers are aware of the ecological requirements of the palms. Of the coconut growers interviewed only few considered that palms could be grown just anywhere, but most had opinions about the places, positions or soils where they grow well. Their references to soils -- in terms like "white, red or black" (soil type, organic matter), "loose or hard" (rooting, texture), "dries fast" (well drained), "keeps rain" (holds water) or "slippery" (contains clay) -- indicate that several factors are taken into account.

The choices of prospective coconut growers were increasingly limited by lack of suitable land. From the beginning of this century many people migrated or returned to wetter areas where coconut palms could be grown: the coastal strip and a belt along the line Kikoneni -- Matuga - - Rabai -- Kaloleni -- Kauma. Many other farmers tried to grow the palms in the dry areas where they happened to live. Within the higher rainfall areas increasing population density and land scarcity also forced many farmers to plant their palms on less suitable land. Palms under marginal conditions yield much less, but often still enough to satisfy household needs for a calabash of palm wine, some nuts for drink or food, and a few leaves for baskets or thatching huts.

It may take several years for the effects of marginal conditions to show up. For example, in dry areas like Kinarani, young palms planted on the better sites often did surprisingly well at first. However, as they grew older and taller it became more and more difficult to obtain sufficient water. They started tapering (narrowing of trunks to the shape of pencil points) at lower heights than palms in wetter areas. The same appeared to be the case with palms planted on soils with low pH and lack of nutrients, like the sandy red soils of Pingilikani. Qualitative observations throughout Kilifi District suggest that everywhere the incidence of tapering or dying palms is higher under marginal climatic or soil conditions.



Photograph 6.2. In relatively dry areas most coconut palms are found on hilltops and along the foot of the slopes. The cashew trees in the foreground are pruned to allow maize to be grown.



Photograph 6.3. V-shaped notches in the leaves are symptoms of rhino beetle damage; tapering trunks are common in old palms and under marginal conditions.

6.2 Planting materials

In the Mijikenda area both tall (var. *typica*) and dwarf (var. *nana*) coconut palms are found. The former, usually called "East African or Kenya Tall", are by far the most common.

Although they display a large variation in plant characteristics (such as nut size, shape, colour and composition) and yields, no cultivars are distinguished. The average production is about 30 nuts palm⁻¹ year⁻¹; most of the estimates and data used to reach that figure refer to the coastal strip of southern Kenya and northern Tanzania (Eijnatten 1979a).

Occasionally one or a few dwarf palms are encountered; they have slender yellow, orange nuts or green fruits and are referred to as "Pemba" (Eijnatten 1979a, 1981f; Odoyo 1983). They bear earlier than tall palms and usually have smaller nuts, which produce little copra but when immature provide excellent fresh drinks. They have been reported to be unsuitable for palm wine production (Acland 1971). However, because they are short they are very easy to tap, which did not escape the attention of Mijikenda farmers.

There have been no coconut breeding programmes in Kenya (Acland 1971). Proposals for genetic improvement of the coconut palm were presented by Eijnatten (1979a). One method would be by crossing tall palms with imported or local dwarf palms; a selection of the latter material was described in Eijnatten (1981f). The plant material distributed to farmers via government nurseries in the Coast Province of Kenya was from local tall palms and was often of poor quality. For many years the nurseries bought their seed nuts by tender, with the lowest bidder winning the contract. The nuts came from unknown trees and were only checked for water content and pest damage. The plant material selected in this way was probably inferior to farmers' own selections. Nursery practices did little to improve on this starting point. Often nuts were planted in the wrong season and young palms were left in the nursery for too long. There they might suffer from lack of water and competition with weeds. Finally, to keep output numbers high only the very poorest plants were discarded (Eijnatten 1979ac; Muturi 1981).

Tall palms take 6 to 10 years to come into bearing and can reach an age of 60 to 100 years. This, and the reluctance of many Mijikenda to cut unproductive palms means that the effect of poor planting material may be felt for a very long time. Fortunately, most farmers select their own plant materials; even the subsidized prices at which the government seedlings are sold cannot seduce local farmers into buying them (Eijnatten *et al.* 1977). Most farmers prefer large good looking nuts with water inside and from tall or old and productive trees. Several farmers choose nuts from successfully tapped palms; I did not ascertain whether they see a positive relation between toddy and nut production or were interested in palms for toddy. Some farmers pick up nuts that have already germinated.

6.3 Plantation management

In Mijikenda agriculture one cannot talk of plantations in a strict sense. The palms are grown in dense clusters around houses, widely scattered in maize fields, as narrow fringes along the edges of the valleys, or as dense groves on the valley bottoms. In relatively uniform coconut

fields around Kaloleni the average density is 90-100 palms ha⁻¹ (Floor 1981). However, such fields are an exception rather than the norm and overall palm densities are much lower.

Planting

The dry and seasonal climate of the Mijikenda area makes crop establishment difficult. Some farmers, especially in the dry Kinarani, plant seed nuts directly in the field, others first germinate them in a nursery and later transplant the young palms. The best time for transplanting is at the start of the long rains in March or April, which means that the nursery has to be watered throughout the preceding dry season. Sometimes seed nuts are planted behind the house where they receive thrown away water and rain from the roof (often that is their only care). To overcome the lack of a nearby water source nuts often are germinated in the rainy season and transplanted when the rains are nearly over.

The young palms or seed nuts are planted in holes well below the soil surface. In drier areas and sandier soils the holes are usually larger and the nuts or palms are planted deeper, so that from a distance one may not even see that palms have been planted in a field.

Weeding

Most new palms are planted in maize fields or near houses. Therefore during the early years they are more or less regularly weeded. Older palms may also be intercropped with food crops like maize and cassava, or mixed with tree crops like cashew, citrus and mango. However, in most cases the undergrowth consists of grasses and herbs - occasionally slashed, or grazed by goats - with varying amounts of shrubs like *mshomoro* (*Lantana camara*).

Complaints about the deleterious effects of neglect and weeds, notably shrubs, on coconut production are quite old (Fitzgerald 1898; Hobley *et al.* 1914). In the 1950s and 1960s compulsory campaigns were organized to clean plantations of *Lantana* (DoA, 1954a). They had some success but apparently the effect did not last: "Lantana appears to be as much a problem at present as it was 15 to 20 years ago" (Eijnatten 1979: 6). Indeed most coconut fields are far from clean weeded, but the complaints may be somewhat disproportionate: in 1980 it proved difficult to find enough "bush-plots" to evaluate the effect of the type of undergrowth on palm tree characteristics (Floor 1981).

Floor's (1981) study, carried out in Mwarakaya (soil unit UL_{C1}) and Kizurini (USKf or USKA₁), indicated that compared to a food intercrop a shrub undergrowth negatively influenced various plant characteristics related to nut yields (table 6.7). The differences may be due to competition for water, notably during the dry season. Most shrubs have deep and extensive root systems and retain their leaves during the dry season. The superficial cultivation for food crops does not harm coconut roots; the main food crop, maize, is

cultivation for food crops does not harm coconut roots; the main food crop, maize, is harvested at the start of the dry season, and the remaining annual weeds usually die quickly. Farmers appear to be aware of the difference. They lend their land under coconut palms to others with lack of land to clear the shrubs and grow food crops (see also Nauta *et al.* 1981). Fifty years ago the same practice was already observed in the Tanga area, northern Tanzania coast (Swynnerton 1946).

Interestingly, Floor (1981) found that plots with a food intercrop averaged 100 palms per ha, compared to 90 for plots with shrub undergrowth. Possible explanations -- apart from coincidence due to the large variation in tree densities -- are the dying of long-neglected palms or less replacement in shrub plots (Floor 1981). However, there may also have been *a priori* differences between plots, which caused farmers to use some for food crops and to neglect others and allow them to be invaded by shrubs. Observations by myself and others (Nauta *et al.* 1981) confirm that growing food crops under palms is usually limited to the more fertile spots. Maize yields under coconut palms are considerably lower than in the open (Wassink 1983; Sprenkels 1985). Labour inputs (weeding) also tend to be lower, but in spite of this compensation, apparently only on the very best spots are the returns on labour found to be sufficiently attractive to grow maize.

Grazing

Grazing or browsing is another way of keeping on top of weeds. In the coastal strip of Tanzania dairy cattle are kept in pastures under coconut palms (Childs & Groom 1964; Groeneveld 1968). A study in Kenya showed that pastures under tree crops -- in the case under investigation cashew -- have a low but evenly spread herbage production and a pleasant microclimate (Goldson 1981). However, most coconut plantations are found in densely populated areas, where they are interspersed with food crop fields. For the majority of the Mijikenda farmers the cost of fencing and the problem of water supply are prohibitive. The few farmers who occasionally do graze cattle under coconut palms usually have them herded or tethered with long ropes. Tethering of goats is much more common and practical, because as they eat less their positions do not have to be changed so often. However, their selective browsing tends to cause an increase in the presence of less palatable shrub species and so in the long run may increase the weed problems.

Mulching

Of the 31 farmers interviewed 28 did mulch their coconuts, although several answered with "when young" or "not much". Young palms are often mulched with crop and weed residues. The intercropping of older palms is less common and "mulching" in many cases is no more than leaving the slashed undergrowth on the ground. Occasionally one sees the practice of placing the coconut husks around the base of palms in order to reduce evaporation. Some

farmers refrain from mulching young palms for fear of termites or ants. Termites may actually attack debilitated palms, ants can burrow so much around the roots that young palms die.

Manuring

None of the farmers interviewed apply fertilizers or manure; some considered mulching with weed residues as a kind of manuring. Part of the coconut plantations receive a little manure in the form of the droppings of goats or cattle. These do not add extra nutrients, but make those present in weeds available for the palms. Soil fertility probably limits coconut yields, as most soils are poor chemically, and the levels of N, P, Ca and Mg in the leaves are around or below the critical levels, while those of K and Cl are quite high (Floor 1981; Brom 1981). The high levels of K may be related to the low N levels and indicate adaptation to lack of N or to the dry conditions under which the palms are growing (Floor 1981).

The need to amend soil fertility deficiencies has long been recognized. It received attention in the report of the 1914 Coconut Commission. Some of the informants of the commission said that the application of manure or seaweed was beneficial, others that it was not necessary, provided weeds were controlled, others again that it might kill young palms or cause palms to overbear and die early (Hobley *et al.* 1914). In an experiment near Kilifi, comparing seaweed dressing, fertilizers, green manure and fallow, there were no differences in coconut yields (DoA, 1937a). It appears that in the following decades little or no research was done on the subject (Sethi 1954). In an article about the manuring of coconut palms in the "Kenya Farmer" in 1967 the application of manure or fertilizers was recommended -- copra prices were high at that time -- but no specific source or advice were given (Farmer 1967). Experiments in Tanga, northern Tanzania coast, demonstrated a strong effect of fertilizers on the height of young palms (notably those receiving K) and on the earliness of flowering (elements not specified). Preliminary results from older palms showed positive responses of the number of nuts per palm to N, P and K, with the latter having also a striking effect on the weight of the nuts (Anderson 1967). A fertilizer experiment in Matuga from 1969 to 1972 showed a positive response of nut yields to N and a negative one to K; all trees received P, Ca and Mg, so the effect of these nutrients was not determined (Eijnatten 1979a). Three nitrogen trials were laid out in Kilifi District between 1972 and 1974 as part of the FAO Freedom From Hunger Campaign. The 7-9 year old palms, which had just started to bear nuts, responded positively to nitrogen, but the presentation of the results hampers conclusions (Zschernitz *et al.* 1975). In 1979 a fertilizer experiment was initiated in Mtwapa (Eijnatten 1980a), but no results have been reported. Meanwhile 1.5 kg CAN, 0.7 kg SSP and 0.6 kg KCl tree⁻¹ year⁻¹ has been recommended for fruiting palms (CARS 1982).

6.4 Pests and diseases

The most conspicuous and serious pest is the **rhino beetle** (*Oryctes monoceros*), which is indigenous to Africa (Hobley *et al.* 1914). The 4-5 cm large beetle lays its eggs in rotting coconut trunks and other decaying vegetable matter where the larvae hatch and pupate; in 1,000 dead palms 11,974 beetles, 829 eggs, 17,963 larvae and 127 pupae were found (Hobley *et al.* 1914). The adults bore into the terminal bud of the palm where they eat unopened leaves, and sometimes destroy the growing point. The first case is rather common and shows itself in V-shaped notches or incisions in the leaves after opening. The second, which results in the death of the palm, fortunately does not happen often (Pury 1968).

During the 1970s there was concern about a decline in coconut production attributed to a strong build-up of the rhino beetle population. Dieback of 0.8 % of the palms year⁻¹ or between 5 and 75 % in total were reported, with large variations between areas (Bulder 1975; Eijnatten *et al.* 1977; Eijnatten 1979c). Some of the estimates appear exaggerated: the destruction predicted never happened, in spite of late and weak attempts at control. The coconut rehabilitation programme which started in 1979/80 cut only moderate numbers of dead, dying and unproductive palms: 1,600 in Kwale, 1,400 in Kilifi and 2,200 in Mombasa Districts (Nyange 1982). During the 1980s the beetle was still ubiquitous, but dying or dead palms were not very common (Floor 1981; Wassink 1983; Sprenkels 1985).

Even fifty years ago it was noted that around Tanga, Tanzania, the beetle did less damage on small farms than on large plantations. On the small farms the sanitary rules were enforced, the plantation owners supposedly could not get the labour to keep their plantings clean (Swynnerton 1946). Some decades later in Kilifi district the same contrast was observed; whereas small farmers near Kaloleni suffered only light to moderate damage, in Sokoke plantation near Kilifi thousands of palms were dead or dying (Marschall 1976).

It would be unfair to blame the rhino beetle and lack of sanitation for all the damage done. Sokoke plantation presented an unfortunate combination of poor soils (UE₁I₁, UE₁I₂), low rainfall (during the seventies) and weed stress (undergrowth of cashew and shrubs). In many other cases dying or dead palms were also tapering. Therefore it is probable that the beetle finished off palms already weakened by marginal growing conditions. Single trees and plantations with trees of irregular heights -- which give clear silhouettes -- are more likely to be distinguished and attacked by the night flying beetle (Pury 1968). This may also explain why rhino beetle damage and dieback are often observed in marginal areas, where closed and even canopies are less common.

Since 1914 the disposal of potential breeding sites -- mainly dead coconut trunks -- by burying or burning has been the main recommended control measure, apart from occasional beetle catching competitions between schools (Hobley *et al.* 1914; Wheatley 1961; Mburathi 1978; Eijnatten 1979a; Gethi 1980). The rhino beetle can fly distances of at least up to 700 m (Eijnatten 1979a) and so in theory may travel from one end of the Mijikenda area to the

other without ever touching the ground. Therefore sanitary methods only work if all farmers participate. Even then total success is not assured as the beetle may also breed in other organic materials including the palm leaf thatched roofs of the houses; it is not uncommon to hear or feel falling larvae inside the houses.

Farmers do not like the heavy work involved in the cutting and burying or burning of coconut logs. Other ways to dispose of coconut trunks are to split them for use as building materials, or to convert them into charcoal (Eijnatten 1979b). People are getting used to the first solution, but the making of charcoal appears not to have been adopted. The product has a slightly lower energy to volume ratio than that made from other trees. Moreover, most charcoal burners live far from coconut palm areas, and the quantities produced from one or a few trunks may be too small for easy marketing. Use as firewood might be a better option; in densely populated rural areas people are already accustomed to using petioles or even husks as fuel for cooking.

Nearly all farmers try to control the beetles by putting sand in the holes the insects have made or by killing them with a pointed stick or piece of wire. Some mentioned the use of paraffin, toddy plus ashes, or sisal water. In many cases the use of these methods is limited to young or tapped palms, but fortunately these are also the trees preferred by the beetle according to the farmers.

