Traditional vegetable growing in the Embu District, Kenya

SUSUMU YAZAWA and SHOHEI HIROSE[1)]

I. Introduction

The food crisis in Africa in recent years has aroused world-wide concern agriculture in arid and semiarid regions. Along with the need for emergency rescue activity, there is an urgent need to reconstruct the food production system so that it becomes efficient and reliable. We had the opportunity to have a agricultural survey in a semiarid area in Kenya from mid-June till the end of August, 1985.

The purpose of the study was to understand methods of growing the traditional vegetables by small farmers in the semiarid areas. It is important to understand the traditional way of adaptation and the wisdom of the local farmers before making suggestions about how to improve current farming practices.

We thank the team members, Dr. Kazutake Kyuma, Prof. of Soils, Kyoto University ; Dr. Toshiyuki Wakatsuki, Assoc. Prof. of Soils, Shimane University ; Dr. Chitoshi Mizota, Instructor of Soils, Kyushu University ; and Mr. Kazuo Hanzawa, Lecturer of Agricultural Economics, Nihon University.

The Ministry of Education, Science and Culture of Japanese Goverment gave the team grants-in-aid (No. 60041073) that enabled the team to conduct the survery in Kenya.

II. Outline of the study areas

The study areas were selected so as to include various climate and soil condition within a relatively short distance. Five areas (I -V) in the Embu District of the Eastern Province, some 150 km northeast of Nairobi and on the southeastern foot of Mt. Kenya, were selected. The general agro-ecological zones of the area are shown in Fig. 1 (Jaetzold and Schmidt 1983).

The altitude and agro-ecological characteristics of the five areas are as follows :

Area		Sublocation	Location/Division	Altitude, (meters)	Agro-ecological zone
Upper Lands	I	Kiriari, Gitare	Ngandori/Runyenjes Kagaari/Runyenjes	1,600−1,850	Tea and coffee or coffee zone (UM1, 2)
	II	Kangaru	Mbeti/Gachoka	1,400−1,500	Marginal coffee zone (UM3)
Lower Lands	III	Gachoka	Mbeti/Gachoka	1,200−1,250	Cotton zone (LM3)
	IV	Kithunthiri, Mbita	Mavuria/Gachoka	1,100−1,200	Marginal cotton zone (LM4)
	V	Mavuria	Mavuria/Gachoka	1,100−1,200	Livestock and millet zone (LM5)

The Embu District consists of three divisions, Runyenjes, Gachoka, and Siakago, located in the northwestern, southwestern, and southeastern portion, respectively, on the upper and lower slopes of Mt. Kenya. The Embu and Mbere people who live in this district are generally believed to belong to the Bantu tribe, but their origin, route of migration, and period of settlement in this area

1) College of Agriculture and Veterinary Medicine, Nihon University.

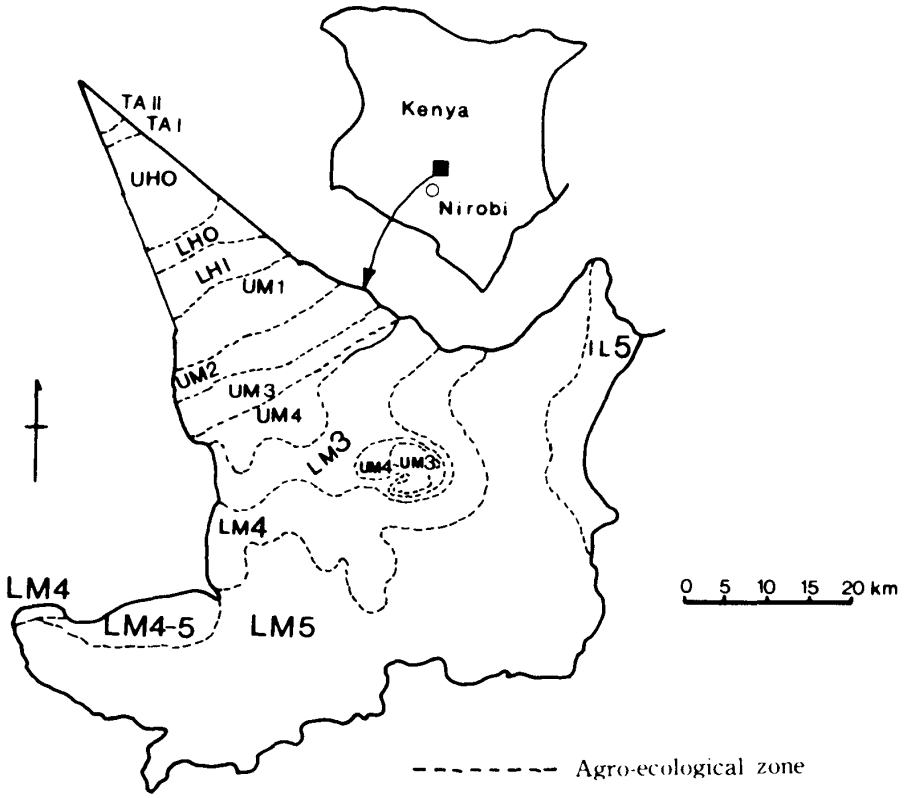


Fig. 1. Agro-ecological zones of the study areas in the Embu District (Jaetzold and Schmidt 1983)

Note) Ta Ⅰ, Ⅱ, trop. alpine moor-and heathlands ; UHO, forest zome ; LH 1, tea-dairy zone ; UM 1, coffee-tea zone ; UM 2, main coffee zone ; UM 3, cotton zone ; LM 4, marginal cotton zone ; LM 5, lower midland livestock-millet zone ; LM 5, lowland livestock-millet zone.

are still unknown. Mwaniki (1973) suggested that these peoples settled in the area via the several routes. According to this writer, the earliest Embu people, who settled in the upper area of the Embu District, were not cultivators but hunter-gatherers who hunted animals in the forest for meat and who supplemented their food supplies with roots, berries, fruits, and vegetables. The Mbere people, who live mainly in the lower area of the Embu District, were not primitive cultivators. According to the oral tradition of the farmers, both peoples were engaged in shifting cultivation up to about the 1960's, when land reform began in these areas. The recent permanent farming system was established in the early 1970's after the end of land reform (Brokensha and Riley 1980).