The other major and common pest is the **coreid bug** (*Pseudotheraptus wayi*), which punctures female flowers and young nuts; these drop, or develop scars and contain less endosperm (Omondi & Eijnatten 1980). Estimates of the damage vary, but it appears that losses can be considerable. The proportions of palms with symptoms on the penultimate bunch were 70 % (Floor 1981), 28 % (Wassink 1983) and 58 % (Sprenkels 1985). In monthly harvests between March and December 1980 at the Coast Agricultural Research Station (CARS) in Mtwapa, between 4 % and 57 % of the nuts were affected. The high infestation levels, on average 22 %, may have caused early fruit drop and so have contributed to the low yield of 21 nuts palm⁻¹ year⁻¹ (Eijnatten 1981b).

Some degree of protection may be obtained by means of intercropping with cashew or citrus; this practice promotes the presence of the *maji-moto* (hot water) or weaver ant (*Oecophylla longinoda*), a predator of the coreid bug (Wheatley 1961). For adequate control at least half of the palms must be colonized (Omondi & Eijnatten 1980). Combinations of coconuts with cashew or citrus are very common but, as far as known, farmers do not intercrop consciously in order to promote the ants and control the bugs.

Since 1964 **bole rot** (*Marasmiellus cocophilus*) has been observed in scattered parts of the Kenya coast. These places included the Coast Agricultural Research Station (CARS) in Mtwapa and nurseries in Matuga and in Mpeketoni, near Lamu (Eijnatten 1979a; Eijnatten & Karisa 1980). The fungus enters the plant via injured roots -- often at the transplanting of seedlings -- and causes a soft rot of the roots and the bole and wilting of the leaves. The

younger the palm, the faster it succumbs. The fungus survives in coconut debris and maybe also in the soil (Wamari 1982). Fortunately, there have been no indications that bole rot is a serious problem in the Kaloleni area, and as long as farmers continue to propagate their own planting materials there is little danger.

7 CROP CHARACTERISTICS

7.1 Methodological problems

Quantitative data on coconut palm characteristics in Coast Province are scarce and sometimes conflicting. This makes it difficult to establish differences in growth and yield and attribute these to specific ecological or management factors. For example, whereas one study indicates that soil unit ULC₁ is less suitable for coconut palms than USKf or USKA₁ (Floor 1981), the results of another survey do not confirm that conclusion (Brom 1981). These problems are related to the objects under study as well as the methodology followed.

Table 6.6. The distribution of some trunk, leaf and bunch characteristics in 25 coconut palms in a homogeneous farmer's field in Chilulu, Coast Province of Kenya, November 1982: number of palms per class and parameter, and mean value and coefficient of variation (CV) per parameter.

	≤5	6-10	11-15	16-20	21-25	26-30	31-35	≥36	Mean (#)	CV (%)
Height (m)	0	3	19	3	0	0	0	0	12.9	18
Leaves palm ⁻¹	0	0	0	2	2	6	13	2	30.4	19
Bunches palm ⁻¹	0	0	13	8	2	2	0	0	17.9	32
Nuts bunch ⁻¹	7	11	3	3	0	1	0	0	8.9	61

The palms belonged to the field used for the "maize under coconut" experiments described by Wassink (1983), Sprenkels (1985), and in chapter 5.

There is much **spatial variation**, between palms within the same field, and especially with regard to generative characteristics (table 6.6). The coefficients of variation (CV) in the example are on the high side; it is a case of measuring all palms within a given area, without avoiding outliers. In the 35 fields studied by Brom (1981) the CV for the number of leaves per palm was 15 % (range 8-25 %) and for the number of bunches 22 % (range 11-40 %). The CVs between fields with the same soil type and undergrowth were smaller, 8 % (5-9 %) for the number of leaves and 10 % (4-15 %) for the number of bunches per palm.

Because of the nature of the studies -- observations at a single point in time -- too little attention has been paid to the **temporal variation** of several palm characteristics. On Zanzi-

bar the number of spadices varied considerably within and between years (Tremlett 1964), and a sample of palms observed by Johns (1938) showed a biennial bearing behaviour that was positively correlated with the productivity of the palms (Eijnatten 1981d). In Mtwapa in 1980 the interval between successive leaves varied from 17 days in July to 48 days in October (Eijnatten 1981a). Under fluctuating rainfall it is probable that most other parameters also vary within and between the years, which hampers the interpretation of non-repeated observations. If, for example, the penultimate bunch of one palm is in the axil of leaf 17 and of the next in that of leaf 28, they flowered at different moments and have different histories of rain and drought. Similarly, the penultimate bunch on a palm recently harvested cannot be compared with that on a palm where the "dropping" of nuts is several months overdue.

In several studies the **sampling** of fields or trees has been fully random, for obvious (sites for trials), logistic (fields near roads) or other good reasons (avoidance of outliers). As a consequence the use of statistical methods to "prove" differences between soils or other factors was invalidated. It also made it difficult to extrapolate sample results to the whole population.

Moreover, the studies differed in the parameters observed or in the ways of **measuring** them. For example, in some the leaf scars were counted over the whole trunk, whereas in others only over a short distance near the ground. Therefore, their periods of formation and their histories of rain and drought were not comparable and the variable under study was confounded with the factor time.

And finally there is the complex problem of **interpretation**. Understanding a single characteristic like the number of nuts on the penultimate bunch is already quite difficult. It becomes even more complicated when evaluating several variables that appear to contradict each other, such as in the combination few large leaves versus many small leaves. And having ascertained that palms under one treatment, say soil unit, do better than on another, the next problem arises: should this difference be attributed to nutrient availability, water-holding capacity or to rainfall, as the soils occur on different sites?

Part of the **solution** to the above problems may be to pay more attention to the temporal variability in palm characteristics. That means not only gathering more detailed information on the history of the palms but also, for example, comparing curves of leaf length and nuts bunch⁻¹ as a function of leaf rank number rather than single points on a poorly defined trajectory. Otherwise prohibitive -- in terms of the work involved -- numbers of sites and palms may be needed, in order to discover little more than farmers know already.

The mentioned methodological issues centred around how to measure and explain variation in palm characteristics, within and between fields. One may also want a **comparison** with some kind of model of how coconut palms behave normally, under less marginal conditions. As quantitative data for East African Tall palms are almost non-existent, such a model has

to be based on information about other tall palms, grown elsewhere in East Africa or the tropics (where complete data sets are also rare). The estimates in table 6.7 are broad indications of the vegetative and generative characteristics of palms under more typical ecological and management conditions. They have no other pretention than to place the palms observed in the Kaloleni area on some kind of scale.

Table 6.7. Values of some vegetative and generative characteristics of "typical" tall coconut palms in East Africa and elsewhere in the world (Child 1974; Floor 1981; Ohler 1984 & 1989).

Characteristic	Values	Remarks
Girth at breast height (cm)	90-110	-
Leaf scars per m of trunk	10-40	Increases with the age of the palm
Unfolded leaves in crown	30-35	About same number not yet unfolded
Total length of leaf (m)	5-6	Decreases with the age of the palm
Number of leaflets (both sides)	200-250	-
Length of middle leaflets (cm)	120-140	-
Leaves unfolding per year	12-16	The same number dies yearly
Inflorescences per year	10-14	One per leaf, but some abort
♀ flowers per inflorescence	20-40	-
Nuts per bunch at harvest	4-8	Most are shed in early stages (physiological causes and pests)
Copra per nut (g)	160-250	-
Copra per palm (kg)	5-15	-
Plant density (palms ha ⁻¹)	120-150	-
Yield of copra (kg ha ⁻¹)	500-2500	The best yields obtained were much higher (Corley 1983).

In the next sections some conclusions are drawn from the information available and presented in figure 6.3 and table 6.8. The sources consist of a study of coconuts in Tezo-Roka settlement scheme north of Kilifi (Eijnatten *et al.* 1977), a characterization of a trial field at the Coast Agricultural Research Station (CARS) in Mtwapa (Eijnatten 1980b), studies of palms

District (Floor 1981; Brom 1981), and experiments and observations to study maize growth and yield under coconut palms around Kaloleni (Wassink 1983; Sprenkels 1985). The information is incomplete, variable and little conclusive, and should be viewed critically. Therefore the results have often been formulated as arguments or questions rather than answers.

7.2 Genes, sites and weeds

The main decisions Mijikenda farmers can make with regard to coconut cultivation are limited to the choice of planting material, the selection of sites and the control of weeds. There is large variation in the yield characteristics of individual palms (table 6.6). The information currently available does not permit a distinction to be made between the environmental and genetic components, but there are indications that the latter exist (Eijnatten *et al.* 1977; Eijnatten 1980b). Most **genetic variation** probably occurs along the coast -- from Tanzania to Somalia -- with a long cultivation history under a wide range in average annual rainfall, from less than 600 mm to more than 1400 mm (Jaetzold & Schmidt 1983). The hinterland has a similar range of rainfall conditions and more variation in soil types but there, due to their recent introduction, the palms have undergone only few selection cycles, implemented by rigid nature or keen farmers. Little is known about the effect of natural selection on drought resistance or of farmers' choices on yield characteristics. Selecting nuts from good parents is thought to be less effective than selecting plantlets in the nursery (Child 1974).

As mentioned earlier, the conclusions about **sites** (soil x rainfall) are contradictory. The variation within units is large and farmers have tended to plant their precious palms on better than average spots so that the soils in coconuts fields may not be representative for the soil units compared. A general impression is that palm characteristics on soil units P₂El₁, ULc₁, USc₁ and USKA₁ are similar, in spite of the differences in texture. From my own subjective observations of palm vigour and yield I would rate USc₁ or USKA₁ near Kaloleni among the best upland sites for coconut palms, but it is hard to say how far the performance of palms there is caused by rainfall rather than soil properties. On the acid and poor soil unit UE₁l₁ palms are relatively scarce and in general do poorly. On the heavy cracking clay of UT₂c₁p drainage and rooting are impeded seriously. On most of the fine sandy USKf palms yield little because of lack of rainfall; early growth is often surprisingly good, but yields tend to be disappointing.

The only study in the Kaloleni area that has paid explicit attention to **management**, more specifically to weeds, is the one conducted by Floor (1981). His conclusion that shrubs adversely affect several palm characteristics is compatible with what one would expect and with qualitative observations. However, the correlation between shrub undergrowth and poor coconuts can be seen as a chicken-or-egg case. Was incidental neglect followed by poor

production or did low yields discourage farmers from looking after their palms? It may also be a matter of mutual reinforcement, which in its early stage can still be reversed but later results in a downward spiral from which there is no escape.

7.3 Root distribution

Roots are the least visible and studied parts of crops, and those of the coconut palm in Coast Province are no exception. Figure 6.3 presents the root profiles observed in a study of maize growth and yield under coconut palms in the Kaloleni area (Wassink 1983; Sprenkels 1985). Five other profiles in the same area and the coastal strip of Kilifi District were described by Brom (1981).

In the quantitative studies and qualitative observations it was striking that, although there was a concentration of primary roots near the bole, the root density especially of the secondary roots remained high until far from the palm. The uniform distribution may be related to the low fertility of the soils or the marginal rainfall. In studies under better conditions (fertilizer, irrigation) in India the roots were much more concentrated (Nair 1979).



Photograph 6.4. Under the relatively dry conditions of the Kaloleni area coconut roots extend far from the palms and form dense mats.

Figure 6.3 indicates that in most soil units the numbers of coconut roots counted were similar. However, in clayey topsoils (ULc₁, USc₁) the peak density tended to be closer to the surface than in sandy topsoils (USKA₁ or USKf). Probably the latter are drier and they are worked deeper, when the palms are intercropped.

The dense mat of coconut roots throughout coconut fields has consequences for intercropping. In farmers' fields maize plants less than 2 m from the bole were visibly affected, and further away the yields were usually also lower than those in the open field. However, the lower yields further from the bole may often be due to lack of light rather than to competition for water or nutrients (Wassink 1983; Sprenkels 1985; see chapter 5).

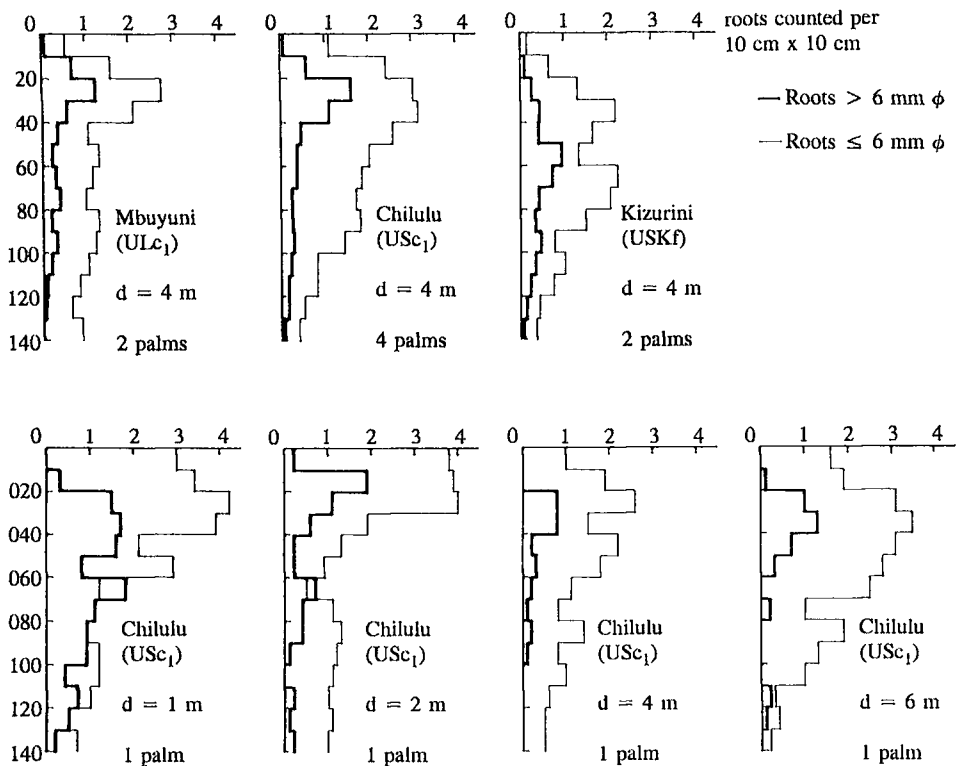


Figure 6.3. Primary and secondary coconut roots in relation to soil unit, distance from the centre of the bole and depth; numbers were counted in 10 cm x 10 cm tangential squares (Wassink 1983; Sprenkels 1985).

7.4 Trunk and leaves

The diameter of the trunk reflects the conditions under which the coconut palm has been growing. The studies summarized in table 6.8 showed that palms on fine sandy soils (USKA₁, USKf) had in general the thickest trunks. Surprisingly, the phenomenon persisted far north-west of Kaloleni where average annual rainfall drops to 900 mm or less. However, nut yields appeared more sensitive to low rainfall, and many older palms showed the "pencil point" symptom. Maybe, young palms by exploiting the rootability that the sandy soils and wide spacings offered and by giving preference to vegetative growth above generative development, managed to do well. Once older they succumbed to the hydrostatic pressures imposed by their own height, exposure to drying winds, and often also competition with shrubs.

The numbers of leaf scars m^{-1} observed in the coastal strip and the Kaloleni area were within or near the normal range given by Ohler (1984). In two studies they were used, together with the approximate age of the palms, to estimate the leaf production rate: 6-8 leaves $\text{palm}^{-1} \text{ year}^{-1}$ (Eijnatten 1980b; Floor 1981). A rate of 12-16 leaves $\text{palm}^{-1} \text{ year}^{-1}$ is considered normal (Ohler 1989). At first sight the low rates may be attributed to the dry climate in general and the weather of the preceding years in particular. However, the palms studied had on average 32 and 28 unfolded leaves, with under normal conditions an expected life span of about 2.5 years (Ohler 1989). That implies average rates of 13 or 11 leaves $\text{palm}^{-1} \text{ year}^{-1}$.