The survey was done by interviewing of the farmers to fill out questionnaires and by observation of their fields. In each area 6 to 12 farms were chosen at random so as to study vegetable growing. Meteorological data were collected from Kenya Meteorogical Department-Dagoretti Corner, Nairobi and from the station nearest to the survey area. Soil in these areas was also studied and taken for analysis.

This field survey was done for the two and a half months from June 15 to August 31 in 1985.

Ⅲ. Natural environment

(1) Topography and climate

The Embu District is located on the southeastern slopes of Mt. Kenya, which reaches 5,199 m.

Brokensha and Riley (1980) write that the Embu District is in the shape of a pie that starts from the upper slopes of the northwestern section and fans out to the middle section of the river valley.

Embu town is at the elevation of 1,470 m and farming land extends higher up to an area about 2,000 m above sea level. On the slopes of Mt. Kenya, many small rivers flow down into the Tana river valley, carving away the surface of the slopes as they descend. Very few of the rivers are perennial ; most dry up in the dry season.

Gachoka Division, which is located on the lower slopes, ranges from about 600 to 1,500 m. This division slopes gradually down the Tana river valley, so that the lay of the division is gentle. There are three hills, Kiambere, Kiangombe, and Kianjiru, that from peaks of about 1,500 to 1,700 m (Brokensha and Riley 1977).

A portion of the Gachoka Division lies to the left bank of the Tana river between 600 and 900 m the rest is between 900 and 1,400 m. This investigation of the agriculture in the semiarid area in this division was mainly concentrated on the latter area.

The distribution of annual rainfall is shown in Fig. 2. The annual rainfall ranged from 1,547

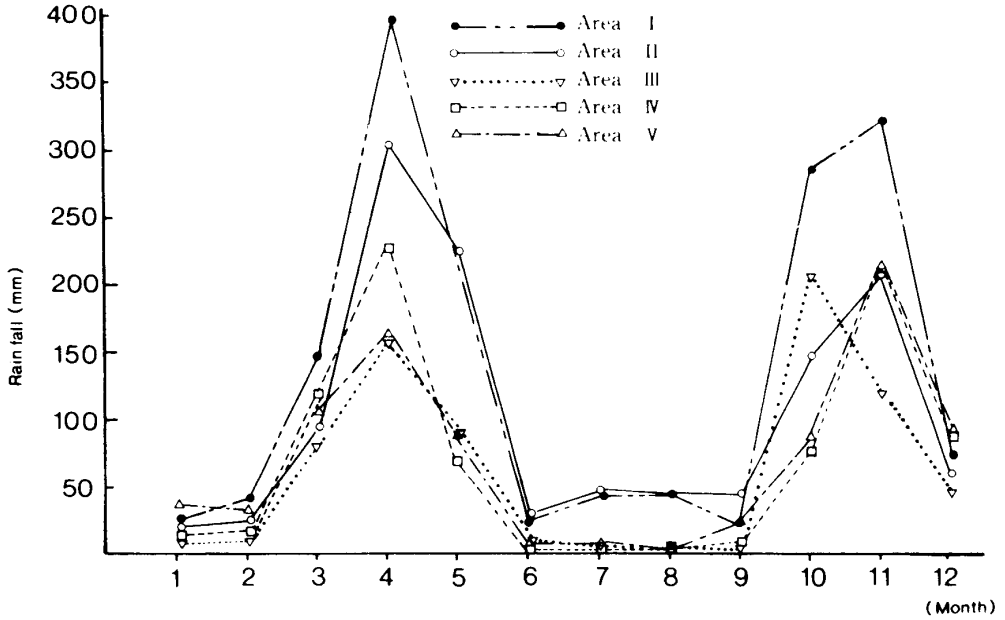


Fig. 2. Annual rainfall pattern in the study areas.

mm at the Runyenjes station to 667 mm at Machanga station near Mavuria ; all five areas had a bimodal pattern of precipitation. The annual amount of rainfall varied to a great extent, as can be seen by the coefficient of variation (CV) in Table 1. It was estimated from the rainfall data that

Table 1. Mean annual rainfall and its coefficient of variation in the study areas.

Area	Name of station	Annual rainfall, mm	Years	CV, %
I	Runyenjes	1242.3 (1547.0) *	6 (18)	26.8
II	Embu Met. Sta.	1208.0	6	20.0
III	Gachoka school	667.0	6	65.7
IV	Kiritiri chief camp	779.6	6	49.2
V	Machanga	787.8	7	36.2

* Mean of 1547 mm over 18 years (Jaetzold and Schmidt 1983).

most farmers would suffer from drought arising from shortage of rainfall at least two or three times during every decade. The wide variation in the time of onset of the rainy season added further difficulties to subsistence farming.

(2) Soil

Soils in the upper lands are well drained, deep dark reddish-brown clayey soils classified as a Nitosol in the FAO/Unesco system. They are derived from basic volcanic rocks or eject or both and are high in natural fertility, water-holding capacity, and erosion resistance. The soils in the lower areas are usually coarser in texture, lighter in color, and poorer in both nutrient and water-holding capacities. They are classified as Ferralsols, Acrisols, or Luvisols, some of which are underlain by murram, a product of long-term severe weathering.

(3) Agro-ecological zones

According to the Farm Management Handbook of Kenya (Jaetzold and Schmidt 1983), the Embu District is divided into several agro-ecological zones by agro-climatic factors and soil patterns. The study areas are described by the length of the cropping season and the agro-ecological zone type in the table below from Jaetzold and Schmidt (1983).