One way to explain the discrepancy is by assuming a longer leaf life. The palms studied by Eijnatten (1980b) and Floor (1981) were growing under low densities (less than 100 palms ha^{-1}). Therefore the older leaves were not shaded much and so might last longer than those in closed plantations, although under the prevailing harsh conditions this is unlikely. It is also possible that the low rates were based on errors in the ages of the palms -- often rough guesses -- or by overlooking the years before trunk formation or the leaves in the crown. Indeed, in a follow-up study of the field characterized in Eijnatten (1980b) the palms were reported 5 years younger (Eijnatten 1981b). The corresponding revised rate of leaf emergence was 15 leaves $\text{palm}^{-1} \text{ year}^{-1}$ on 32 leaves crown^{-1} , which means a longevity of 2.1 years (Eijnatten 1981a).

7.5 Bunches and nuts

The revised rate of 15 leaves $\text{palm}^{-1} \text{ year}^{-1}$ is compatible with the 13.6 inflorescences or bunches on the same palms (Eijnatten 1980b). In the axil of each leaf an inflorescence is formed, which takes about one year from flowering to mature (Ohler 1989). Therefore the number of inflorescences should be about equal to or less than -- some abort -- the leaf emergence rate. The "about" is because of the fact that the rates of emergence of leaves and inflorescences vary with time and need not always be in step, and that farmers may be early (nuts for drinking) or late (nuts for copra) with harvesting.

Table 6.8. Trunk, leaf, bunch and nut characteristics of coconut palms in Kilifi District, Coast Province of Kenya, 1977-1983.

A. Effect of soil type and undergrowth, 7-12 m tall palms, Febr. 1980 (Floor 1981).

2. Site	-----Mwarakaya-----			-----Kizurini-----		
	ULc1	ULc1	ULc1	USK..	USK..	USK..
3. Soil unit	ULc1	ULc1	ULc1	USK..	USK..	USK..
4. Fields	10	10	10	10	10	10
5. Palms field ⁻¹	3	3	3	3	3	3
6. Remarks	food crops	cashew	shrubs	food crops	cashew	shrubs
7. Girth (cm)	96 a	96 a	97 a	99 a	100 a	106 b
8. Scars m ⁻¹	17.7 a	16.3 ab	16.4 ab	16.1 ab	15.2 b	16.2 ab
9. Leaf (m)	4.8 a	5.1 b	5.0 b	5.4 b	5.3 b	5.1 b
10. Leaflet (cm)	136 ab	141 a	133 bc	140 a	140 a	129 c
11. Leaflets	112 ab	107 abc	113 a	106 bc	104 c	110 abc
12. Leaves	30.0 a	29.3 ab	26.0 d	28.5 abc	27.2 bcd	26.7 cd
13. First bunch	7.9 a	7.6 a	7.5 a	7.8 a	8.0 a	7.4 a
14. Last bunch	25.3 ab	24.1 b	22.8 b	27.3 a	24.5 b	24.4 b
15. Bunches	15.1 b	14.4 b	12.7 c	17.2 a	15.2 b	15.0 b
16. ♀♀ bunch ⁻¹	37.0	32.7	33.0	55.2	44.9	25.6
17. Nuts bunch ⁻¹	3.8	2.7	3.5	3.5	3.3	3.1
18. Missing (#)	3.3	3.0	3.5	3.2	2.5	3.0
19. Missing (%)	18	17	22	16	14	17
20. Copra (g nut ⁻¹)	170	194	164	165	163	165

For explanation see next page.

B. Effect of soil type, palms of various heights, July-November 1980 (Brom 1981).

2. Site	Mavueni-	Tezo-	Soko	Mwara-	NE of	N of	Kizurini
	Mtwapa	Roka	ke	kaya	Kaloleni	Kaloleni	
3. Soil unit	P ₂ E.c	P ₂ E.s	UE ₁ ..	ULc ₁	USc ₁	USKA ₁	USK
4. Fields	5	5	5	5	5	5	5
5. Palms field ⁻¹	10	10	10	10	10	10	10
6. Remarks	grass	food crops	food crops	food crops	food crops	food crops	food crops
7. Girth (cm)	91 c	88 c	86 c /	92 b	97 ab	100 ab	102 a
8. Scars m ⁻¹	18.7 a	16.1 a	17.1 a /	12.0 b	11.8 b	12.3 b	13.1 b
9. Leaf (m)	5.8 a	5.6 ab	5.7 ab	5.4 ab	5.5 ab	5.4 ab	5.2 b
12. Leaves	26.3 ab	27.9 ab	24.3 b	28.3 ab	29.0 a	27.2 ab	26.5 ab
15. Bunches	16.2 bc	18.7 a-d	14.7 bcd	19.6 ab	20.3 a	17.2 b	16.5 b

For explanation see next page.

This brings us to the question of how many nuts there are to harvest. In view of the large variation within and between years it is risky to estimate yield levels from non-repeated observations. Nevertheless, it is too interesting a topic to abandon. The samples of table 6.8 had 9 to 20 bunches palm⁻¹ (mean about 15) and 2.7 to 8.9 nuts bunch⁻¹ (mean about 4). If all are harvested one year after flowering this would mean about 60 nuts palm⁻¹ year⁻¹. Even if many farmers harvested late and if the observations were in better than average years -- which may have been the case in 1982 or 1983 -- it seems that around Kaloleni yields were higher than the estimated 30 nuts palm⁻¹ year⁻¹ for Coast Province (Eijnatten 1979a). The latter figure was mostly based on the coastal strip where many plantations, including the CARS field described by Eijnatten (1980b), were less well cared for because of lack of labour. Moreover, around Kaloleni the rainfall distribution may be more favourable for coconut palms.

C. Various other studies in farmers' fields and experimental plots (palms about 10-15 years old, Eijnatten *et al.* 1977; palms about 5 m tall, Eijnatten 1980b; palms about 13 m tall, Wassink 1983; palms about 12, 12 and 18 m tall, Sprenkels 1985).

1. Date	March 1977	March 1977	Nov. 1979	Nov. 1982	Sept. 1983	Sept. 1983	Sept. 1983
2. Site	---Tezo-Roka---		Mtwapa	Chilulu	Chilulu	Mbuyuni	Kizurini
3. Soil unit	P ₂ E..	P ₂ E..	P ₂ E..	USc ₁	USc ₁	ULc ₁	USKf
4. Fields	11	11	1	1	1	1	1
5. Palms field ⁻¹	1	12	360	25	11	11	11
6. Remarks	best of farmer	random sample	CARS trial	maize trial	maize field	maize field	maize field
7. Girth (cm)	84 a	89 a	-1	101	107	91	103
8. Scars m ⁻¹	-1	-1	17.4	13.9	14.3	18.9	13.1
9. Leaf (m)	-1	-1	5.2	4.8	4.4	4.8	3.9
10. Leaflet (cm)	-1	-1	126	139	123	130	107
11. Leaflets	-1	-1	110	116	97	106	104
12. Leaves	24.6 a	23.3 a	31.5	30.4	35.0	33.6	29.6
13. First bunch	6.0 a	6.4 a	8.2	2.1	10.6	8.5	8.2
14. Last bunch	20.3 a	17.5 b	22.8	29.7	29.1	27.6	23.6
15. Bunches	13.0 a	9.1 a	13.6	17.9	15.3	11.7	12.0
16. ♀♀♀ bunch ⁻¹	28 a	34 a	19	73	21	39	18
17. Nuts bunch ⁻¹	7.9 a	5.0 b	2.7	-8.9	4.3	7.3	4.6
18. Missing (#)	2.3 a	3.0 b	2.0	10.7	4.2	8.4	4.4
19. Missing (%)	15	25	13	37	22	42	27

D. Explanation of the variables.

All variables: -1 refers to missing values.

1. Date: important due to the variation in rainfall within and between years.
 2. Site: approximate site(s) of the fields studied, see figures 6.1 and 6.2.
 3. Soil unit: according to Boxem *et al.* (1987); "." refers to approximate classifications or to groups of similar soil units.
 4. Fields: chosen for specific purposes (e.g. experiment) or stratified random sample (sometimes include all fields encountered per stratum).
 5. Palms field⁻¹: total population or random samples (extremes were excluded).
 6. Remarks: characterization of undergrowth, type of sample or field.
 7. Girth (cm): circumference of trunk measured at about 1.5 m height.
 8. Scars m⁻¹: leaf scars per m length of trunk (counted over varying lengths).
 9. Leaf (m): length of one leaf, usually the oldest and lowest.
 10. Leaflet (cm): length of longest leaflet.
 11. Leaflets: number of leaflets per leaf (one side only).
 12. Leaves: number of unfolded and living leaves per palm.
 13. First bunch: rank number of leaf with youngest opened inflorescence.
 14. Last bunch: rank number of leaf with oldest inflorescence (bunch).
 15. Bunches: total number of inflorescences or bunches.
 16. ♀♀♀ bunch⁻¹: number of female flowers on youngest opened inflorescence.
 17. Nuts bunch⁻¹: number of nuts on one but oldest or oldest bunch.
 18. Missing (#): number of aborted inflorescences = (13) - (12) + 1 - (14).
 19. Missing (%): % of missing inflorescences = 100 * (17) / ((13) - (12) + 1).
 20. Copra (g nut⁻¹): oven dry (0 % moisture).
- Statistical significance is as given by the sources.

The distribution of nut yields appears to be very skewed, with many palms yielding none or few nuts and some trees yielding many nuts. Of a sample of 132 mature palms on 11 farms in Tezo Roka, north of Kilifi, 18 % was unproductive (Eijnatten *et al.* 1977). Of the 480 palms in the CARS field monitored in 1980 15 % did not yield any nuts at all (Eijnatten 1981b). Of the 120 palms observed in Mwarakaya and Kizurini 26 % had 0 nuts on the penultimate bunch (Floor 1981). At the other end of the spectrum are cases in which less than a quarter of the palms

accounted for 50-60 % of the nuts, and less than half for 70-90 % (Eijnatten 1981b; *Wassink 1983*). In other studies the numbers of palms did not allow conclusions to be drawn per field, but their overall results confirmed the picture sketched (Floor 1981; Brom 1981; *Sprenkels 1985*).

From the above there appears to be little doubt that a quarter of all the palms in the area could be cut (especially the ones whose vegetative characteristics are also disappointing) without appreciably affecting the total nut yield. Some farmers maintain that a palm with at present only few nuts might do better next year. This view is supported by the biennial bearing pattern in a sample of palms on Zanzibar. However, these palms also showed a high consistency in nut yields; correlations between the yields in individual years and the five-year averages varied between 0.73 and 0.88 (Eijnatten 1981d). Therefore, a poor palm may improve somewhat, but is unlikely to turn into a high yielder. Nevertheless, many farmers appear to prefer to have a few nuts now rather than the promise of many in the future.

Estimates of the quantity of copra per nut vary: about 140 g (after Hobley *et al.* 1914), 163 g (Sethi 1953), 142 g (Bulder 1975) and 170 g (Floor 1981); they are all on the low side compared to copra yields elsewhere (table 6.7).

8 PALM WINE

8.1 Alcoholic drinks

The tapping of palm wine in East Africa was already recorded in 1505, when the Portuguese d'Almeida sacked Kilwa and Mombasa (Freeman-Grenville 1962). At that time and up to the late 19th century most Mijikenda still depended on alcohol from other sources. They drank *utsoro*, a beer made from grain (Herlehy 1985) and various other alcoholic beverages.

"The Wa-Giriama are extremely fond of drink, and make *tembo* (beer) from the coconut palm, *mkoma* (hypharne palm), *wimbi* (honey, sugar-cane), *mtama* and *mohindi*. They prefer the *tembo* made from the coconut palm, as it is the strongest." (Barrett 1911: 26)

Although these drinks are still occasionally encountered today, in the course of the 19th century palm wine gradually became the principal alcoholic beverage and until far in the 20th century remained the main product of the coconut palm.

"The WaNyika [Mijikenda] regard a coconut palm as primarily a producer of *tembo*, nuts being regarded as a by-product, and only receive attention from a few of the more enlightened." Champion (1914b: 93)

In the late 1920s "George Piwa", a freed slave, came from Kisauni a village just north of Mombasa to Rabai, where he taught the people how to distil palm wine into the strong liquor *piwa* (Herlehy 1985). Among the Mijikenda this spirit is much less popular than palm wine -- and somewhat associated with alcoholics -- but it has the advantage that it can be made from old palm wine and stored for long periods. At first men were the distillers, but gradually women obtained the main role in the distilling, transporting (smuggling) and selling of the liquor, whose production, marketing and consumption was prohibited in 1941.

Apart from the above locally made beverages one can drink European style lager beers like "Tusker" or "White Cap", made by Kenya Breweries and sold in bars in the towns and large villages. However, for most people these are not realistic alternatives, as they are vastly more expensive than the "local brews".

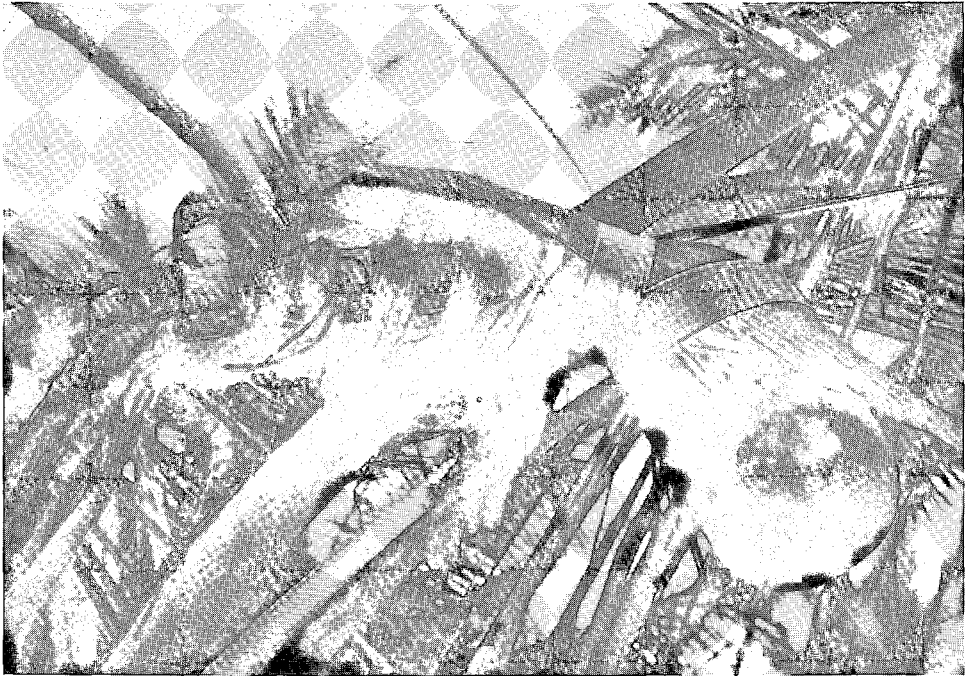


Photograph 6.5. In the past after toiling in the sun farmers used to relax in the shade enjoying a calabash of palm wine.