Areas	Sublacation	Zone	Length of cropping season*)
I	Kiriari, Gitare	Coffee-tea (UM1) Main coffee zone (UM3)	m/l+ m/s/m + s/m
II	Kangaru	Marginal coffee zone (UM3)	m/s + s
III	Gachoka	Cotton zone (LM3)	s + s
IV	Kithunthiri, Mbita	Marginal cotton zone (LM4)	s/vs + vs/s
V	Mavuria	Livestock-millet zone (LM5)	vs/s + vs

* +, District arid (dry) period between growing periods
m, Medium (135-154 days)
l. Long (195-214 days)
m/s, Medium to short (115-134 days)
s/m, Short to medium (105-114 days)
s, Short (85-104 days)
vs/s, Very short to short (55-74 days)
s/vs, Short to very short (75-84 days)
vs, Very short (40-54 days)

In the study areas, the higher the altitude, the longer the cropping season, resulting in higher potential yields. The potential yields of the crops decreased and the dependence on livestock increased with a decrease in the altitude. This second pattern was widespread in the Mavuria area, which was classified as a livestock-millet zone.

Ⅳ. Vegetable production

(1) Cowpea leaves

Cowpea leaves are an important vegetable in the diet of the people in the lower lands. In the local language the leaves are called *'nyenyi'* and the seeds are called *'nthoroko'*, thus *nthoroko* and *nyenyi* are important foods for these people. As the leaves of cowpeas cannot be harvested from July to September in the lower lands the people buy them during this period at the market, which is supplied with leaves from the fields along the river called the *'kianda'* in a later section. The price of a handful of these leaves is about one Kenya shilling, or seven Japanese yen (Plate 1).

There is no one particular variety cultivated exclusively for the gathering of cowpea leaves.

Some farmers preferred the taste of the purple leaf variety to the greenish one. Others told us that the purple ones were more resistant to drought than the greenish ones, but we cannot scientifically varify that fact in this survey. The crimbing variety produces a higher yield of seeds than the bush one.

The nutritional value of the cowpea leaves is shown in Table 2. The data indicate that it is high-

Table 2. The nutritional value of the cowpea leaves, pumpkin, leaves, cabbage, *solanum nigrum* leaves (per 100 g fresh weight)

	Protein (g)	Calcium (mg)	Iron (mg)	Beta-Carotene (μg)	Vitamin-C (mg)
Cowpea leaves	4.7	256	10	8,000	90
Pumpkin leaves	6	400	9.3	9,900	130
Solanum nigrum (leaves and stem)	6	300	12	9,000	140
Cabbage	1.7	50	1	100	54

er in nutrients than cabbage. The young pod of the cowpea is rarely eaten. The seeds of cowpeas are primarily sown in March or September. The leaves can be harvested one month after the seeds sprout. The plants begin to flower from 4 to 6 weeks after sowing, and the seeds are harvested about 4 weeks after the flowering. Cowpeas mature in about three and a half months (kidney beans require two and a half months, *Dorichos* three and a half months).

Cowpeas originated on the African continent and are therefore well adapted to the high temperature and dry climate prevalent there, as their roots grow usually deep into the soil. Our measurement in the Mavuria shows that the main root penetrates as deep as 25 to 30 cm under the soil surface. The results of the survey in the lower lands as to the order of drought resistance of pulses grown in this area as follows : the most drought resistant pulse is cowpeas, followed by pigeon peas, then *Dorichos*, and finally green grams and kidney beans.

In the lower lands the parasite called '*kiriti*' represents a serious problem in the growing of cowpeas. The damage of this parasite is very severe and will be described in detail in a later section titled parasite with *kiriti* on cowpeas and its damage.

In the upper land (ca. 1,800 m) the temperatures are too low for the seed of the cowpeas to mature but they can grow cowpeas therefore the leaves. The seeds are sown from August to October, and the farmers can continue to harvest the leaves until January. However, the seeds of the non-climbing variety of cowpeas will mature even at 1,600 m.

As mentioned above, cowpeas are used for seed production and the gathering of leaves for vegetables. Therefore the authors think that the branching cowpea varieties which bear the most branches are best suited to the purposes of the people in this region, since branching cowpeas produce a greater yield of seeds and the leaf harvest increases after pinching.

(2) '*Mutanga*' (*Citrullus lanatus*)

Mutanga is the name of a type of watermelon whose fruit is characteristically not sweet. Similar to cowpeas, the growing of *mutanga* is limited to the lower lands (Plate 2-1). Its young or mature fruit and young leaves and stem are eaten as vegetables. In Kithunthiri and Mbuita it is called *mutanga*, in Mavuria, *metanga*. Cowpea leaves and *mutanga* are two of the few traditional vegetables still grown in these areas. '*Njima*', a dish made from *mutanga* and millet, is a very old one in the lower lands.

The method of growing *mutanga*, which is sown in April or October, is very simple and requires

no special techniques. Three to four seeds are sown together in a small hole. *Mutanga* is commonly sown together with maize or cowpeas. A *mutanga* with small fruit (ca.1 kg) will yield about 50 fruits per plant. The harvest of fruits begins 3 months after sowing the seeds and continues for 4 months. Two kinds of *mutanga* are cultivated in this area. They are the oblong type (*magunthi* in the local language) and the round type (*cianguri*). The oblong type is the bigger of the two. The fruit weight of the oblong type is over 15 kg (Plate 2-2). It is said that the round type of *mutanga* is older than the oblong type and there are two kinds of seeds color. The seed of the oblong type is reddish brown while that of the round type, of which a netted and complicated design runs along the surface of the fruits, is black. Some of the farmers interviewed told us that the Kamba tribe have been growing *mutanga* from times of old. It is possible to store the mature fruit for 8 to 10 months. *Mutanga* is the most important vegetable in the diet during the period when the growing of cowpeas is impossible. There is no sweet watermelon in this area.

Citrullus lanatus, which originated on the African continent similar to cowpeas as described above, is one of the crops which is resistant to drought. In Mavuria, even the *mutanga* frequentry dries up for lack of water. In the lower lands, people do not grow sweet watermelons, and most of them do not know of their existence. We do not know whether people can grow the sweet watermelon in this area or not, but it may be cultivated sometime in the future. If it is, the root stock of the *mutanga* should be used and the seedlings should be raised in a nursery.

(3) '*Sukumawiki*' (*Sukuma*)

The scientific name of *sukuma* is *Brassica oleracea* var. acephara. It is called kale or corad in English. It is eaten very often in most families, for it is an important mineral source in both the lower and upper lands.

The *sukuma* originated near the Mediterranean, and it was introduced to Kenya by the Europeans only about a century ago. As shown in Table 3, most farmers said that *sukuma* was the newest vegetable to be cultivated in both the upper and lower lands.

Table 3. The newest vegetables cultivated in the upper and lower lands

	Sukuma	Cabbage	Carrot	Garden pea	Tomato	Egg plant
Lower lands	64%*	23	0	3	6	3
Upper lands	64	22	14	0	0	0

* Percentage of farmers who answered *sukuma* is the newest vegetable.

Sukuma leaves are picked one by one, then boiled or fried. The taste of the leaves is more bitter than that of cabbage, but the people like the bitterness of *sukuma* leaves. The *sukuma* will not flower unless it has experienced a period of low temperatures (below 10°C) for several weeks during the growing season. However, there is no such cold period in the lower lands and therefore the *sukuma* does not flower or, consequently, not produce seeds. In the upper lands it is possible to produce the seeds, although the quantity is small. *Sukuma* seeds are therefore largely imported from Europe. In the lower lands, people must tax their ingenuity to cultivate *sukuma*. Cultivation of *sukuma* in the lower lands is described below.

Most of the farmers grow *sukuma* from seedlings produced in the upper lands, or sold at the market. In Table 4 we can see the survival rate of the *sukuma*, from the seedling to the mature stage. The survival rate of *sukuma* is 20 % in the lower lands. Of the plants which survive, some grow to over 40 cm in height, although 20 cm is the average height. The *sukuma* is grown either in the *kianda*, in the swampy plots of the fields (called '*kithithinia*' or '*saba*' in the local language),

Table 4. The survival rate of *sukuma* in the lower lands

Farmers	Survival rate
A	5%
B	25
C	16
D	66
E	50
F	50
G	0
H	35

around the cattle corrals (known as '*boma*' in the local language) (Plate 3) or on termite hills. Leaves can be harvested from the same plants for a period of 6 to 8 months.

In the lower lands there is what is called '*coro*', a vegetable similar to the *sukuma* (Plate 4), *coro*, whose scientific name is *Brassica carinata*, is called Abishinian mustard in English. *Coro* originated on the high lands of the African continent, and is therefore better adapted to high temperatures and drought than the *sukuma*. Moreover, it is easier to obtain seeds from this crop than from the *sukuma*. Some of the farmers grow *coro*, in place of *sukuma*, though most people prefer eating *sukuma* leaves to those of *coro*. If it is possible to develop an improved variety of *coro* whose leaves are as tasty as those of the *sukuma*, more people may begin growing *coro* in the lower lands than *sukuma*.

We believe that kairan (*Brassica oleracea* var. alboglabra), a vegetable similar to the *sukuma* and cultivated in South East Asia, could be used to improve the *sukuma*, since kairan flowers readily in tropical regions.

Let us now look at the cultivation of *sukuma* in the upper lands. Most farmers sow the seeds during the long rainy season, although in areas where irrigation is used they can sow it throughout the year. Harvest of the leaves begins 2 months after sowing. Since the *sukuma*, which dies after flowering, does not flower in this area, most farmers can continue harvesting leaves from the same plant for 3 to 4 years (Plate 5). The number of nodes and the plant height of the *sukuma* sown one year ago are shown in Table 5. In the upper lands there are both branching and nonbranching

Table 5. Plant height and number of nodes of *sukuma* about one year after sowing (in the upper lands)

Plant height	Number of nodes
62cm	95
63	92
65	96

varieties of *sukuma*. In the case of the branching variety, leaves can only be harvested for one year, as the branching variety flowers easily in this area. Growing of it in the upper lands is easier than in the lower lands, but there are some problems in growing it, the first being damage from aphids and scales, the second the production of seeds.

(4) '*Kikuyu onions*'

Until now the production of *Alliums* except gallic on the African continent has not been introduced to Japan. However, *Alliums* are widely grown in Kenya.

In the Embu District they are consumed daily, though the actual amount consumed every day is

not so great. The leaves of *Alliums* in Kenya are more slender and shorter than those of the Japanese welish onions (Plate 6-1, 2), and the taste is very hot. Since they rarely bear flowers, they seldom produce fertilized seeds. They are therefore propagated through the dividing of the stands or the bulbil (Plate 6-3). When we tried growing them in Japan, they remained dormant during the summer season and grew in the autumn or spring season. We would assume that they belong to the shallot family from the viewpoint of the morphology of the flowers and the ecological characteristics described above. It is said that they were introduced by an Arab into Kenya, although it is not known from which country they came nor how they spread. They are called '*gitunguru*' in the local language, and *kikuyu onions* by the Africans when they speak in English. People use *kikuyu onions* in all of their fried dishes. Generally, the growing of *Alliums* in the areas where the temperatures are very high is inferior to the growing of *Alliums* in temperate zones. Therefore, *kikuyu onions* do not grow well in the lower lands in the Embu District where the temperatures are too high. Thus they are trucked them to the Embu District from the upper lands, for example Nyeri. The price is very high, 2 to 3 onions being sold for one Kenya shilling (seven in Japanese yen). The farmers in the lower lands would very much like to grow *kikuyu onions* themselves and are trying to do so but it is very difficult in this hot climate. Like the *sukuma*, the *kikuyu onions* grow best in the *kianda*, on termite hills and in swampy fields. *Kikuyu onions* are planted during either the long or short rainy season, and the harvest begins one month later.