8.2 Tapping palm wine

"Coconut palms are planted mostly in and around the kraals and are so extensively tapped for toddy that it is very difficult to say if they would bear well if given an opportunity." (Champion 1914a: 9)

According to the farmers I interviewed not all palms are equally suited for tapping. Most farmers select their palms on the basis of previous results and by trial and error. When they choose new trees they look for good looking trees with many healthy leaves. Photograph 6.7 shows how the palms are tapped. Just before flowering the spathe is tied with a rope, so that it cannot open. If necessary, it is bent down with a stick, its surface is beaten for several days to initiate the flow of sap and its tip is cut. Two or three times a day a fresh thin slice is cut off. When the sap starts to flow a small calabash is hung at the top of the spathe. Insects are kept out by covering it with the fibrous material which supports the leaf sheaths and tying this with the leaflets of the palm. Every morning and evening the sap is collected into a larger calabash and a fresh thin slice is cut off the spathe; some tappers also re-cut the spathe during midday. Yeasts in the less than sterile calabashes immediately start to ferment the sweet sap. Therefore upon collection it already contains some alcohol. Some hours later it reaches the preferred alcohol content and flavour. Older wine may be mixed with younger wine to obtain the required taste. As no actual brewing takes place many Mijikenda object to the use of the word "brew" for their popular drink.



Photograph 6.6. Inflorescence of dwarf coconut palm being tapped. The spathe is bent down with a stick and tied with a rope so that it cannot open. The calabash is covered with fibres from the leaf sheaths, which are kept in place with a leaflet.

As palms form up to 10 or more spathes per year and the tapping of a single spathe may last 1-2 months, a palm often has 2 or even 3 spathes being tapped at any given time (moreover, spathes often come in flushes). Usually palms are tapped more or less continuously for a period of 4 to 8 months, after which they receive a long rest period, which may be a year or even longer. Several informants of Hobbly *et al.* (1914) reported more or less set periods of tapping following by set rest periods. In my survey the farmers around Kaloleni varied the tapping and resting periods in accordance with the conditions of the palm and the season. Toddy yields tend to be low during the April-June rains, from August they gradually build up to reach a peak in the dry months from December to February, to drop again at the start of the new rains (Mbotela 1974; Herlehy 1985). In Kaloleni farmers' words, they are low during the maize season and high during the pineapple and cashew harvest. Farmers report yields of about 1 bottle (0.7 l) palm⁻¹ day⁻¹, with peaks of up to 3 bottles depending on the palm, the number of spathes tapped and the season.

To facilitate the tiresome climbing, sometimes small steps are cut in the trunks of tapped palms. The steps, often enlarged by rot, reduce the number of vessels available for transport of water, minerals and assimilates. The presence of such steps indicates that at some time during its life the palm has been tapped. A palm actually being tapped can be recognized from a great distance by its drooping leaves and the open crown caused by the removal of fibres and leaflets. This not only helps *askari* (policemen) to spot illegal tapping, but also strongly reduces the photosynthetic capacity of the canopy. Therefore, it takes the palms much longer to recover than the four months recorded in the literature, for palms treated probably more gently (Child 1974).



Photograph 6.7. The use of leaflets for the tapping of palm wine reduces the leaf area and photosynthetic capacity; the coconut palm on the right is being tapped.

During the 1960s the Kenyan government made attempts to improve tapping methods (Grimwood 1969). They had little success; apparently the labour intensive Ceylonese methods they were advocating were inappropriate for the plantations of the Mijikenda, where palms vary considerably in height and where at any given time only a few are being tapped.

"... those people of Ceylon came and said that we [Mijikenda] are damaging the coco tree by putting those holes for placing your leg when going up. They said that people should use ropes and tie them from one tree to another to all of them. Then people can go from one tree to another by using those ropes. They can be used for collecting cocos or even for tapping. They showed us the system, but people found it not good, so they started using the old method again." (*Bennett 1985*)

8.3 Regional trade

For the Mijikenda, palm wine -- apart from its use in ceremonies -- was primarily a locally consumed product to be enjoyed in the company of friends and neighbours. Palm wine was a gift: an excuse to invite friends to a drinking party, or to visit them and take a calabash as a present. Once the present was finished, the host would probably send one of his sons to get some more. There were no bars and attempts to introduce them initially met with little enthusiasm.

"Tembo [palm wine] of course accompanies nearly every ceremony but in that case it is purchased by the Kazama [large calabash] from the producer and retailed by gift and not by sale. You cannot control the retailing in the Nyika [Mijikenda] country. Every house is a public house once or twice every month. Natives do not care to walk two hours over to the one licensed banda in the neighbourhood, pay six cents for a cup of tembo and walk home again. They like to have a sort of drinking club and make a night of it at a friend's village close by." (*Champion 1914b: 94/95*)

The consumption pattern described above has changed little, but apart from its role in cementing local friendships palm wine has also become a cash crop. It played an important role in the trading networks of the mid 19th century, not only as trade article but also as a lubricant in the sometimes strained tribal relations (Krapf 1860; Herlehy 1984b, 1985). There was a lively south-north trade amongst the Mijikenda themselves as well as east-west exchange with Kamba, Taita and others who passed through Mijikenda territory on their way to or from Mombasa. In the later part of the 19th century the Mijikenda contribution to the long-distance ivory trade declined, but the regional trade in palm wine continued to grow.

Between the mid 19th and the mid 20th century the palm front moved northwards from Rabai to Kauma. Therefore the wine traffic gradually shifted from south-north to east-west, towards the Duruma, Giriama, Kamba and Taita pastoralists and agriculturists of the dry hinterland, where palms could not be grown. Another market was formed by the labourers of European owned plantations in the coastal strip. In the course of the 20th century the focus of the

expanding palm wine trade changed towards the strongly growing urban centres, notably Mombasa and to a lesser degree Malindi, Kilifi and Voi (Mukabi & Hendrickx 1980). There it was consumed by Mijikenda workers and by other wage labourers who soon got used to the cheap and refreshing drink. Most of these consumers were young; from being the privilege of a few old men, palm wine became the refreshment for a majority.

The new markets, the increase in volume and a gradual improvement of the road infrastructure and means of transport caused changes in the organization of the trade (Herlehy 1985). During the 19th century it was most common for buyers -- more often their sons -- to come to the homesteads of producers to buy the wine and carry it home (*Wakanyoe* 1984). In the early 20th century, when intertribal hostilities had ceased, women increasingly became involved in the trade. They carried the wine on their heads to the plantations and towns in the coastal strip, where they sold it for their fathers or husbands or on their own behalf.

Later in the century the long-distance transport was taken over by cars (pickups) coming daily from the towns to wine-producing areas. Local female traders bought the wine from the tappers, carried it to collection points and sold it there to the pick-up owners. These transported the wine to the towns, where it was consumed the same day in *pombe* (palm wine) clubs or beer halls. In organization and efficiency the marketing of the perishable palm wine could probably compare favourably with any milk collection system.

Until 1981 the sale of palm wine was the main source of cash income for many Mijikenda households. Compared with other economic activities its production required few inputs, gave a relatively high and regular income, and allowed the producer to stay at home. The approximately 20 palms a tapper could handle daily yielded enough to buy food in shops, pay for clothes and to invest in farming and other business and in the children's education (Nation 1982). The coconut palm - as a producer of wine - was without doubt the best cash crop of the Mijikenda, both by virtue of its own and for lack of alternatives (O'muga 1982).

8.4 Government policy

Not all opinions on the production and consumption of palm wine were positive. One of the points Muslim proselytizers and Christian missionaries had and have in common is their rejection of palm wine (Krapf 1860; New 1873; Hobley *et al.* 1914). Followers of these religions had to forsake the (public) consumption of palm wine. In time, palm wine consumption with its social and ritual connotations came to be seen as a central characteristic of Mijikenda paganism (Parkin 1970, 1972). A happy neighbour explained to me that a Muslim could drink beer, and Allah would forgive him his weakness, but he should not touch the heathen palm wine.

Another group of opponents to palm wine was formed by colonial officials and European settlers. Their concern did not spring so much from religion as from economics. They feared the negative influence tapping and drinking had on copra production, labour availability and development in general. Even their moral indignation often had an economic undertone.

"Its physical effect is bad and it also tends to undermine the moral character of the individual. It is further believed to have a detrimental effect on the material progress of the people and on the output of economic products generally." (Hobley *et al.* 1914: 4).

The colonial government actively discouraged the production and sale of palm wine. As early as 1897 licences and fees for palm wine traders were introduced in Rabai and Ribe (Herlehy 1985). The tapping of palm wine was a central issue in the report of the Coconut Commission appointed in 1914 to "consider the question of the improvement of the coconut industry" (Hobley *et al.* 1914: 1). The commission considered that it should and could not be extirpated as that would cause too much hardship for those depending on it and, moreover, such action would be impossible to implement because of a lack of staff and might meet with strong opposition. Instead the commission proposed to curb the production, trade and consumption of palm wine by making it more expensive by means of regulations and taxes, with the taxes themselves paying the cost of their enforcement (Hobley *et al.* 1914).

The main measures implemented to control the trade of palm wine were the *mabanda* (licensed clubs) system from 1905 to 1943, tappers' licences from 1926 to 1970, laws which gradually restricted the role of women in the palm wine trade, and occasional transport limitations (Herlehy 1985). The Mijikenda reaction -- friendly but determined circumvention -- is aptly characterized by the following quotation.

"So far the Waduruma have taken my refusal to supply permits for beer very well indeed and with the utmost good nature but probably attempts will be made to obtain beer illicitly from Kilifi District." (KNA, 1940a)

It was not easy to enforce the regulations. The district headquarters in Kilifi and Kwale were far from the main production areas, field supervision was hindered by lack of staff, and the Mijikenda -- including many chiefs -- almost unanimously opposed the regulations. Several British officials even stated that drinking in the Mijikenda area was in fact no worse than elsewhere and that the restrictions on the profitable cash crop were somewhat unfair (Herlehy 1985).

The government of independent Kenya at first had a more lenient view on palm wine production, which showed itself in various ways. In 1968 a visiting Ceylonese expert taught the Mijikenda the latest tapping methods (Grimwood 1969). In 1970 president Jomo Kenyatta abolished the tappers' licence law (Herlehy 1985). Palm wine became so respectable that a tapper was declared "farmer of the month" (Grimwood 1969) and a Provincial Director of Agriculture could afford to describe the tapping procedure in the periodical "Kenya Farmer" (Mbotela 1974).

However, in 1981 president Daniel Arap Moi outlawed all locally made brews including palm wine, except for ceremonial purposes, because of their supposed retarding influence on economic development (Herlehy 1985). In contrast with previous restrictions he aimed at complete extirpation. As in the case of earlier measures the implementation of the prohibition was far from complete. The "ceremonial purposes" were interpreted as widely as possible. Inside the palm areas the control of tapping and drinking was impossible anyway, and smuggling to areas outside became the order of the day (Nation, 1984e). Nevertheless, the effects of the ban were substantial. Hundreds of people were arrested and convicted and many more were deprived of their drink (Standard 1982a, 1984e; Nation 1984a).

Although the ban did not stop the trade, it certainly reduced its volume as our sample of 31 Chonyi, Jibana and Giriama farmers in Kaloleni division showed. Before the prohibition, 26 of them tapped an average of 15 palms each, whereas afterwards 15 tapped 9 palms each, a reduction of 42 % in the number of tappers and of 65 % in the number of palms being tapped. Also local consumption may have diminished in frequency and/or quantity. Of the 31 farmers 16 did not change their behaviour (including some teetotallers), 14 drank less (due to lack of money or opportunity) and only 1 had increased his consumption (while waiting for customers).

8.5 Wine or development?

All over Kenya the ban sparked much discussion, but nowhere did it become as hot an issue as in Coast Province, and notably in Kwale and Kilifi districts. Elsewhere the ban robbed many poor people of their favourite drink, but only a few of their livelihood. Here it interfered with the main source of income of a large part of the population, who had but few alternatives (O'muga 1982). The ban became a central theme in local politics and a hot news item (Standard 1982b; Raymond 1983). Expressions from opposing sides displayed an impressive mixture of truth and exaggeration.

"The Kilifi Resident Magistrate said the [palm wine] trade was becoming a menace in Kilifi District, and that women and children were starving while men drank themselves to death." (Nation 1983: 15)

"Kilifi South MP [member of parliament] ... said: "Miji Kenda have been utilizing mnazi [palm wine] for earning a living and for traditional ceremonies since time immemorial. They have therefore no intention of abandoning mnazi which is the most lucrative and life sustaining product of our mother tree ... Dr. Chibule [the member of parliament] claimed that more children were out of school than ever before as the people were economically disabled because there were no alternative jobs available." (Nation 1982: 3)

As before, the central theme behind most rhetorical smoke was economic. In the background, morals (or the supposed lack of them) may also have played a role, but in public both parties preferred to point to the economic consequences of the palm wine trade or of its prohibition.

Tapped spathes do not produce nuts. However, as only a small fraction of the palms was tapped the direct effect of tapping on nut and copra production was rather limited. Of more interest is the possible negative effect tapping might have on the future productivity of the palms. As they are tapped in some sort of rotation this would affect large numbers of palms.

At the usual production levels a tapped palm yields more in terms of joules than one harvested for nuts, but there is no proof that this weakens the palm (Ogotu 1981; Ohler 1984). A palm tapped during six months of the year and yielding one bottle (0.7 l) of wine day⁻¹ with a sucrose content of 15 % yields about 20 kg of sugar year⁻¹. The same palm might produce 30 nuts with a copra content of about 160 g nut⁻¹ or 4.8 kg in total, plus the dry matter in husks and shell. Taking into account the energy contents of their constituents the amounts of joules harvested with nuts and palm wine differ but little. The picture would differ in the case of tapping for longer periods, or with higher yields.

Some of the Kenyan and British informants of Hobley *et al.* (1914) claimed that nut yields were lower after tapping, but others thought that they were better. Most of the farmers I interviewed did not seem to see the issue as a potential problem. Many of them admitted that the rhino beetle prefers tapped palms, but on the other hand beetles in tapped palms are much more likely to be noticed and destroyed (Hobley *et al.* 1914). The practices of cutting steps in trunks and using the leaflets and fibres of the palms being tapped do undoubtedly harm the tree and are not easy to change. However, as long as the harm is richly compensated by the profits of palm wine production, it should perhaps be tolerated.

Coast Province is a net importer of food, and malnutrition is common. However, unlike many other alcoholic drinks palm wine is not made from cereals and therefore does not compete directly with food consumption. Instead it complements the diet of the drinker with sugar, a little protein, iron and some vitamins (Platt 1962; Ogotu 1981). Indirectly palm wine has contributed to malnutrition when, as in other societies, some fathers overly fond of it have neglected their women and children. However, palm wine has provided many more with the cash to buy the foods, which their small and exhausted maize fields could not produce, not even with multiples of the labour needed for tapping.

In the national press Coast Province, especially Kwale and Kilifi Districts, figures as a backward area (Times 1983; Standard 1983). In some cases palm wine may have retarded development (Nation 1984e), but in general the causes are less simple and tapping was one of the few flourishing economic enterprises responsible for the little prosperity there is (O'muga 1982).

In spite of many assertions to the contrary, the overall level of alcohol consumption in Kwale, Mombasa and Kilifi Districts before the prohibition in 1981 was moderate. If we assume that of about 2.5 million palms 8 % were tapped with a yield of 0.7 l palm⁻¹ day⁻¹, the production would be at most 0.15 l person⁻¹ day⁻¹. According another estimate (which is probably too low because it is based on interviews in beer halls) the consumption of palm

wine was less than one fifth of the above and unimpressive compared to alcohol consumption elsewhere in Kenya (Nout 1981). Therefore, the idleness and -- possibly seditious -- gossip related to drinking were probably more deleterious for development than the quantities of alcohol consumed.

The 20th century growth in palm wine production has taken place in spite of strong government opposition. In the name of development, palm wine has been forbidden, discouraged or at best tolerated for most of this century. In spite of the noble intentions the attitude to palm wine always has always been somewhat hypocritical. For example, an informant of the Coconut Commission who proposed that *tembo* (palm wine) should be prohibited, himself expressed the yield per palm as "about half a whisky bottle in amount" (Newitt 1914: 28). Not surprisingly, many poor Mijikenda have difficulty accepting the attacks against their *mnazi* (palm wine) from the mouths of administrators who themselves can and do buy the expensive "Tusker" or "White Cap" beers of Kenya Breweries, one of the most flourishing industries of the country.

For the future of Kilifi and Kwale districts it might be better to use the local interest in palm wine as a basis for development, for example by setting up a distillery to substitute for the import of liquors (Standard 1984d). Regulating instead of prohibiting the production, processing and commercialization of palm wine products would have various benefits:

- taxes to be used for development and a cheap drink for the rural and urban poor who cannot afford expensive beers;
- income for palm owners and tappers, who will no longer be seen as parasites but as respected members of the Kenya society, like the upcountry farmers who grow barley for Kenya Breweries.

9 NUTS AND COPRA

9.1 Coconut producers

In the early 20th century the use of coconut palm products was ethnically differentiated. Arabs and Swahili grew nuts for home and local consumption, the British produced copra for export, and the Mijikenda tapped wine for local consumption and regional trade.

Coastal Muslims

The Muslim Arabs and Swahili of the coastal towns and villages use sweet palm wine and oil extracted from *nazi* (ripe nuts) for cooking and *madafu* (immature nuts) as a fresh drink.

Their greatest demand for coconuts is during the fast of Ramadan, when often the first drink after a day of fasting is the water of a *dafu*, and when many special dishes are prepared for the night.

The Arabs and Swahili also involve(d) themselves in the production of copra, but their proximity to coastal villages and towns made the sale of nuts more attractive. After the prohibition of slavery many compromised somewhat with their belief and had palms tapped by Mijikenda, notably Rabai (Cooper 1981; Herlehy 1985). In that way they were less affected by the prevalent theft of nuts, they received some income, and their palms some care. A full discussion of coconut growing and the use of coconuts by Arabs and Swahili falls outside the scope of this paper.

White man's burden

"... a European holding at Sokoke coming into bearing. This plantation may be considered a model plantation and is of considerable educative value not only to planters but also to natives would the latter but read its lesson." (DoA 1926: 205)

The main interest of early 20th century European coconut growers in the coastal strip was in the production of copra for the export market. Although these producers have long since disappeared, they are discussed briefly, as their views influenced government policies affecting Mijikenda coconut growing.

In spite of Fitzgerald's (1898) optimistic writing on the agricultural potential of the Kenya coast it proved rather difficult to find crops that could be successfully grown on a plantation scale.

"There are hundreds of men willing to stake their last farthing that there is a "great future" before the country, but though this phrase has been in vogue some years, no definite hint has yet been given as to what that future will be." (Stigand 1913: 183)

After the 1913 rubber crash the growing of coconut palms for copra production was one of the few alternatives left for white planters. It proved no lasting solution; the fame of Denys Finch Hatton does not stem from his success as a coconut grower, but from his role in "Out of Africa" (Blixen 1937).

"Men joined together in syndicates to find gold, to buy land and develop it in coconut and other plantations. It was my sad duty to wind up one of the last of the syndicates - the Nazi (coconut) Syndicate which had as partners men like Denys Finch Hatton, M. S. H. Montagu, John Milligan, Tich Miles and others. When the last man, Milligan died I took over the company's affairs and sold the last of their holdings at the Three Hills for £ 25 an acre. Fire had killed every tree on the coconut plantation." (Rodwell 1984: 14)

Other plantations fared little better. Of the impressive Sokoke plantation just northwest of Kilifi in 1981 only dead stumps and dying palms were left, a much quoted example of the dangers of the unchecked breeding of rhino beetle (Marschall 1976; Eijnatten *et al.* 1977). Indeed, the beetle formed a constant threat, conveniently blamed on lack of phytosanitation in Mijikenda plantations (Hobley *et al.* 1914). However, various other factors were involved in the failure of large-scale coconut growing:

- The stealing of coconuts was rampant in the coastal strip, in contrast with the Mijikenda area where social control did prevent such practice. A tapper in Malindi claimed: "Anyone who can climb a palm will steal" (Hobley *et al.* 1914: 39).
- Although the rainfall is too low for optimal growth and yield, at the same time the high humidity and cloudiness make it difficult to produce quality copra throughout the year without artificial drying (Vianna 1969).
- Low copra prices (in relation to costs) and the crisis of the 1930s caused a strong decline in "non-African" coconut acreage and copra production (Ogutu 1981; Herlehy 1985).
- Lack of cheap wage labour, often attributed to Mijikenda fondness for palm wine and laziness, formed the main constraint and made coconut a peasant crop instead of a plantation crop (Ogutu 1981).

Government measures in the areas of theft prevention, rhino beetle control, discouragement of palm wine, and labour policy were apparently unable to stop the collapse of large-scale coconut production. The 1,200 ha Msambweni Development Co. plantation between Mom-basa and the Tanzania border is now the only surviving large scale coconut producer (Ngugi 1983).

Black farmers' enterprise

To the regret of early colonial officers the Mijikenda mainly exploited the coconut palms for wine. Unripe nuts were and are a popular drink, frequently offered to visitors. The use of ripe coconuts for cooking is of less importance than among Swahili and Arabs, perhaps because the staple food of the Mijikenda is *ugali*, a thick porridge of maize meal, rather than rice.

At the start of this century most of the little copra and coconuts produced came from the "*Ahendakudza*" (people who came late). The term refers to slaves who in the 19th century fled from the coastal strip to the Protestant missions that had been established in Rabai and Ribe (Herlehy 1985). They were converted to Christianity and so could not (openly) engage in palm wine production. Moreover, being educated at mission schools, many found work as clerks in the government service and in commerce. This was incompatible with the daily

palm wine tapping and trade, but could easily be combined with the periodic harvesting, processing and selling of nuts or copra.

In the course of this century many Mijikenda also turned to the production of **copra**. The main factors behind this move were the growth of the numbers of palms beyond what could be tapped and the high prices of copra during the fifties. Farmers around Kaloleni tried to increase their access to palms, nuts and copra by planting new palms or by borrowing already producing ones. This process led to a general scarcity of land and palms, to differentiation between palm owners and those who did not have palms or had lost them, and to some specialization in palm products or other economic activities (Parkin 1972).



Photograph 6.8. Most Mijikenda farmers produce only small quantities of copra; here it is being dried in the sun.

During the 1960s the copra price dropped again and farmers renewed their interest in palm wine or exploited the market for fresh **nuts** created by population growth and made accessible by improvements in road infrastructure. The resulting scarcity of copra in 1984 was expressed in a price war between private oil millers in Mombasa and the Kilifi District Cooperative Union (Standard 1984a). The millers lured farmers by paying high prices immediately on delivery and the union had to follow suit in order to defend their investments

in an oil mill established in Kilifi in the early 1980s. Farmers claimed for higher official prices and meanwhile smuggled their copra to Mombasa.

The above sketch is a simplification. In reality there was considerable variation in production and marketing between areas and farmers, related with population and coconut palm density and distances to markets or access to transport. Before examining the reasons and logic underlying the various choices and changes, the practice of the production of nuts and copra will be described first.

9.2 Harvesting of nuts

Contrary to what the "joke" in the introduction to this paper suggested, most coconuts are harvested actively. Every 2-6 months or whenever there is need for food, drink or cash, somebody climbs the palms to throw down the nuts. Where large numbers of palms are involved hired labour is often used, usually paid in kind, e.g. 2 nuts per palm harvested. The nuts are transported in bags or in simple baskets, plaited on the spot from coconut leaves. The owner may bring the nuts to Mombasa or other markets himself, via middlemen with vehicles, or via the conductors or ticket sellers on the buses that ply between the country and the towns.

Fresh and ripe nuts are often mentioned in one breath, but they are very different products. The former have to be picked at exactly the right stage, usually one bunch per palm per harvest, and must be marketed quickly. They are sold with the husks, as dehusking might damage the soft shell, removes the thermal isolation, and makes the product look less attractive. Therefore, fresh nuts are a bulky product with high transport costs. Ripe nuts for cooking are sold without the husks. They can be harvested at longer intervals, which means dropping more bunches at a time. They keep longer and, as the husks are removed, require more labour, but are easier and cheaper to transport.

In the case of copra production the nuts are usually carried to the homestead (dehusked, if the distance is great). There the dehusked nuts are cut in half and sundried for one or two days to loosen the fruit flesh (endosperm) from the hard shell. After separating the flesh from the shell with a spatula, it is dried for one or more days. Then the copra is bagged and transported to a nearby cooperative society or smuggled to Mombasa. Although most copra is produced during the dry period from January to March, it is generally of poor quality because of drying on the bare earth of the homestead, the high humidity of the air or too short a drying time. The lack of a price differential between low and high quality copra may explain why previous attempts to introduce kiln-drying have failed (Vianna 1969; Eijnatten *et al.* 1977; Ogutu 1981).

Fresh nuts, ripe nuts and copra can all be produced and marketed in many different ways. Some farmers do all the work themselves or hire labour only for the dangerous job of dropping the nuts. Others employ hired labour for several or all stages of the processing or depend on middlemen for transport to a cooperative society or to an oil miller. Coconuts can be sold at all stages, while still on the palm, after dropping, after dehusking, as dried copra to the miller or as drinking nut to the consumer. That makes attempts at calculating cost prices or gross margins difficult and the results questionable (Eijnatten *et al.* 1977; Mukabi & Hendrickx 1980).

9.3 Choice of products

The question of how the Mijikenda should use their coconut palms has kept them and other people busy since last century. The choices are exclusive as -- per palm -- the major products are incompatible: tapped spathes do not make nuts and nuts sold for drinking or cooking do not give copra.

Before considering the details, it is helpful to have some idea of the returns on wine, nuts and copra production; the prices refer to the period 1981-1984. Tapping 20 palms, each yielding 1 bottle or Ksh 2.50 palm⁻¹ day⁻¹, and sharing fifty-fifty between owner and tapper, gives an income of about Ksh 9,000 year⁻¹ each. For the same income, without accounting for labour or other costs, each of them would need 300 palms yielding 30 nuts year⁻¹ and sold at Ksh 1.00 nut⁻¹; for most of the year the fresh and ripe nut prices are lower. To produce 1 kg of copra 6-7 nuts plus extra labour and dry weather are needed. With farm gate nut prices of Ksh 0.40-2.00 nut⁻¹ and official copra prices of Ksh 2.50-4.50 kg⁻¹ the balance in most cases is in favour of selling nuts.

The main questions about the production and marketing changes sketched above are, in more or less historical order, why wine instead of copra, why copra instead of wine, and why nuts instead of copra?

Why wine instead of copra?

If the *Ahendakudza* early in the 20th century had good reasons to make copra, the Mijikenda had strong arguments not to produce it:

"The work of husking, etc. is considered too arduous and not sufficiently remunerative."
(Champion 1914b: 93)

This short summing up may need some refinement. Making copra requires much labour in relation to the value of the product, although less per palm than palm wine tapping. At the start of the century most farmers had only a few palms, and wine gave and gives the highest

revenue per palm (Herlehy 1985). Furthermore, copra -- and coconuts even more -- are bulky products and they had to be carried over long distances because of the absence of road infrastructure at the start of the century. In contrast, palm wine was usually sold at the producer's homestead and carried home by the buyer. Copra had to be sold via Indian, Arab and Swahili middlemen. The fact that many Mijikenda were in debt to these traders may have discouraged them from selling their copra to them. The main obstacle for nuts and copra was probably that there was a much more profitable and enjoyable alternative: palm wine.

Why copra instead of wine?

The later move towards copra and coconuts was stimulated by various factors. There was a strong increase in the number of coconut palms, as their cultivation extended into nearly every area where they could be grown. Whereas early 20th century descriptions gave the impression of isolated palms dotted around homesteads, at present areas like the Rabai -- Kaloleni -- Chonyi triangle are endless coconut forests.

The demand for palm wine has not kept pace with the number of palms planted. Moreover, its production was restricted by the number of palms a tapper can handle. The production of coconuts and copra requires far less labour per palm and therefore more palms could be planted and handled. Not only were there increases in the number of growers and in the number of palms planted per grower; there was also a concentration of usufruct or ownership by acquisition. Parkin (1972) sketches the formation of a class of capitalistic Giriama entrepreneurs characterized by accumulation of palms and production of copra. Giriama by custom did not tap their own palms, but could harvest their own nuts and make copra, or hire people to do this for them on a strictly labour basis.

The prices of copra have varied, but there has always been a demand. It was bought by Indian, Arab, Swahili and later also Mijikenda middlemen, who sold it to oil mills in Mombasa. In Kilifi they were replaced by the Kilifi District Cooperative Union (KDCU), established in 1965 and the sole legal buyer of copra. From the twenties copra exports were replaced by oil production for the growing domestic market (Herlehy 1985). Kenya imports most of its vegetable oil needs (Ngugi 1983). Local production is inadequate in quantity and quality, and only competitive because of the import duties on imported oil palm and coconut oil (Mureria 1981).

Why nuts instead of copra?

There are several reinforcing reasons why during the recent decades coconut farmers have turned their attention to the sale of nuts for drinking or cooking. Copra prices in general were considered too low to compensate for the effort of dehusking, splitting, drying, removing shells, and further drying. Some farmers kept making it, during dry periods,

because they lived far from roads, or because of the ease of marketing copra. Others exploited their position with regard to towns or roads and their access to buses or pick-ups to sell nuts, directly or via intermediaries, to Mombasa and other coastal towns. Populations are growing very fast, and so is the demand for nuts used in cooking and for drinking. Nuts fetch high prices of Ksh 2.00 each or even more especially during the fast of Ramadan.

The improvement of road infrastructure and bus services reduced the transport costs and relieved a major bottleneck in the marketing of bulky products like nuts. Since the 1970s Kaloleni has been connected with Mombasa via a tarmac road and moreover it is a focal point in a bus network connecting it with Kilifi, Bamba, Mariakani, Mazeras and Mombasa.

Probably, the prohibition of palm wine has also had some influence. The direct effect must have been limited, as only a small proportion of the palms were tapped. Indirectly, the loss of income caused by the ban may have stimulated farmers to put more effort into the marketing of nuts.

Prospects for nuts and copra

In view of the strong commitment of the Kenya government to eradicating the production and consumption of local brews, it is unlikely that palm wine will regain its prominent role in the Mijikenda economy in the near future. The production of copra will probably be limited to areas far from markets and with large surpluses of nuts and to periods with dry weather and low nut prices. Copra production will be particularly affected in years in which the fast of Ramadan coincides with the dry season. Copra prices are unlikely to rise much and, if the import duties are rescinded, they may even fall. Therefore, any increase in production must come from a large expansion of the areas planted or a marked increase of the yields.

Small increments in areas and yields are easily absorbed by the growth of the population of the countryside and the towns. In the early 1980s Coast Province had about 1.5 million inhabitants (CBS 1981). With a consumption of only 1 nut person⁻¹ week⁻¹ they could easily absorb the total production of 2.5 million palms with a yield of 30 nuts palm⁻¹ year⁻¹. A study by the Ministry of Cooperative Development estimated the demand at more than twice this (Hendrickx 1981). This suggests that fresh nuts are the product of the future, being the only product not threatened by moral objections, cheaper imports or lack of demand.

10 OTHER PRODUCTS

"The coconut palm said: 'It is true, good is rewarded with evil. Man takes my nuts, taps my saps, and to cap it all, he cuts off my leaves for his roof.'" (Knappert 1970: 131)

The "tree of life" is famous for its wide range of products. Wine, copra and fresh nuts are only some of them. Nearly every part of the palm is used. Although compared to wine, nuts and copra, the other products are of little importance, together they make a considerable contribution to household employment and income among the Mijikenda.

Trunks

Some farmers split coconut trunks to make poles to build walls, but most still reject the cutting of palm trees and such evil use of the trunk. However, the hardwood poles for the construction of the usual mud-and-wattle during my short stay in Kaloleni more than doubled in price. Further rises are likely to change the local mores with regard to the coconut palm.