As stated above, the growing of *kikuyu onions* in the lower lands is very difficult. Therefore we would suggest that the Chinese chive (*Alliums tuberosum*) which belongs to the *Allium* genus and is very resistant to high temperatures, be adapted for cultivation in the lower lands. Although the taste, which is somowhat different from that of the *kikuyu onions*, may not be preferred, we believe the growing of Chinese chive should be tried in this area. On the other hand, it is not so difficult to grow *kikuyu onions* in the upper lands, although they have the problem of water shortage during the dry season there.

(5) Lima beans (*Phaseolus lunatus*)

People use the powder of the lima seeds with grains in their diet, and while they utilize the young leaves and stems as vegetables. Lima beans are called '*mbumbu*' in the local language (Plate 7). They are also called *mbumbu* in the upper lands, where their leaves and stems are eaten. There are two kinds of lima beans, one being the large seed variety and the other the small. *Mbumbu* is of the later variety. In this district it is an old crop, although lima beans originated on the new continent.

Seeds of lima beans are sown during the period of the long rainy season, and the stands will survive up to 2 to 3 years after sowing. As it is a climbing vine, most farmers grow it up trees which are 3 to 4 m in height. The young leaves and stems are used for cooking the same as with the cowpea leaves. It is said that the taste of seed is similar to that of *Dorichos* beans but the taste of the later is of a higher quality. As with the cowpeas, lima beans are not grown in large numbers. In many cases small numbers are planted on the homestead or on the corners of the fields. They are cultivated more in the upper lands than in the lower lands, as the temperatures in the lower lands are too high to produce seeds. It is very difficult to grow the *Dorichos* beans in the upper lands due to damage from scales, so the farmers there grow lima beans, which are rarely attacked by scales, instead.

(6) Other vegetables

Edible bottle gourds are called '*mungu*' in the local lunguage. The bottle gourds, which are used for bottles, bowls etc., are very bitter and they cannot be eaten. The indigenous people told us that they can distinguish bitter bottle gourds from nonbitter ones by biting the leaves of the seedlings.

The gourd known as '*shunguru*' (Plate 8) has warts on the surface of the fruit and is similar to the wart bottle gourd in Japan. The young fruit of *shunguru* is either fried or boiled. *Shunguru* is a very old traditional vegetable in the lower lands, as is the *mutanga*. But now it is very rare in this area and few people even know the name *shunguru*. The fruit is about 10 cm in length and 15 cm in circumference and the surface of the mature fruit is very hard. The relationship between *shunguru* and bottle gourds should be researched sometime in the future.

The other vine vegetables are cucurbits and chayote. In the cucurbits genus, *Cucurbita moschata*, *C. maxima* are grown in the upper lands, while in the lower lands only *C. moschata* is grown.

In Table 6 is a list of the weeds which are utilized as vegetables at present. Nowadays the utilization of weeds is not as common as it used to be, although in ancient times they were used frequently. The weeds are gathered and eaten during the rainy season but they are hardly utilized during the dry season. We could not see the weeds used in cooking, since our survey was conducted during the period of the dry season. Therefore, I cannot identify their botanical names and will present only a list of the local names of the weeds.

Table 6. List of weeds utilized as vegetables in the survey areas

Managu, Kithi, Mukima, Terere, Karini ka nthia, Buoga, Kanguru, Mukangati, Mukengeria, Ruoga, Kigerema, Gokisi, Kimore, Mathorokwe, Mutegenge, Kingóngóya, Kirigirigi, Makumbui, Mukangati, Kingóngó ya, Gicue gue, Gakangati, Muka uri ibu, Karimi ka nthia, Macuicue, Mategenge, Matamba na ngoa, Girigi, Ndamba na ngaa, Karange, Kiruma audu, Kithugio, Mategenge, Gatandoro, Karini ka nthia, Muthigiriri (tree), *Gatandoro, Irunandu, Ndanbana ngae, Ngengeria, Ngangati, Karikanonongwe, Matu ma nthia, Kankanonogue, Kithu kia mbiti, Ngengeria, Murega, Magwata ngonedu, Makuru, Monagu, Makiri, Ndamba na ngoa, Gikiri, Kithu kia mbiti, Mabiubu, Ikrimbui, Ndorimukia, Mariaria, Maboga, Mruroro, Maboga*

Sometimes the young buds of trees are utilized for vegetables in South East Asia, though they are not so utilized in this area. There are also examples of medicinal plants being utilized for vegetables in South East Asia. But in this area it is a rare that people put medicinal plants to use as vegetables.

V. Places of vegetable production in the semiarid zone

(1) Homesteads

Homesteads are important places for the growing of vegetables in the semiarid zone, that is, the lower lands. The people recycle waste water to irrigate or for growing of vegetables (Plate 9). Crops produced on the homesteads are indispensable in the daily lives of the people and also serve as a source of food during times of famine. The growth of the crops occasionally fails due to a shortage of water during a draught, but even more devastating are the locusts which appear in large quantities following a draught and completely devour the crops. One of the reasons why the tuber crops are grown on the homesteads is that the damage from locusts does not reach the part of the tubers under the soil. Therefore, people can avoid starvation by eating what remains of the tuber. It is said that by growing crops around the houses it is possible to avoid damage from animals, such as monkies eating the crops.

The vegetables grown on the homesteads in the lower lands are *sukuma*, cowpeas, sweet potatoes, *kikuyu onions*, tomatoes, chilli, pumpkin, cassava and the other vegetables. They are cultivated on homesteads in the upper lands. *Mutanga*, bottle gourds and *shunguru* are cultivated only in the lower lands, while yams, chayote, potatoes, cabbages and carrots are grown mainly in the higher lands.