Petioles and leaflets

The petioles are already a common construction material. They replace the *fito* (tough twigs), which were a by-product of the long fallow periods of the past, but now are becoming scarce. Another alternative is to use split sisal poles, but these appear to be more susceptible to termites and, because of the reduction in sisal acreage, also less readily available. The thick bases of the petioles are used as fuel for cooking, especially in areas where firewood is scarce (as is the case in most areas with many coconuts and a high population density).

The green leaves are plaited -- on the spot -- into baskets for the transport of coconuts, citrus fruits or mangoes. They are also used for temporary doors or screens, e.g. around bathing places. The dry and fallen leaves are taken to the homestead where women, sometimes also men, plait the leaflets and pieces of petiole into *makuti*. Two of these square roofing tiles of about 60 cm x 60 cm can be made from one leaf. They have a farm-gate value of Ksh 0.50 each. Most *makuti* are used on the farm, even a small house needs several hundreds of them and they have to be replaced every three years. However, they are also a handy means of earning some little cash for household requirements and used as such by enterprising women. Most are made during the dry months between December and March, but there is also a small peak in June, possibly related to the scarcity of money just before the maize harvest. Some farmers avoid the labour-intensive making of *makuti* by selling coconut leaves to more industrious or needy neighbours.

The use of *makuti* increased after the abandonment of the *makaya*, where oval houses thatched with grass were the rule and rectangular houses were looked at with disapproval. Another stimulating factor was probably the disappearance of tall grasses like *muchuchi* (*Hyparrhenia rufa*) caused by the expansion of intensively cropped land. Nowadays, nearly all houses are rectangular and made of wattle and mud or coral blocks and cement, and covered with *makuti* or corrugated metal sheets. The latter last much longer and are conquering both countryside and coastal towns, where their use is stimulated by low-income

housing projects funded with foreign aid (Macoloo 1991). This has been compensated for by luxury houses and tourist hotels on the coast, where *makuti* are appreciated for the cool and rustic atmosphere they create.

Another product is the small brooms made from the midribs of the leaflets. About 200-300 leaflets are needed per broom. These brooms are sold at Ksh 0.60-1.00. They are much less bulky than *makuti* and therefore easier to transport and sell.

Coconut palms are also used to harvest rainwater: it is concentrated by the crown, flows downwards along the trunk and is guided into a vessel by a leaf tied to the trunk. In places where women have to walk long distances to a water tap or muddy pool this simple contraption saves much effort.

Inflorescences and nuts

Some husks are sold for the production of coir fibre, others are used as fuel, but most are left to rot scattered in the field or in heaps near the homestead. In Kenya little coir is produced, by Msambweni Development Company Ltd. (Ngugi 1983) and another small factory near Mtwapa. Husks, placed with the outside upwards, are also used as floor material in bathrooms. The fibres of the husks are used for cleaning cooking utensils. Laddles and cups are made from the hard shells of the nuts. The rachis appears the least used part of the palm; it is only used as fuel.

11 DISCUSSION

Historical context

Agricultural innovation in Africa, e.g. the adoption of new plants or practices, is often seen as a slow and difficult process. Colonial literature abounds in remarks on the unreceptive minds of the native population and more recently newspapers and television are full of the food crisis and environmental deterioration in Africa, and of the apparent inability to do something about it. They overlook the fact that in the last few centuries African agriculture has undergone tremendous changes, with in many cases considerable improvements in productivity and sustainability. The changes that are observed are often attributed to external factors, such as the introduction of a new crop, although even then its acceptance and adaptation into cropping and farming systems were a process within the local community.

Richards (1985) presents an interesting discussion of the role of farmers in agricultural innovations in West Africa. In East Africa there are also examples of rapid and fundamental

change in small farmer agriculture, such as the success of coffee and hybrid maize in highland areas (Heyer & Waweru 1976). The coconut story in this paper is another case of successful agricultural innovation. It differs from many other innovations that have gone almost unnoticed or have received active official encouragement. The coconut growers of Coast Province have attracted much attention, but until recently they received very little support and were more often discouraged.

Social aspects

Social scientists are often called into agricultural development projects to understand or remove obstacles in the way of successful introduction of new crops, inputs or techniques. Once the stumbling blocks have been removed, the further steps are seen as a technical or even mechanical process of adapting the innovation to the local conditions or vice versa.

The case of the coconut palm and the Mijikenda people shows that farmers do not only accept and grow a new crop, but integrate it into their life and culture. The palm is not just a building block in some agricultural or economic subsystem of their world. It has become a part of their life style and almost of their identity, defining them in their own eyes and in those of outsiders. This intimate relation between man and crop is usually overlooked in research and extension, where a crop is a piece of vegetable matter and a farmer the one planting or weeding it.

The identification of the Mijikenda with the coconut palm has more than sentimental value. It is not only a matter of comparing coconut palms with mothers or wives, which are to be respected and certainly not to be killed. Farmers know that their dealings with palms have economic consequences, and that the unproductive palms they do not want to cut have a price tag on them. Most are still willing to pay it.

Economic choices

The coconut palm and its diverse products play an important role in the economy of the Mijikenda. It brings some kind of security in an otherwise risky existence and provides a rich range of opportunities for getting food, drink and cash income. The choice between palm products for home consumption and cash income differs between and within areas and households. One person may dedicate himself to tapping palm wine, another to selling fresh nuts or making copra during his leave from work in town, and a third to making some small cash by plaiting *makuti* in her spare time. What all share, is the strong market orientation of their production; in spite of its social roles and the importance of home consumption the coconut palm is a real cash crop. Of the 31 growers interviewed most sold 2, 3 or even 4 products and only three did not sell anything. Before the ban nearly all of them tapped and sold toddy.

Cultivation practices

Mijikenda coconut palm management differs from that recommended in textbooks in various aspects. Many Mijikenda grow the palm far outside the usual ecological limits, pay little attention to crop protection, apply tapping techniques that are downright harmful, and respectfully refuse to eliminate unproductive palms. Most if not all of such agronomically unsound practices can be explained by the following factors:

- Learning how to grow coconut palms is a slow process. The effects of site selection and management practices only become visible after a long period and even then may not be very clear. Nevertheless, many Mijikenda have an extensive knowledge of the rather recently introduced coconut palm growing.
- Most people have little choice about where to plant palms and how well to care for them; suitable land is scarce and the short-term labour demands of maize cultivation or off-farm work often overrule the attention required by permanent crops.
- Apparent lack of care and harmful practices may be economically insignificant or even sound; it is undoubtedly much cheaper to cut steps in palm trunks than to break a leg.
- Mijikenda views of the coconut palm differ from those of outsiders who see it as just one more producer of vegetable oil.

It is hard to blame the Mijikenda for not accepting textbook recommendations. Little research has been done in the area itself and there have been few shining examples. Fertilizer recommendations, for example, have so far been based on the literature. At 1982 subsidized prices the rates proposed cost Ksh 10 or the equivalent of 3 kg copra or 19 nuts palm⁻¹. Such a large yield increase is not impossible, but a farmer needs a strong commitment to weather the years before the results of fertilizer application show up in the harvest. Meanwhile, he is losing the interest on the money invested and on the not yet included costs of going to buy the fertilizer and of transporting and applying it. That is not to say that such proposed improvements are not worthwhile, but that farmers may need more convincing proof than the words of well-meaning officials.

Palm characteristics

It is difficult to ascribe differences between palms in farmers' fields to soil or management factors, as demonstrated by Floor (1981) and Brom (1981). Very large numbers of palms are required in order to detect statistically significant differences. Therefore farmers should be given credit for intuitively interpreting what they have observed and acquiring detailed knowledge of where and how to grow their palms. By comparison, quantitative diagnostic methods need still some fine tuning, especially to cope with spatial and temporal variation.

The palms have an extensive root systems, which is no luxury under conditions of 800-1,200 mm year⁻¹ rainfall, 2,000-2,200 mm year⁻¹ potential evapotranspiration, and with ground-water out of reach. The low density of no more than 100 palms ha⁻¹ appears an appropriate adaptation to the marginal rainfall and soil fertility conditions. It is not surprising that on moist valley bottoms dense palm groves are found. In general, the vegetative characteristics of the palms appear less affected by the marginal conditions than the generative ones. The palms tend to have few bunches, many aborted spathes, and few and small nuts.

Palm wine

Throughout the last century palm wine has been associated with drunkenness and laziness. However, the main factors behind its success have been its cheapness compared to other alcoholic drinks and the profitability of the tapping and trade. With possible exceptions, both producers and consumers acted rationally when they opted for palm wine.

The profitability of tapping palm wine is relative. An income of Ksh 9,000 year⁻¹ is, by any standards, quite modest and barely sufficient to pay for food, clothes and housing. Moreover, the work is risky and broken legs are a common occurrence. However, there are few alternatives apart from scarce well-paid off-farm jobs. Palm wine just happened to be the surest and most lucrative cash crop of the Mijikenda.

The decision to ban palm wine can also be justified on rational grounds. There are arguments in favour and against. Depending on the choice one would expect the government to regulate the tapping, or to improve the production and marketing of nuts and copra. The more than a century old history of resentment against tapping shows that a clear choice was never made, but that governments vacillated between ineffectively opposing one alternative and doing little or nothing for the other. The present government made an understandable choice against palm wine, but it remains to be seen what they will do next. The situation should change from the state of affairs fifty years ago:

"The conditions in all the coastal areas are similar, a neglected people and a neglected industry ..." (Swynnerton 1946: 111)

Nuts and copra

It is interesting to compare the factors which stimulated the move from palm wine to copra and later again to palm wine and fresh nuts. It was clearly not a matter of the stubborn Mijikenda finally recognizing the benefits of copra and nuts, although there have also been changes in farmers' attitudes. They reacted rationally to changes in the supply and demand conditions under which they operated. When they had planted more palms than they could tap they shifted to the production of copra, and when the prices of the latter lagged behind those of fresh nuts, they drew their own conclusions. That does not mean that all behave in

the same way, just as not all are in the same condition with regard to land tenure, ownership or usufruct of palms, availability of labour, and distance or access to markets.

Other products

The many other products of the palm play an inconspicuous but important role in the Mijikenda economy. For example, *makuti* alone can give an extra income of Ksh 12 palm⁻¹ year⁻¹ above the Ksh 20-30 obtained from the sale of nuts or copra. Of course, in comparison with the proceeds from palm wine the extra cash is negligible, but tappers and drinkers also need a roof above their heads.

The use of each and every part of the palm also means an inconspicuous but important export of minerals to outside the farm, or at least a concentration of the scarce soil fertility near the houses. In the longer run that will cause a depletion of the fertility of coconut fields to show up in falling yields, which can only be reversed by applying manure or fertilizer. The tree of life is a willing giver, but so much good should not be rewarded with too much greed.

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7 GENERAL DISCUSSION

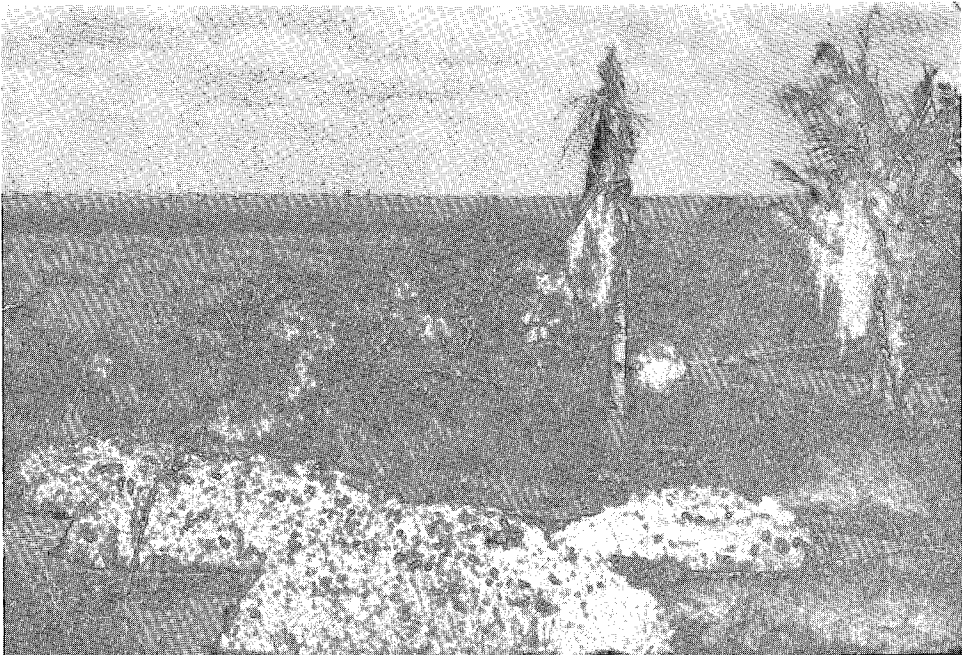
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1 BOTTLENECKS FOR DEVELOPMENT

The diverse bottlenecks that limit the development of Mijikenda agriculture can be grouped around three keywords. The first is tradition and refers to all obstructions related to the characters, opinions and practices of the Mijikenda themselves. There is ample evidence that the Mijikenda have not let their traditions stand too much in the way of necessary or profitable changes. The second is ecology and includes the soil and climate factors that limit the distribution or productivity of farm activities. Farmers rightly complain that they cannot do much about the land they inherit from their fathers or about the rains they receive from God. Fortunately, this has not prevented them from developing numerous agronomic practices that are well adapted to the various ecological niches of the area. The third keyword is policy and stands for the whole of official involvement in research, extension and marketing. In this field of activity numerous errors have been made which can be summed up as the discouragement of local initiatives and the failure to work out feasible alternatives.

Most policy makers in Coast Province have been outsiders whose views and choices have been coloured by values, fashions and interests from elsewhere. Many came with the best intentions but only very few took the opportunity to learn from and hence appreciate the people and agriculture they had to deal with. This discussion will not dwell on old policy errors but will stress what can be learnt from the past experiences with a view towards the future. After a brief review of some aspects of the methodologies employed for this thesis the discussion turns to the history, farms, crops, livestock and prospects of the Mijikenda.



Photograph 7.1. The future need not look like this; charcoal burning and palms tapped to death at the foot of the Mangea hill, Coast Province of Kenya.

2 METHODOLOGICAL CHOICES

Agriculture in the Mijikenda region, as elsewhere in tropical Africa, is characterized by much variation and confounding of numerous variables, between and within areas, villages, farms and fields. That makes it difficult to discover what has been called the "hidden order in seeming chaos" (Schlippe 1956: 101). In the research described in this thesis several procedures were followed to characterize and analyse the reality in farmers' fields; these approaches have their equivalents in the recent literature.

The first approach is to analyse causes and effects by means of observations of the jungle of factors in farmers' fields. The relationships between the measured variables are then ascertained by means of multivariate analysis. An example is the cluster analysis of secondary forest relevés in southwest Ivory Coast and its environmental and historical interpretation (Rouw 1991). The disadvantage of observations in farmers' fields or fallows is that they are time consuming and that usually a large part of the variation remains unexplained. Experiments -- with varying degrees of farmer involvement -- can reduce the number of variables, exclude their confounding, and limit the error variance. Examples of such on-farm research are maize cultivar and composite fertilizer trials in southern Cameroon (Poku & Baker 1989). Experiments in farmers' fields explain a large part of the variation studied, but at the cost of reducing reality. But then, most such experiments are not primarily intended to understand farmers' fields but rather to improve them. Another alternative is to eschew quantitative analysis and acknowledge that the farmer knows best. In this approach the farmers themselves develop and adjust most of the new technology, with the researcher in the role of humble facilitator (Rhoades 1989). This approach seems to be rather subjective and somewhat unscientific.

In practice there are no clear boundaries between the approaches. Observations on stratified samples of delimited populations have much in common with experiments. Transitions from experiments designed and managed by researchers to trial and error tests by farmers are gradual. In all approaches "expert" judgement plays an important role, for example, in the choice of the variables to be measured, in the selection of the treatments to be included and in the evaluation of the benefits and risks involved. Often also a choice will have to be made between practical relevance or scientific understanding. In the research described in this thesis the emphasis was on the latter.

3 FOCUS ON CASES AND STORIES

Several of the studies presented in this thesis, and in farming system analysis in general, are also biased by the emphasis on numerous interviews and large samples (Shaner *et al.* 1982). The most common methods, especially in the first stages of research, appear to be rapid

sondeos (informal talks) for a first rough picture followed by questionnaire interviews to obtain statistical evidence. Detailed case studies of families and fields are less common and usually serve as illustration afterwards rather than as research tools. Examples in this thesis are the fictitious stories about Kadzo's family and the cases that follow the classification of farmers in the Kaloleni area. However, case studies often contribute more to the understanding of farmers and farms than large data files (Maxwell 1986). If the work for this thesis could be done all over again it would probably start with one or two farmers per village, although after a while more cases might be included, both modal ones and outliers.

Detailed studies of farms and farmers show reveal the real people like Kadzo and Jira who are otherwise so easily obscured by multitudes of data, abstract models or colourful scenarios. That danger has increased during the last ten years in which the growing fear of worldwide environmental deterioration has spawned the tendency to worry more about the future of the land than about that of the farmer. Within a decade the farming system approach (FSA) with its focus on the small farmer has been ousted by a natural resources management (NRM) preoccupation with that farmer's -- but more especially our -- environment.

The close contact made in case studies enables researcher and farmer to get to know and trust each other. This benefits the quality of the information and the understanding obtained. Questions are answered with confidence, missing data can be completed easily, errors can be corrected, and interpretations can be verified. Instead of isolated facts and figures the researcher acquires coherent information and insights.

Meanwhile the researcher can learn what to ask, and why, and how to phrase the questions. One of the inherent weaknesses of the farming system approach is the lack of hypotheses, apart from the assumption that there are bottlenecks or problems. Case studies contribute to the generation of hypotheses, proposed by the partner-farmer, stumbled across in her fields, or resulting from analysis of the information. Specific hypotheses can be tested by means of formal interviews or observations with samples adequate for statistical analysis.

Case studies are especially useful to explore the history of farm and farmer, the evolution of opinions and practices, the fate of introduced changes and the solutions for previous problems. An analysis of the historical decision and development trees of individual families, farms and fields probably reveals more about constraints and alternatives than questioning farmers about general history, as was done for this thesis. Life, farm and field stories are an underexploited tool in the study of tropical agriculture.

4 TWO HISTORICAL RECORDS

The Mijikenda have an impressive record of changes in their society and agriculture. Some changes came about as a result of pressures from outside but in many others the Mijikenda themselves played an active or even enthusiastic role. We may dispute whether the Mijikenda are traditional or not, and there may be disagreement about the exact meaning of the term. However, the historical record leaves little doubt that tradition as such did not stand in the way of change and development (Waaijenbergh 1991).

It seems as though the Mijikenda were more responsive to new crops and cultivars than to new practices and methods. Almost all the crops they grow today were introduced in the last 300 years and most of the cultivars of annual crops have been introduced in the last 100 years. There are many more maize, rice, cowpea, cassava and banana cultivars than the names in this thesis suggest and the lists are still growing. On the other hand there is little indication that the Mijikenda cling on to their plant materials, as several crops and cultivars that used to be common have become rare or extinct.

The changes in cultivation methods have been less obvious and fewer in number. The planting stick was replaced by the hoe, broadcasting by dibbling, and the axe by the tapping knife. Locally, tractor ploughs have eased the burden of land preparation. The use of fire has diminished, and crop and weed residues are left as mulch or collected into trashlines. In livestock husbandry there are signs of a transition from free ranging or herding to tethering or zero grazing. Other changes such as using a larger hoe, planting in rows, buying chemical inputs and tying ropes between coconut palms to facilitate tapping have found less acceptance.

The difference probably has nothing to do with seeds and methods as such. New crops or cultivars can be tried out on a small scale and this involves little effort, low costs and risks, and has the promise of a pleasant surprise. It is probably no coincidence that many references to farmers' experiments are about the introduction of new species and cultivars (Johnson 1972; Richards 1985). Most of the new methods advocated mean hard work or cash inputs, often with little guarantee of high yields or returns. If things go wrong much more is lost than just a handful of seeds. Therefore the Mijikenda are rightly sceptical when it comes to change their old and proven practices for new and risky methods (Humphrey 1939; Gerlach 1964). However, they are easily won over by clear evidence of labour saving (as in the example of tractor ploughing), or of profitability (as in the case of zero grazing).

The history of zero grazing illustrates the importance of the timing and the conditions for innovations. The technique took root about 90 years after it was first proposed (Fitzgerald 1898), and 40 years after the first attempt to put it in practice (Humphrey 1939). Apparently it had to wait for the right mix of farmers with money to invest, high local prices for milk, and sufficient scarcity of land (Leegwater *et al.* 1991). Several other good ideas initially ran aground on the rocks of unfortunate timing. Among the examples are erosion control with

trash lines (Ngala 1949), and attempts to improve annual cropping by rotation or fallowing (Clarke 1962). The first had to wait until increased land scarcity overcame the aversion against what appeared at first sight to be unproductive labour. Research on rotation and fallowing was neglected during the decades that cheap fertilizers and pesticides appeared an easier solution, but it has recently reappeared in the form of experiments with alley cropping (Macklin *et al.* 1988). Although in retrospect several errors are apparent -- as indicated in the maize and coconut papers -- the historical record of research and extension efforts is also well worth of studying for the useful lessons that can be learnt.

5 MODELS OF FARM AND FARMER

A farm having an area of 5 ha, of which 1.5 ha is used for a homestead surrounded by tree crops such as coconut, cashew, kapok, citrus, banana and timber, a cassava plot and a vegetable garden, 3 ha for annual crops grown in rotation, 0.5 ha with fodder crops, a flock of chickens, some tethered goats and if possible some cattle. This is not a description of the property of a well-off Mijikenda farmer nor a recurrent theme in the dreams of his poorer neighbour, but a blueprint for the farms of the Gedi settlement scheme established in 1937 (Humphrey 1939).

The Gedi scheme itself was not much of a success and several of the original settlers absconded after their crops had exhausted the soils and their goats had destroyed the trees (KNA 1946). However, the scheme's designers would probably be pleased to learn how closely many of the present farms throughout the Mijikenda area resemble their ideal. Of course there are several differences. The actual layout is much more mixed up than in the blueprint, in which the annual crops were to be rotated in an orderly way, separated from the perennial crops, and hedges of kapok and cashew were grown as windbreaks on the borders of the farm. The relative importance of the activities has also changed, with coconut and cashew more dominant and kapok and timber less common than envisaged. No off-farm work was mentioned in the blueprint; it was indeed less important than it is today.

The main feature shared by the model for the scheme and today's reality is the diversity of farm activities. All Mijikenda households, from poor to relatively rich, tend to divide their eggs over many baskets. There are many differences between the farms, but it is difficult to distinguish clear patterns. The latter is especially true for the densely populated Chilulu where, with some exceptions, all farms look similar, with the main differences probably in the amount of off-farm income. In all villages some of the diversity is coincidental, with some farmers thanks to their parents having better land, more palms or a better education than their neighbours. Other farmers have deliberately chosen specific pathways to increase their income or develop their farms. The outcome is only partly predictable. Households with little land, labour, trees and livestock find it almost impossible to improve their lot, much

less that of their children. The future of those that are currently well endowed depends on the balance between the growth in the size of the household and the development of their economic activities. The future will not be easy for any of them.

6 PRODUCTION OF ANNUAL CROPS

The production of annual crops -- in this thesis most attention was paid to maize -- is mainly limited by ecological factors such as the physical and chemical properties of the soils and by the unreliable rainfall and high humidity. Other major problems are weeds, especially in maize and rice, and diseases and pests, which cause much damage in cassava and cowpea. Several experiments have shown that there is some potential for yield improvement.

Nevertheless, continuing with a maize-based food production system may prove an unwise gamble. In the past, in spite of limitations and opposition maize earned itself a place as a major staple food and cash crop, but its numerous critics had time on their side. With the increase in population cropping had to be intensified, leading to exhausted soils and declining yields. In many areas maize has been ousted by coconut palms and other tree crops. Elsewhere the crop has persisted only because of food preferences and lack of alternative uses for problem soils or female labour. It is true that there is scope for the improvement of productivity, but there are better endowed areas in Kenya where the same inputs would give higher returns (Mathez 1972).

Maize may have a future in Ngamani, where about ten thousand hectares of relatively fertile land are less suitable for tree crops such as coconut. On the slopes strips of perennial grasses or hedges of shrubs should be planted, as the trash lines used by the farmers are unable to halt erosion. On the flat parts of these fertile soils such strips or hedges have fewer benefits and would interfere with tractor ploughing and land use planning by the farmer. In Ngamani, the key to higher maize yields is the control of weeds, especially of itch grass. Suggestions for its eradication are given by Terry (1984). Weeds that germinate later in the season, for example goat weed, may be suppressed by much more systematic inter- and relay cropping with rice, cassava and cowpea. The returns on land, labour and capital and the stability of multiple cropping are probably far higher than those of maize alone. They would increase further by improvement of the marketing of cassava, the adoption of cassava mosaic virus control, and methods to suppress the pests that depress the pod yield of cowpea.

As long as there is land with no alternative use and people without employment, maize will continue to be grown in less suitable areas. On poor soils alley cropping with shrubs such as *Leucaena* may be a feasible option to improve soil conditions and suppress weed growth (Macklin *et al.* 1988). The labour required for the hedges and the competition with crops for soil moisture may restrict the adoption of the technique. The older ideas of relay cropping

or rotation with legumes such as pigeon pea and cowpea grown for seeds, mulch or fodder are equally worth studying (Clarke 1962). These have the advantage of lower investments and more flexibility. Better yields of maize or other foods increase the farmers' degrees of freedom. They may opt then to plant the same area and achieve self-sufficiency, or to reduce the area planted and use the freed labour for other activities.

The improvement of the numerous valleys which occur in most of the Mijikenda area is a land use alternative with great potential. Extending the present fragmentary bunds into networks that include the lower slopes would reduce the risk of rice and other crops being swept away by flash floods, retain soil moisture for longer periods, and increase yields. The borders of valleys and the lower slopes are suitable for banana groves and vegetable plots which, provided there is a market, give higher returns than other annual crops.

7 GROWING PERENNIAL CROPS

In the paper about the coconut palm the ecological bottlenecks were overshadowed by the conflicting views about the choice and use of the palm's products, notably wine and copra. However, the points of agreement deserve also mention. Large areas with above-average soil and rainfall conditions are covered with coconut palms. Regardless of the use of its products the coconut palm has proven itself one of the most reliable and profitable food and cash crops. Farmers are unlikely to replace their tree of life with any other land use, however promising.

The space between and under the palms is a different matter. The canopy of coconut crowns is rather thin and full of gaps that allow enough light for intercropping. There is not always enough for maize, but less demanding crops such as citrus, pineapple, banana or plantain may fill the niches not fully exploited by the coconut palms. Another option is to grow leguminous cover crops that provide fodder for small herds of goats; even a single cow is out of the reach of most farmers and would involve too much risk. The weaver ants commonly found on citrus trees may contribute to the control of the coreid bug on the coconuts. The attention given to the intercrops or the manure produced by the goats may compensate for the extra competition or even improve the productivity of the palms. Banana and plantain are especially interesting options, as they produce large amounts of organic matter and are almost certain to give a harvest, although under marginal conditions they may take a long time to do so.

Two aspects require special attention in multiple cropping with coconut palms. One is the timing of the soil moisture requirements by the choice and management of the intercrops. In the study by Floor (1981) the beneficial effect of intercropping with maize on coconut palm characteristics was attributed to the absence of competition for water during the dry

season. Another aspect is the vertical and horizontal architecture of the multiple cropping system. The common grid arrangement of coconut palms and its less orderly local approximations are probably the least suitable for intercropping. In Mozambique an estate has experimented with coconut palms in small and dense clumps separated by wide open spaces (Child 1955). In Tanzania the recommended 9 m by 9 m spacing has recently been modified to 9 m by 15 m, to facilitate intercropping (Behrens *et al.* 1993).

In densely populated areas with relatively high rainfall and numerous coconut palms cashew is likely to disappear. The rainfall and humidity reduce the yield, and land scarcity will push the crop to areas with poor soils and low rainfall. There a hedge system, maybe in combination with clonal material, may increase productivity (Eijnatten & Abubaker 1983). Isolated hedges along the borders of fields or pastures may have the greatest advantage, as they retain the increase in productivity and avoid the competition for soil moisture and nutrients likely to occur in compact plantations. These hedges may also serve as windbreaks for annual crops or as fences for livestock.

8 LIVESTOCK HUSBANDRY

In this thesis livestock has not received the attention it deserves. Goats or cattle are an important component of many farms, both for their place in the views of the people and for their role in the economy of the household. The Kenyan Dairy Development Programme (DDP) has shown that there is a considerable potential for the improvement of husbandry methods.

The success of zero grazing in terms of the number of cows involved and the litres of milk produced distracts attention from the fact that the greatest beneficiaries are urban consumers and rich farmers. Improving the husbandry and productivity of small livestock would benefit many more rural households. Most farmers in the Kaloleni area have some goats or sheep and nearly all have chickens or ducks. The importance of these small animals is greater than their numbers suggest, as they have much shorter reproductive cycles than cattle.

The distribution of zero grazing appears to be determined mainly by socio-economic factors. The land in Ngamani has two advantages from the viewpoint of productivity: the Sabaki - Mombasa pipeline for drinking water, and large areas of fertile soils for fodder production. The only problems could be the survival of perennial grasses and the preservation of silage for the dry season. Elsewhere valleys and bottomlands may prove suitable sites for the production of fodder.

In general, livestock and cropping activities in the Mijikenda area are little integrated, especially with regard to the use of manure and crop residues. One of the few exceptions is

the use of maize or rice bran by chickens and ducks. Any consumption of maize, rice or cowpea residues by cattle or goats in most cases is, in most cases, opportunistic. The dung of animals is washed by rain or swept by hand from the homestead yard and benefits only the crops in its immediate surroundings. Abandoned corrals are sometimes planted with vegetables or tobacco. A more systematic use of crop residues and manure and the introduction of herbaceous or woody fodder crops would increase the productivity of both crops and livestock. The ability to feed livestock on the farm might help to control the spread of pests and diseases and so reduce the risk of animal losses.



Photograph 7.2. Multiple cropping is already common in the Kaloleni area, Coast Province of Kenya.

9 SCENARIOS AND PATHWAYS

This thesis ends with a confession. None of the suggestions for improvement in the previous sections are new. They are all based on old ideas found in the literature or picked up in talks with farmers or during observations in their fields. Most are already being practised, albeit on a small scale and by few farmers. The suggestions deal with exploiting the ecological potential of every nook and cranny of the Mijikenda area more systematically. This implies

development scenarios that cover all relevant spatial variation. To date, recommendations or plans have been specified for broad agro-ecological zones, based mainly on rainfall characteristics. They should also include factors such as topography, soil conditions, population density and past investment in land use. As many factors vary within villages, farms and fields, the farmers themselves must prepare their own scenarios.