Table 7. List of crops cultivated in the *kianda* in the survey areas

Lower lands	
	sukuma, *kikuyu*, *onions*, red onions, maize, bananas, *Dorichos*, sugar cane, sweet potatoes, tomatoes, taro, pumpkin, cowpeas, chilli, cabbage
Upper lands	
	sukuma, *kikuyu onions*, maize, bananas, sugar cane, sweet potatoes, tomatoes, taro, pumpkin, *mbumbu*, cassava, mungo, passion fruit, avogados, yams, pineapples, kidney beans

In the lower lands pesticides and fungicides are rarely used. We believe the production of vegetables on the homesteads of the lower lands will be of increasing importance in the future. By selecting suitable crops in this area and by rotating crops, damage from soil dieases and insects may be minimized.

In selecting of the kinds of crops to be grown on the homestead, of course the preferences of the people must be taken into consideration, and foods which have been grown in this area from ancient times should be maintained.

(2) *Kianda*

The fields along the rivers are called *kianda* in the local language. *Kianda* is a very important field for people in both the lower and upper lands. Table 8 shows the distribution of the *kianda* in

Table 8. Percentage for possessing of *kianda* in the survey areas

	Possessing rate
Lower lands	
Mavuria	0%
Kithunthiri, Mbita	25
Gachoka	82
Upper lands	
Kangaru	75
Kiriari, Gitare	80

the upper and the lower lands. The *kianda* is most abundant in the Gachoka region. In Mavuria the rivers run dry during the dry season and therefore most farmers do not have *kianda*. The crops grown in the *kianda* are bananas, sugar cane, sweet potatoes, *sukuma*, tomatoes, *kikuyu onions*, taro, among others.

The distribution of crops grown in the *kianda* can be seen in Table 7. It is said that the soil of the *kianda* is more fertile than that of ordinary fields. The results of soil analysis show that while some of the *kianda* are fertile (Table 9), others are not. The *kianda* represents a very important growing place in the lower lands during the dry season.

People can grow cowpeas in the *kianda* in August and September, a time when they cannot be grown in ordinary fields. The size of the larger *kianda* is about 10 acres while the smaller ones are from 1 to 2 acres (Plate 10). Percentage for possessing of *kianda* in the lower and the upper land is shown in Table 8. The distruction of *kianda* from tampering with the rivers through the building of dams, etc., could present a serious threat to the people of the this area and it is therefore necessary to take the *kianda* into account when changing the geography of the rivers.

(3) Termite hills

It is known that the water condition of the soil of the termite hills is very good and the soil is more fertile than that of ordinary fields. The results of soil analysis show that most termite hills

Table 9. Soil analysis of the *kianda*, termite hills and and swampy fields

	pH (HO)	C %	N %	Ex. Cations K (meq/100g)	Na (meq/100g)	Ca (meq/100g)	Mg (meq/100g)	Avail. P (mgP_2O_5/g)
I *Kianda*	7.06	1.87	0.160	1.78	0.35	11.00	3.39	0.001
	6.97	1.83	0.140	0.77	0.82	8.59	3.39	0.001
	6.39	0.45	0.040	0.44	0.05	1.96	0.48	0.025
	6.14	2.39	0.210	2.31	0.05	8.66	2.85	0.003
II Termite hills	7.79	1.22	0.110	1.62	0.05	11.59	1.28	0.031
	7.90	1.74	0.130	1.07	0.05	32.00	2.79	0.360
	8.04	1.46	0.130	0.98	0.05	20.80	1.71	0.058
III Swampy fields	6.88	0.26	0.027	0.15	0.24	0.99	0.33	0.023
	8.17	0.61	0.056	0.28	0.15	4.81	0.39	0.057
	6.10	0.85	0.075	0.93	0.05	1.50	1.13	0.008
	6.80	0.97	0.081	0.81	0.05	5.25	0.85	0.300

Table 10. The soil analysis of infected with *kiriti* and not infected

Area	Condition of sampling field and sampling farmer No.	pH (H_2O)	C %	N %	Ex. Cations C/N	K (meq/100g)	Na (meq/100g)	Ca (meq/100g)	Mg (meq/100g)	Avail. P (mgP_2O_5/g)
Kithunthiri										
I	(No. 21 farmer)									
	Field without *kiriti*	6.60	0.45	0.042	10.7	0.52	0.05	1.16	0.44	0.025
	with *kiriti*	6.22	0.40	0.033	12.1	0.29	0.05	1.19	0.25	0.014
II	(No. 27 farmer)									
	Field without *kiriti*	7.06	0.57	0.052	10.9	0.29	0.05	2.76	0.34	0.050
	with *kiriti*	7.03	0.44	0.038	12.0	0.30	0.05	2.92	0.56	0.120
III	(No. 31 farmer)									
	Field without *kiriti*	6.40	0.45	0.043	10.4	0.39	0.05	1.71	0.44	0.014
	with *kiriti*	6.36	0.042	0.042	10.0	0.38	0.05	1.58	0.48	0.001
Mubita										
I	(No. 24 farmer)									
	Field without *kiriti*	6.26	1.00	0.092	10.8	0.77	0.05	3.75	1.21	0.037
	with *kiriti*	6.73	0.89	0.081	10.9	0.84	0.05	3.98	1.25	0.050

are very fertile, and calcium and potassium in particular are more abundant than in ordinary fields (Table 9). The pH value is also slightly higher, 7 to 8 in most termite hills. Crops are rarely planted near the top of the termite hills. The termite hills are cultivated to about two thirds of their height since water evaporation from the soil is very high near the top of hills and the salinity of the soil therefore increases, causing unfavorable conditions for plant growth.The termite hills used for the growing of crops are limited to those found in the fields. There are no termite hills in the upper lands. They are found only in the lower lands. The number of termite hills decreases where the soil is sandy, as in areas such as Mavuria. Among the areas surveyed the greatest number of termite hills were located in Gachoka, Kithunthiri and Mbita.

The crop most commonly grown on the termite hills is *Dorichos* beans. *Dorichos* beans, which require very fertile soil, grow well on these hills. As shown in Plate 11, the farther *Dorichos* beans are planted from the termite hills, the worse they grow. Frequently, people use the termite hills

for the growing of *kikuyu onions*.

Generally farmers use the termite hills which are at least 3 years old, although in rare cases they use those of only one year. The months for sowing and planting on the termite hills are April and sometimes October. There appears to be no problem of termites eating the crops. In the rainy season termites go up toward the top of the hill, but in the dry season they remain down below. Therefore that is the best season for growing the crops.

(4) Swampy fields

Mavuria in the lower lands, there are few *kianda* and termite hills. One of the places where vegetables are grown in this area is the swampy places of the common fields. It is not known why swampy fields exist in the dry fields. The swampy fields are called '*kithithinia*' (the areas of green plant), '*saba*' (Plate 12).

The results of soil analysis in the swampy fields show that the content of calcium there is higher than in the common fields (Table 9).

Sukuma, *kikuyu onions* and other vegetables are grown in the swampy places of the fields. The size of these fields is not very large, generally measuring about 100 m^2. These places very small, but they are very important for the growing of vegetables in the dry areas.

Ⅵ. Damage from '*kiriti*' (parasite) and scales

(1) *Kiriti* and its damage

In Mavuria, Kithunthiri and Mbita of the lower lands the damage from *kiriti* is a very serious problem of the growing of cowpeas (Plate 13). The scientific name of *kiriti* is *Alectro orokanochoides*.

In some fields of Mavuria as much as 45 % of cowpeas was attacked by *kiriti* during the growing season while this figure reached 80 % in Kithunthiri. *Kiriti* have been present since ancient times in this areas. The damage from it is less in the new fields than in the old ones. Damages from the parasites have increased with continued cultivation of cowpeas in the same fields. *Kiriti* appears in greater numbers during the long rainy season than in the short rainy season. They also do serious damage in the sandy fields.

Kiriti appears at flowering stage of cowpeas, and are found in greater numbers in the fields of pure stands of cowpeas than in those of mixed cropping. Some farmers told us that the number of *kiriti* in the fields mixed with maize is greater than in those mixed with millet. However, *kiriti* rarely appear on termite hills. At this point no method of preventing infestation has been discovered. Some farmers told us that the utilization of organic manure in the fields helps reduce the damage by *kiriti*.

The results of soil analysis in fields infected with *kiriti* and those which are not, are shown in Table 10. The results show that there is no relationship between the occurence of *kiriti* and fertility of the soil.

(2) Damage from scales

Crop damage from scales is higher in the upper lands than in the lower lands. Scales are called '*kathua*' in the local language. It is said that the damage from scales increased immediately after the introduction of coffee to this area, that is, in the 1930's in the upper lands. Scales do serious damage to coffee, *Dorichos*, yams etc. Before the introduction of coffee to this area *Dorichos* was widely cultivated, but it is now rarely grown in the upper lands. According to the farmers, the growing of *Dorichos* and yams became increasingly difficult three years after coffee was introduced.

Before the introduction of coffee, the main crops in the upper lands were millet, yams and

Dorichos. At that time the long rainy season was called *'njavi mbura'*, which means *'Dorichos* season', and the short rainy season was called *'mbura mwere'*, which means 'millet season'. The damage from scales is more serious during the short rainy season than during the long one. The damage from scales to yams is so severe in Kangaru of the upper lands that people can scarcely grow them (Plate 14).

It is a serious problem for the people in the upper lands that the traditional food crops cannot be grown due to the introduction of foreign crops. One possible method of controling scales might be the introduction of their natural enemies. At any rate it is urgently necessary to survey the present progression of damage by scales. As to the avoidance of damage from scales, people control the scales by scattering ash at the root of the yams or applying fowl droppings to them. In this survey we cannot clarify scientifically the positive effects of these procedures on scales. However, the farmers told us that these methods work well in controling of scales.

References

Acland, J.D. (1971) : "East African Crops" Longman Group Lts, London.

Asahira, T. and S. Yazawa (1981) : Traditional methods of vegetable cultivation in South India and Sri Lanka. Special Report of Lab. Vegetable and Ornamental Hort., Faculty of Agr., Kyoto Univ.

Blundell, M. (1982) : "The wild flowers of Kenya" Collins, London.

Brokensha, D. and B.W. Riley (1980) : "Introduction of Cash crops in a marginal area of Kenya" In "Agricultural development in Africa" edited by Bates, R.H. and M.F. Lochie. Praeger Publisher, London.

Goode, P. (1973) : Some local vegetables and fruits of Uganda. Nairobi Univ.

Ivens, G.W. (1967) : "East African weeds and their control" Oxford Univ. press, Nairobi.

Jaetzold, R. and H. Schmidt (1983) : "Farm Management handbook of Kenya. Vol. Ⅱ" National Condition and Farm Management Information-Part C. East Kenya, Ministry of Agriculture, Kenya, in Cooperation with the German. Agricultural Team (GAT) of the German Agency of Technical Cooperation (GTZ).

Kokwaro, J.O. (1976) : "Medicinal plants in East Africa" East African Literature Bureau, Nairobi.

Koeune, E. (1977) : "Cooking for the family in East Africa" East African Literature, Nairobi.

Linley, K. and B. Baker (1972) : "Flowers of the Veld. Rhodesia" Longman Group Ltd., New York.

Mwaniki, H.S.K. (1973) : "The living history of Embu and Mbeere to 1906" East African Literature Bureau, Nairobi.

Ndett, K. (1972) : "Elements of Akamba life" East African publishing house, Nairobi.