Researchers and extensionists can contribute ideas and material and facilitate the spread of improvements. There is also work to be done to solve specific problems such as the weeds that compete with maize and rice or the pests that affect cowpea and pigeon pea. Their tasks will not be easy, as they have little to offer to the farmers apart from "modern" inputs or "improved" cultivars. Scientific understanding of complex crop, livestock, weed, pest and disease mixtures is still very limited; most research on multiple cropping deals with only two species. Farmers cannot wait until research has unravelled each problem. Solutions will have to be based on trial and error in farmers' fields.

The government should abandon its patronizing attitude towards supposedly ignorant farmers, and instead should become a facilitator of initiatives developed by its clients. A difficult task lies ahead in the marketing of small quantities of many commodities produced by numerous small farmers. The diversification of farm activities is attractive for various ecological and economic reasons, but it makes great demands of the organization of transport and marketing. The only way to make land use ecologically sustainable is to make it economically attractive.

There is scope for optimism, as the Mijikenda can produce several crops which do not grow well elsewhere in Kenya, because of temperature or rainfall. Moreover, they are favourably located near the country's second largest city and a large tourist industry. All they have to do is to sell five coconuts a year to each of their fellow countrymen, to capture a larger share of the Mombasa vegetable and fruit market, and to educate foreign visitors to appreciate the delicious taste of exotic fruits. However, will the Mijikenda develop indeed a more productive and sustainable agriculture? Yes, because they have little choice now and have always been quick to grasp opportunities.

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Annexes: acronyms, names and terms

ACRONYMS

CARS	Coast Agricultural Research Station (Mtwapa)
DO	District Officer (headquarters in Kaloleni)
IBEA Co.	Imperial British East Africa Company (19th century)
KCC	Kenya Cooperative Creameries (milk processing)
KDCU	Kilifi District Cooperative Union (buyer crop produce)
Ksh	Kenyan Shilling, approx. US\$ 0.10 during 1981-1985
LNC	Local Native Council (during colonial period)
Rs	Rupee, currency used in late 19th and early 20th century
TA	Technical Assistant (agricultural extensionist)

NAMES OF WILD AND CULTIVATED PLANTS

African eggplant	<i>Solanum macrocarpon</i>	Jambolan	<i>Syzygium cumini</i>
Amaranth	<i>Amaranthus</i> spp.	Jute	<i>Corchorus</i> spp.
Anatto	<i>Bixa orellana</i>	Kale	<i>Brassica oleracea</i>
Aubergine	<i>Solanum melongena</i>	(sukuma wiki)	var. <i>acephala</i>
Bambara nut	<i>Voandzeia subterranea</i>	Kapok	<i>Ceiba pentandra</i>
Banana	<i>Musa</i> AA, AAA, ABB, AAB	Lablab bean	<i>Lablab purpureus</i>
Baobab	<i>Adansonia digitata</i>	Lemon	<i>Citrus limon</i>
Bean	<i>Phaseolus vulgaris</i>	Lemon grass	<i>Cymbopogon</i> sp.
Black nightshade	<i>Solanum nigrum</i>	Lime	<i>Citrus aurantifolia</i>
Calabash	<i>Lagenaria siceraria</i>	Loofah	<i>Luffa cylindrica</i>
Cashew	<i>Anacardium occidentale</i>	Maize	<i>Zea mays</i>
Cassava	<i>Manihot esculenta</i>	Mandarin	<i>Citrus reticulata</i>
Castor	<i>Ricinus communis</i>	Mango	<i>Mangifera indica</i>
Cinnamon	<i>Cinnamomum zeylanicum</i>	Okra	<i>Abelmoschus esculentus</i>
Citrus	<i>Citrus</i> spp.	Orange	<i>Citrus sinensis</i>
Clove	<i>Eugenia caryophyllus</i>	Orchella weed	<i>Rocella</i> spp.
Coconut	<i>Cocos nucifera</i>	Pawpaw	<i>Carica papaya</i>
Cotton	<i>Gossypium</i> spp.	Pearl millet	<i>Pennisetum americanum</i>
Cowpea	<i>Vigna unguiculata</i>	Peppers (hot)	<i>Capsicum</i> spp.
Custard apple	<i>Annona reticulata</i>	Pigeon pea	<i>Cajanus cajan</i>
Eggplant	<i>Solanum melongena</i>	Pineapple	<i>Ananas comosus</i>
Fig tree	<i>Ficus</i> sp.	Pumpkin	<i>Cucurbita maxima</i>
Finger millet	<i>Eleusine coracana</i>	Rice	<i>Oryza sativa</i>
Foxtail millet	<i>Setaria italica</i>	Rubber (cultivated)	<i>Manihot glaziovii</i>
Goat weed	<i>Ageratum conyzoides</i>	Rubber (collected)	<i>Landolphia</i> spp.
Green gram	<i>Vigna radiata</i>	Sesame	<i>Sesamum indicum</i>
Groundnut	<i>Arachis hypogaea</i>	Sorghum	<i>Sorghum bicolor</i>
Guava	<i>Psidium guajava</i>	Soursop	<i>Annona muricata</i>
Gum copal	<i>Hymenaea verrucosum</i>	Sugar cane	<i>Saccharum officinarum</i>
Itch grass	<i>Rottboellia exaltata</i>	Sunflower	<i>Helianthus annuus</i>
Jackfruit	<i>Artocarpus heterophyllus</i>	Sweet potato	<i>Ipomoea batatas</i>

Tamarind	<i>Tamarindus indica</i>	Turmeric	<i>Curcuma domestica</i>
Tobacco	<i>Nicotiana tabacum</i>	Velvet bean	<i>Mucuna</i> or <i>Stizolobium</i> sp.
Tomato	<i>Lycopersicon esculentum</i>	Yam	<i>Dioscorea</i> sp.

NAMES OF CROP PESTS

Armyworm	<i>Spodoptera exempta</i>	Pink stalk borer	<i>Sesamia calamistis</i>
Coastal stalk borer	<i>Chilo orichalcociliella</i>	Pod borers	<i>Maruca testulalis</i>
Coreid bug	<i>Pseudotheraptus wayi</i>	Rhino beetle	<i>Oryctes monoceros</i>
Maize weevil	<i>Sitophilus zeamais</i>	Spotted stalk borer	<i>Chilo partellus</i>

SWAHILI AND MIJIKENDA (GIRIAMA) TERMS

<i>Askari</i>	Policeman	<i>Mvule</i>	Tall tree with good timber (<i>Chlorophora excelsa</i>)
<i>Chandarusi</i>	Gum copal from the tree <i>Hymenaea verrucosum</i>	<i>Mwamba nyama</i>	Itch grass, very noxious weed (<i>Rotthoellia exaltata</i>)
<i>Duka</i>	Shop	<i>Mzungu</i>	White man
<i>Dzadza</i>	Common weed, <i>Commelina</i> spp.	<i>Ndago</i>	Noxious weed, sedge (<i>Cyperus</i> spp.)
<i>Dzumbe</i>	Large field worked by all household members	<i>Nyere</i>	Grown up man
<i>Enyetsi</i>	Elders dealing with land tenure	<i>Nyumba</i>	House, homestead
<i>Fingo</i>	Medicine/charm buried in <i>kaya</i>	<i>Panga</i>	Cutlass, machete
<i>Jembe</i>	Hoe (small, with short handle)	<i>Pombe</i>	Beer, wine
<i>Kambi</i>	Initiated <i>kaya</i> elder	<i>Rika</i>	Age set (people initiated at the same time)
<i>Kaya</i>	Mijikenda town (or village)	<i>Sima</i>	Stiff maize porridge
<i>Koho</i>	Small field worked by individual household members	<i>Shamba</i>	Field (or farm)
<i>Lwanda</i>	Meeting house of clan elders	<i>Tembo</i>	Palm wine
<i>Mahunda</i>	Bridewealth, paid to the father of the bride	<i>Tindi</i>	Creeping tomato with small fruits (<i>Solanum lycopersicon</i>)
<i>Makuti</i>	Pieces of palm leaf thatch	<i>Uchi</i>	Palm wine
<i>Mboko</i>	Calabash cup for palm wine	<i>Uji</i>	Thin gruel of cereals
<i>Mbuyu</i>	Baobab (<i>Adansonia digitata</i>)	<i>Ugali</i>	Stiff maize porridge
<i>Mnazi</i>	Coconut palm, palm wine	<i>Vigango</i>	Large grave figurines
<i>Moro</i>	Meeting place of <i>kaya</i> elders	<i>Vipande</i>	Piece work
<i>Msala</i>	Small grave figurine		
<i>Muchuchi</i>	Tall grass used for thatching (<i>Hyparrhenia rufa</i>)		
<i>Mugandi</i>	Fig tree (<i>Ficus</i> sp.)		
<i>Muji</i>	Village or homestead		
<i>Munda mbomu</i>	Large field worked by all household members		
<i>Mutsunga</i>	Leaf vegetable (<i>Launaea cornuta</i>)		
<i>Mutsungu</i>	Small tree, source of arrow poison (<i>Acokanthera</i> spp.)		

Samenvatting (abstract in Dutch)

In het achterland van de Keniaanse kust wonen de Mijikenda, een volk van arbeiders en boeren met kleine bedrijven die voor zelfvoorziening en voor de markt produceren. Zij verbouwen mais, rijst, cassave en koeieboon en telen kokospalmen en cashew- en fruitbomen. Sommige huishoudens houden rundvee, de meeste hebben enkele geiten of schapen en bijna alle hebben een koppel kippen. Omdat de bedrijven klein zijn en de opbrengsten van gewassen en dieren laag, werken veel mensen in de steden langs de kust. Het gangbare beeld van de Mijikenda is dat van traditionele boeren die onwillig zijn hun maatschappij en landbouw aan te passen aan de eisen van morgen.

Tussen 1981 en 1985 werd een serie studies uitgevoerd met als doel de landbouw van de Mijikenda te beschrijven en analyseren, om beperkingen op te sporen en, zo mogelijk, wegen aan te geven waarlangs de landbouw verbeterd kan worden. De studies werden gekenmerkt door een "farming systems" benadering, aandacht voor de beperkingen opgelegd door de ecologische omstandigheden, en een open oog voor de rol van historische processen in het vormen van de werkelijkheid van vandaag. De methoden omvatten literatuurstudie, formele en informele interviews, kwalitatieve en kwantitatieve waarnemingen, en kleine experimenten in boerenvelden. Het veldwerk was geconcentreerd in vier dorpen in het gebied rond Kaloleni, Kilifi District, Coast Province van Kenia.

Na een inleiding over het Mijikenda volk en de opzet van het onderzoek worden de resultaten gepresenteerd in vijf *papers*. De eerste is een bundel korte verhalen over een dag in het leven van een huishouden op een boerderij net ten zuiden van Kaloleni. Zij introduceren de spelers en tonen het toneel waarop de landbouw zich afspeelt. Er wordt beargumenteerd dat verhalen niet alleen in de fictie thuishoren, maar ook bruikbare gereedschappen kunnen zijn voor landbouwkundig onderzoek en voorlichting.

De tweede *paper* duikt in het verleden en schetst een aantal opmerkelijke veranderingen in de maatschappij en landbouw van het Mijikenda volk. Binnen enkele eeuwen zijn de spelers, het toneel en het spel vrijwel onherkenbaar veranderd. Deze veranderingen vallen des te meer op tegen de achtergrond van apathie die vaak wordt toegeschreven aan de Mijikenda boeren.

In de derde *paper* wordt de huidige landbouw in het gebied rond Kaloleni beschreven, als ruimtelijk gedifferentieerd landgebruik bepaald door ecologische condities en als bedrijven gekenmerkt door vestigingspatroon, de samenstelling van het huishouden en de organisatie van de velden. Er wordt ingegaan op de vraag of alle bedrijven ongeveer hetzelfde zijn of dat er specifieke bedrijfstypen kunnen worden onderscheiden. De toevallige en gekozen verschillen worden besproken met het oog op hun betekenis voor de vooruitzichten van de bedrijven.

De vierde *paper* beschrijft de produktie van mais in het Kaloleni-gebied, waar de grootste arealen met mais van Kilifi District en Coast Province voorkomen. In de 19e eeuw verdrong mais sorghum en gierst als het hoofdvoedsel van de Mijikenda. Diverse aspecten van de produktie van mais worden behandeld, van de keuze van plantmateriaal tot het gebruik van de oogst, en van ecologische beperkingen tot voedselzekerheid. Op dit moment is de produktiviteit

van de maisteelt laag en zijn onderzoek en voorlichting weinig effectief, maar er zijn mogelijkheden voor verbetering.

De laatste *paper* behandelt de kokospalm, een overheersend element in veel landschappen en de economische steunpilaar van talrijke boeren. Hoewel ook enige aandacht wordt besteed aan ecologische en teeltkundige aspecten van het gewas, ligt de nadruk op de controversiële gebruiken van de palm, voor de oogst van noten, het maken van copra of het tappen van palmwijn. Over het laatste hebben de Mijikenda en de Keniaanse overheid vaak lijnrecht tegenovergestelde standpunten gehad. Gedurende meer dan een eeuw werd meer energie verspild aan geruzie over palmwijn dan aan de verbetering van de teelt van de palm of de vermarkting van haar overige produkten.

De algemene discussie gaat in op de gebruikte methoden en doet suggesties voor verbeteringen. Er wordt geprobeerd de kennis van de vroegere en huidige landbouw te vertalen in scenarios en wegen tot verbetering. De Mijikenda hebben zich nooit door traditionele opvattingen *per se* laten afhouden van noodzakelijke of aantrekkelijke veranderingen. Bodem en regenval beperken wel de verspreiding en winstgevendheid van landbouwactiviteiten, maar de Mijikenda hebben diverse teeltmethoden ontwikkeld die goed zijn aangepast aan de ecologische niches van hun gebied. Wat vooral heeft ontbroken is een aangepast onderzoeks-, voorlichtings- en afzetbeleid, dat rekening houdt met de behoeften en mogelijkheden van de Mijikenda.

Curriculum vitae

Hendrik (Henk) Waaijenberg was born in 1955 in Ede, The Netherlands. In 1974 he obtained the Gymnasium- β diploma at the Marnix College in Ede, and in the same year he started his studies in Tropical Crop Science at Wageningen Agricultural University, The Netherlands. In 1977-1978 he spent a year in the tropical rainforest of southeastern Cameroon studying soil fertility and maize agronomy aspects of the shifting cultivation system of the *Maka du Nord*. He obtained his degree in 1980 with a specialization in Soil Fertility, Tropical Soil Science and Development Economics.

From 1981 to 1985 he was employed as a researcher by Wageningen Agricultural University, and was seconded to its soil survey and land evaluation project in Coast Province of Kenya, where he studied the farming and cropping systems of the Mijikenda. Although the emphasis of the field work was on maize production, several other crops were also studied by means of interviews of farmers and observations and experiments in their fields, such as coconut, cashew, cassava, cowpea and rice. In 1985 a summary report on agriculture in the Kilifi Area (mapsheet 198), Kenya, was completed.

In 1986 he was asked to join the Atlantic Zone Programme of the Centro Agronómico Tropical de Investigación y Enseñanza (CATIE), the Ministerio de Agricultura y Ganadería de Costa Rica (MAG) and the Wageningen Agricultural University (WAU). The research consisted of *sondeos* (rapid rural surveys) about problems at farm and subregional level and of analyses of selected cropping systems involving maize, plantain, cacao, pejibaye, macadamia and ornamental crops. Experiments and observations in farmers' fields focused on the production and distribution of biomass in eddoe, relay cropping of maize and eddoe, methods of planting cassava, and the management of plantain by small farmers.

In 1991 he returned to Wageningen to analyse and publish the results of the experimental work, and to lecture on the methodological aspects of cropping systems analysis and on ecophysiological aspects of banana and plantain cultivation. Meanwhile he continued with the analysis of the information collected about the agriculture of the Mijikenda of Kenya, resulting in this thesis. At present he is preparing to return to the tropics.

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