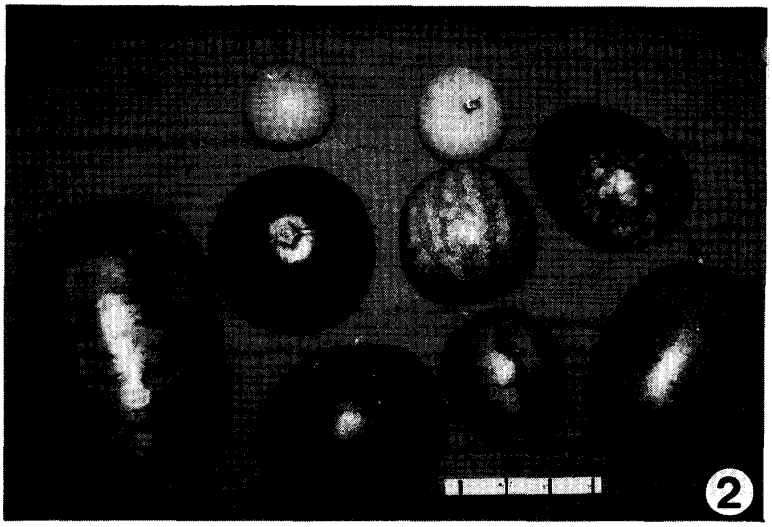
Terry, J.P. (1984) : "A guide to weed control in the East African crops" Kenya Literature Bureau, Nairobi.

Vivekanandan, M. and M.K. Kandasamy (1982) : Physiological effect of termite soil on plant growth. *Comp. Physiol. Ecol.*, 8, 92-95.

Wielemaker, W.G. (1984) : "Soil formation by termites, a study in the Kisii area, Kenya" Department soil science and geology, Agricultural Univ., Wageningen.

Plate 1 Cowpea leaves sold at the local market.

Plate 2 1 : Growing of *mutanga* in the field.



2 : Various cultivars of *mutanga*.

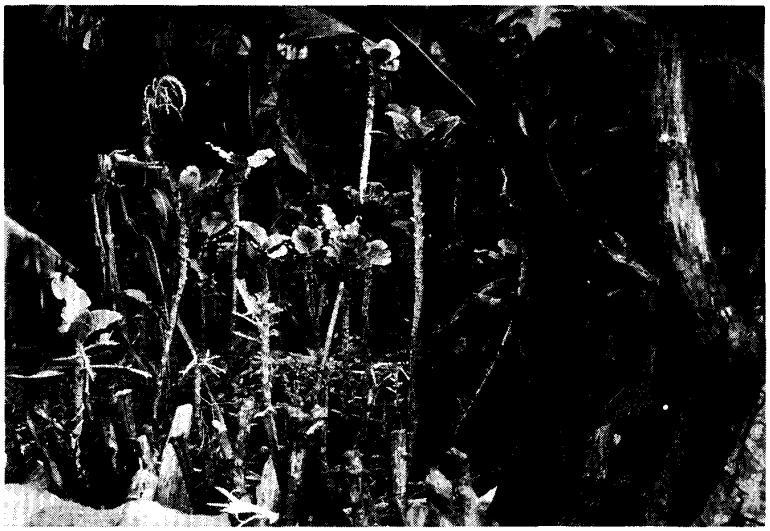


Plate 3 Growing of *sukuma* near *boma* in the lower lands.

Plate 4 *Coro* (*Brassica carinata*)

Plate 5 Growing of *sukuma* in the upper lands.

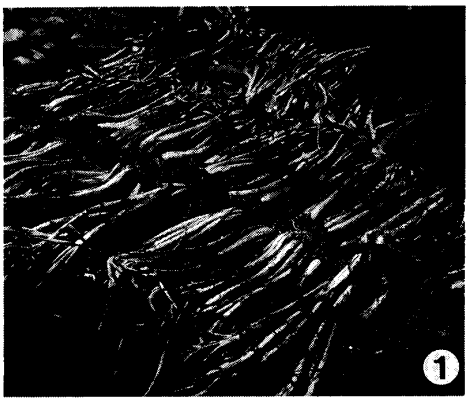


Plate 6
1 : *Kikuyu onions* sold in the local market.
2 : Growing of *kikuyu onions*.
3 : Bulbiles and flowers of *kikuyu onions*.

Plate 7 *Mbumbu* (lima beans, *Phaseolus lunatus*).

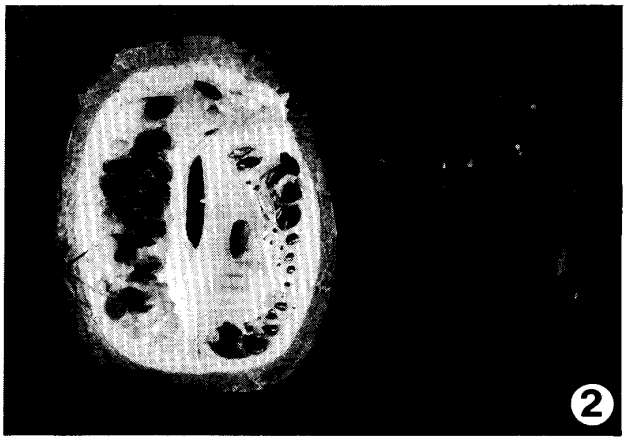


Plate 8 1 : Growing of *shungru*.
2 : The fruit of *shungru*.

Plate 9 1 : Homestead in the lower lands. 2 : Homestead in the upper lands.

Plate 10 1 : The large *kianda*. 2 : The small *kianda*.

Plate 11 Cultivation of *Dorichos* on the termite hill.
The farther *Dorichos* beans are planted from the termite hill, the worse they grow.

Plate 12 Growing of tobacco in the swampy field.

Plate 13 *Kiriti* is parasitic on cowpeas.

Plate 14 Yam damaged by scales.